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2011

### Academic Catalog: 2011-2012

State University of New York College of Environmental Science and Forestry

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**2011-2012 Catalog**  
**SUNY-ESF**  
**Improve Your World**



# About This Catalog

The calendar, courses, tuition, and fees described in this catalog are subject to change at any time by official action either of the State University of New York Board of Trustees or of the SUNY College of Environmental Science and Forestry. Additional information is available upon request from any addresses found below.

## Accreditation

The State University of New York College of Environmental Science and Forestry is accredited by:  
Middle States Commission on Higher Education  
3624 Market St.  
Philadelphia, PA, 19104-2680  
215-662-5606.

The bachelor of science degree in forest resource management is accredited by the Society of American Foresters (SAF). SAF is recognized by the Commission on Recognition of Postsecondary Accreditation as the specialized accrediting body for forestry in the United States:  
Society of American Foresters  
5400 Grovenor Lane  
Bethesda, MD 20814-2198  
301-897-8720

The bachelor of science degree in wood products engineering with the wood products concentration is accredited by:  
The Society of Wood Science and Technology  
P.O. Box 6155  
Monona, WI 53716-6155.

The bachelor of science degree in forest engineering is accredited by:  
Engineering Accreditation Commission/Accreditation Board for Engineering and Technology  
111 Market Place, Suite 1050  
Baltimore, MD 21202  
410-347-7700

The bachelor of science degree in paper engineering is accredited by:  
Engineering Accreditation Commission/Accreditation Board for Engineering and Technology  
111 Market Place, Suite 1050  
Baltimore, MD 21202  
410-347-7700

The bachelor of landscape architecture and master of landscape architecture degrees are accredited by:  
Landscape Architectural Accreditation Board  
603 Eye St. NW, Suite 500  
Washington, D.C. 20001

The joint program in science teaching leading to teacher certification (offered in collaboration with the School of Education at Syracuse University) is accredited by:  
The National Council for Accreditation on Teacher Education  
2010 Massachusetts Ave. NW, Suite 500  
Washington, D.C. 20036  
202-466-7496

## Equal Opportunity and Affirmative Action

The State University of New York College of Environmental Science and Forestry values diversity. We welcome and appreciate all people in order to become a community of equality and diversity.

SUNY-ESF will provide equal opportunity and will not discriminate because of race, color, religion, sex, national origin, age, disability, marital status, sexual orientation, or status as a special disabled veteran, Vietnam Era veteran, or other disabled veteran.

The coordinator for 503-504 Programs and the Americans With Disabilities Act is Joseph Rufo, Vice President for Administration, 208 Bray Hall.

## Campus Safety Report

A Campus Safety Report is filed as required by the federal "Crime Awareness and Campus Security Act," or "Clery Act." The purpose of this report is to provide our faculty, staff and students with campus safety information including crime statistics and procedures to follow to report a crime.

The report is prepared and published each Oct. 1 by our University Police, Judicial Affairs and Environmental Health and Safety Department. The report is available on the University Police Department website at [www.esf.edu/univpolice/crimereports](http://www.esf.edu/univpolice/crimereports).

It is also available in printed format from the University Police Department in Room 19 Bray Hall on request.

## Collegewide Smoking Policy

New York State legislation regulates smoking in all workplaces. Effective July 24, 2003, smoking is prohibited in all indoor areas on College property. Individuals who choose to smoke may do so outdoors, no closer than 20 feet from building openings such as doors, windows, air intakes, loading docks or similar structures, or in any area where flammable substances or combustible materials are used or stored. Smoking also is prohibited in all College vehicles.

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# Academic Calendar

## Fall 2011

### Syracuse Campus

New Student Orientation Program	August 24-28, Wednesday-Sunday
Residence Halls Open	August 24, Wednesday
Registration for New Students	August 27, Saturday
Classes Begin	August 29, Monday
Labor Day (no classes)	September 5, Monday
Last day to add a class	September 6, Tuesday
Last day to drop a class	October 26, Wednesday
Advising for Spring 2012	November 2-8, Wednesday-Tuesday
Registration for Spring 2012	November 9-18, Wednesday-Friday
Thanksgiving Recess	November 20-27, Sunday-Sunday
Last Day of Classes	December 9, Friday
ESF Convocation	December 9, Friday
Reading Days	December 10-11, Saturday-Sunday
Final Exam	December 12, Monday
Reading Day (a.m.)	December 13, Tuesday
Final Exams (p.m.)	December 13, Tuesday
Final Exams	December 14, Wednesday
Reading Day (a.m.)	December 15, Thursday
Final Exams (p.m.)	December 15, Thursday
Final Exams	December 16, Friday

### Wanakena Campus

Wanakena Campus Opens	August 21, Sunday
Ranger School Orientation/Registration	August 21-23, Sunday-Tuesday
Ranger School Classes Begin	August 24, Wednesday
Labor Day (no classes)	September 5, Monday
Columbus Day (no classes)	October 10, Monday
Thanksgiving Recess	November 23-27, Wednesday-Sunday
Last day of Classes	December 16, Friday

## Spring 2012

### Syracuse Campus

Registration of New Students	January 14, Saturday
Martin Luther King Day (no classes)	January 16, Monday
Classes begin	January 17, Tuesday
Last day to add a class	January 24, Tuesday
Spring Break	March 11-18, Sunday-Sunday
Last day to drop a class	March 20, Tuesday

Advising for Fall 2012	April 2-5, Monday-Thursday
Registration for Fall 2012	April 9-17, Monday-Tuesday
Last day of classes	May 1, Tuesday
Reading Day	May 2, Wednesday
Final Exams	May 3-4, Thursday-Friday
Reading Days	May 5-6, Saturday-Sunday
Final Exams	May 7-9, Monday-Wednesday
ESF Convocation	May 12, Saturday
Commencement	May 13, Sunday
Summer problems and theses courses	May 14-August 10, Monday-Friday

**Wanakena Campus**

Martin Luther King Day (no classes)	January 16, Monday
Classes Begin	January 17, Tuesday
Spring Break	March 24-April 1, Saturday-Sunday
Graduation	May 19, Saturday

**Summer 2012**

Summer problems and theses courses	May 14-August 10, Monday-Friday
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# State University of New York

## SUNY Board of Trustees

Chairman: Carl T. Hayden, Elmira

### Trustees:

Kaitlyn Beachner, student trustee  
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Cary Staller, Old Field  
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### University Administration

Chancellor of the University: Nancy L. Zimpher

## About the State University of New York

[www.suny.edu](http://www.suny.edu)

The State University of New York's 64 geographically dispersed campuses bring educational opportunity within commuting distance of virtually all New Yorkers and comprise the nation's largest comprehensive system of public higher education.

- SUNY's 64 campuses are divided into four categories based on educational mission, the kinds of academic opportunities available, and degrees offered. These are university centers/doctoral granting institutions, university colleges, technology colleges and community colleges. Together they offer the widest selection of higher education opportunities in the United States.
- The State University offers students a wide diversity of educational options: short-term vocational/technical courses, certificate programs, associate degrees, baccalaureate degrees, graduate degrees and post-doctoral studies. The University offers access to almost every field of academic or professional study somewhere within the system, with more than 7,500 degree and certificate programs overall.
- SUNY curricula range from those in the more conventional career fields, such as business, engineering, medicine, teaching, performing arts, social work, finance and forestry, to those concerned with tomorrow's developing and societal needs in the areas of environmental science, urban studies, immunology, information systems, biotechnology, telecommunications, microbiology, and health services management.
- SUNY has a total enrollment of nearly 467,000. Students pursue traditional study in classrooms and laboratories or work at home, at their own pace, through such innovative institutions as the SUNY Learning Network and Empire State College.
- SUNY students are predominantly New York State residents, representing every one of the state's 62 counties. SUNY students also come from every other state in the United States, the District of Columbia, from four U.S. territories, and 160 nations around the world.
- The State University enrolls about 30 percent of all New York State high school graduates, and its total enrollment (full-time and part-time) is nearly 40 percent of the state's entire higher education student population.
- SUNY students represent the society that surrounds them. In fall 2010, 21.4 percent of all students were minorities; in fall 2009, full-time minority faculty members made up more than 14 percent of all full-time SUNY faculty.
- As of fall 2009, the University had more than 2.5 million graduates on its rolls. The majority of the University's alumni reside and pursue careers in communities across New York, contributing to the economic and social vitality of New York state.
- SUNY is committed to bringing its students the very best and brightest scholars, scientists, artists and professionals. SUNY campuses boast nationally and internationally recognized faculty in all the major disciplines. Their efforts are regularly recognized in numerous prestigious awards and honors.
- SUNY's 32,000 faculty have won awards including the Nobel Prize, Pulitzer Prize, Fields Medal, Dirac Medal, National Medal of Science, and Grammy, Emmy and Tony awards.
- State University research contributions are helping to solve some of today's most urgent problems. At the same time, contracts and grants received by University faculty directly benefit the economic development of the regions in which they are located. State University researchers pioneered nuclear magnetic resonance imaging and the supermarket bar code scanner, introduced time-lapse photography of forestry subjects, isolated the bacteria that causes Lyme disease, and developed the first implantable heart pacemaker. Other University researchers continue important studies in such wide-ranging areas as sustainable energy, breast cancer, immunology, marine biology, sickle-cell anemia, and robotics, and make hundreds of other contributions, inventions and innovations that benefit society.

# Introducing ESF

The State University of New York College of Environmental Science and Forestry (ESF) is recognized and emulated all over the world.

The College was founded in 1911 through the efforts of Syracuse University Chancellor James R. Day and respected state leaders, such as Louis Marshall, who were attuned to a growing national sentiment in favor of forest conservation and sensed the need for a professional school of forestry.

Under the leadership of its first dean, Hugh P. Baker, ESF looked to serve the broad needs of environmental professionalism. As other forestry schools became more specialized, ESF expanded its scope to include such essentials of environmental science as design, engineering, life sciences and resource management.

The College is a doctoral-granting institution, one of only 13 in the 64-campus SUNY system, with highly focused research and service programs that reach across the globe to search for new knowledge and to improve the quality of life. Students share in the vast array and excitement of these opportunities through direct contact with distinguished faculty and researchers. They gain plenty of hands-on experience in conducting scientific research and applying the results of their work. Quality instruction and experiential learning opportunities for students ESF's priorities.

About 2,200 students are enrolled at the College's main campus in Syracuse, N.Y. The College also features a number of regional campuses located on more than 25,000 acres of forest property throughout Central New York and the Adirondack Park. ESF's Ranger School campus in Wanakena, N.Y., offers the College's associate degree programs in an environment renowned for its natural beauty and abundant recreational opportunities. The College also maintains biological stations in the St. Lawrence River and Costa Rica.

ESF's students are divided almost equally between men and women. Graduate students make up approximately one-quarter of the total student body. Most students who attend ESF are residents of New York state, but the campus draws students from 34 states and 39 different countries. More than one-fifth of the current freshman class has enrolled from other states, and the ethnic and geographic diversity of ESF undergraduates has risen steadily in recent years.

The size of the student population means students receive a lot of individual attention from faculty and staff. The student-faculty ratio is 13-to-1 at the Syracuse campus and 7-to-1 at The Ranger School. Students get to know one another and form long-lasting friendships.

But the close nature of the ESF community is not inhibiting. The Syracuse campus is located adjacent to Syracuse University, a major private university with big-time sports and more than 300 student and professional clubs and organizations. ESF students have the advantage of being considered students at both institutions.

ESF and SU have a dynamic and long-standing partnership that goes back to the founding of the College. From the beginning, the College has contracted with SU to provide accessory instruction, recreation programs, health and counseling services, library facilities and other services for students. In a very real sense, ESF students have the best of both worlds: the intimacy and intellectual atmosphere of a small dynamic college and the exciting atmosphere of one of the nation's leading university centers.

SU enrolls a total of about 19,000 students at its main and branch campuses, including 12,000 undergraduates. Students select from more than 200 majors available within the University's nine colleges, which include the prestigious Maxwell School of Citizenship and Public Affairs and the S.I. Newhouse School of Public Communications.

ESF and SU together are located on one of several hills that overlook downtown Syracuse and nearby Onondaga Lake. The greater metropolitan area is home to about 750,000 people and offers a variety of cultural, educational and recreational opportunities.

The city has several fine museums, including the renowned Everson Museum of Art, and several excellent theater companies. The downtown OnCenter and Landmark Theatre feature performing artists from around the world. The area is home to several colleges and universities. The State University of New York Upstate Medical University, Le Moyne College and Onondaga Community College join ESF and Syracuse University in the city, while Cazenovia College is nestled in a nearby suburb. There are many other institutions of higher education within a short drive, including Colgate University, Cornell University, Hamilton College, Ithaca College, SUNY Cortland, SUNY Institute of Technology, SUNY Morrisville, SUNY Oswego and Utica College.

There are more than 50 state, county and city parks in the area and several nature centers. The Adirondacks, Lake Ontario, the Finger Lakes, downhill and cross-country skiing facilities, and golf courses are also within easy driving distance, and make Central New York a haven for recreation and nature lovers.

Syracuse is called the Crossroads of New York State, because it is situated at the intersection of two major highways: the 500-mile east-west New York State Thruway (Interstate 90) and the north-south Interstate 81. The driving time to New York City, Boston, Philadelphia, Toronto or Montreal is approximately five hours, while Buffalo and Albany are less than three hours away.

The city is also served by Hancock International Airport, Amtrak, and major bus lines, which make it a convenient home for students and faculty alike.

Students come to ESF because they care about the environment and want to make the world a better place to live. They're smart and hardworking and ready to apply what they've learned in real-world situations.

As society becomes increasingly concerned about the environment, ESF graduates find their services in demand. Modern civilization with its compelling demands from industry and government needs people who think objectively and constructively, and act creatively and responsibly.

From its start in 1911, the College has served the state, nation and world in meeting the needs of its citizens through education, research and public service. Faculty and students at ESF are committed to resolving immediate environmental hazards, learning how to avoid future problems, and offering policy, engineering and design alternatives that will both protect the environment and meet the needs of a global society.



# Academic Programs

## Degree Programs and Areas of Study

ESF is authorized by the New York State Department of Education to offer undergraduate and graduate degree programs as described in this catalog. The Higher Education General Information Survey (HEGIS) code is the number assigned to programs registered by the commissioner of the New York State Department of Education. The Classification of Instructional Programs (CIP) Code allows the U.S. Department of Education to track educational programs for financial aid eligibility. Enrollment in programs that are not registered or otherwise approved may jeopardize a student's eligibility for certain financial aid programs.

### Associate in Applied Science (A.A.S.)

- **Environmental and Natural Resources Conservation** (HEGIS Code 0115, CIP Code 030101)  
[The Ranger School](#)
- **Forest Technology** (HEGIS Code 5403, CIP Code 030599)  
[The Ranger School](#)
- **Land Surveying Technology** (HEGIS Code 5309, CIP Code 151102)  
[The Ranger School](#)

### Bachelor of Landscape Architecture (B.L.A.)

- **Landscape Architecture** (HEGIS Code 0204, CIP Code 040601)  
[Department of Landscape Architecture](#)

### Bachelor of Science (B.S.)

- **Aquatic and Fisheries Science** (HEGIS Code 0115, CIP Code 261304)  
[Department of Environmental and Forest Biology](#)
- **Bioprocess Engineering** (HEGIS Code 0905, CIP Code 140501)  
[Department of Paper and Bioprocess Engineering](#)
- **Biotechnology** (HEGIS Code 0499, CIP Code 261201)  
[Department of Environmental and Forest Biology](#)
- **Chemistry** (HEGIS Code 1905, CIP Code 400501) with options in biochemistry and organic chemistry of natural products, environmental chemistry, or natural and synthetic polymer chemistry.  
[Department of Chemistry](#)
- **Conservation Biology** (HEGIS Code 0420, CIP Code 261307)  
[Department of Environmental and Forest Biology](#)
- **Construction Management** (HEGIS Code 0599, CIP Code 469999) with elective concentration in sustainable construction and renewable materials.  
[Department of Sustainable Construction Management and Engineering](#)
- **Environmental Biology** (HEGIS Code 0420, CIP Code 261305 )  
[Department of Environmental and Forest Biology](#)
- **Environmental Resources Engineering** (HEGIS Code 0999, CIP Code 140101)  
[Department of Environmental Resources Engineering](#)
- **Environmental Science** (HEGIS Code 0420, CIP Code 030104 ) with options in renewable energy, environmental information and mapping, watershed science, health and the environment, earth and atmospheric systems science, environmental analysis, or environmental engineering science.  
[Division of Environmental Science](#)
- **Environmental Studies** (HEGIS Code 0201, CIP Code 030101) with options in biological science applications; environmental policy, planning and law; or environmental communication, culture and writing.  
[Department of Environmental Studies](#)
- **Forest Ecosystem Science** (HEGIS Codes 0114, CIP Code 030502)  
[Department of Forest and Natural Resources Management](#)
- **Forest Engineering** (HEGIS Code 0999, CIP Code 140101)  
[Department of Environmental Resources Engineering](#)
- **Forest Health** (HEGIS Code 0114, CIP Code 030599)  
[Department of Environmental and Forest Biology](#)
- **Forest Resources Management** (HEGIS Code 0115, CIP Code 030501)  
[Department of Forest and Natural Resources Management](#)
- **Natural History and Interpretation** (HEGIS Code 0499, CIP Code 269999)  
[Department of Environmental and Forest Biology](#)

- **Natural Resources Management** (HEGIS Code 0115, CIP Code 030201)  
[Department of Forest and Natural Resources Management](#)
- **Paper Engineering** (HEGIS Code 0999, CIP Code 149999) with a minor in management.  
[Department of Paper and Bioprocess Engineering](#)
- **Paper Science** (HEGIS Code 0999, CIP Code 149999) with a minor in management.  
[Department of Paper and Bioprocess Engineering](#)
- **Wildlife Science** (HEGIS Code 0107, CIP Code 260709)  
[Department of Environmental and Forest Biology](#)
- **Wood Products Engineering** (HEGIS Code 0999, CIP Code 030509) with elective concentrations in sustainable construction and renewable materials, marketing and production, or wood science.  
[Department of Sustainable Construction Management and Engineering](#)

#### **Bachelor of Landscape Architecture/Master of Science**

- **B.L.A./M.S. Fast-Track** (HEGIS Code 0204, CIP Code 040601)  
[Department of Landscape Architecture](#)

#### **Advanced (Graduate) Certificates**

- **Bioprocessing** (HEGIS Code 0199, CIP Code 019999)  
Division of Engineering, [Department of Paper and Bioprocess Engineering](#)
- **Environmental Decision Making** (HEGIS Code 0420) [restricted to students matriculated at Syracuse University]  
[Division of Environmental Science](#)

#### **Master of Forestry (M.F.)**

- **Forest Management and Operations** (HEGIS Code 0115)  
[Department of Forest and Natural Resources Management](#)

#### **Master of Landscape Architecture (M.L.A.)**

- **Landscape Architecture** (HEGIS Code 0204, CIP Code 040601) with areas of study in community design and planning, cultural landscape studies and conservation, or landscape and urban ecology.  
[Department of Landscape Architecture](#)

#### **Master of Professional Studies (M.P.S.)**

- **Environmental and Forest Biology** (HEGIS Code 0499, CIP Code 261305) with areas of study in applied ecology, chemical ecology, conservation biology, ecology, entomology, environmental interpretation, environmental physiology, fish and wildlife biology and management, forest pathology and mycology, plant biotechnology, or plant science and biotechnology.  
[Department of Environmental and Forest Biology](#)
- **Environmental and Forest Chemistry** (HEGIS Code 1905, CIP Code 400599) with areas of study in biochemistry, environmental chemistry, organic chemistry of natural products, or polymer chemistry.  
[Department of Chemistry](#)
- **Environmental and Resource Engineering** (HEGIS Code 0999, CIP Code 141401) with an option in **construction management and wood products engineering** and areas of study in construction and construction management or wood science and technology.  
Division of Engineering, [Department of Sustainable Construction Management and Engineering](#)
- **Environmental and Resource Engineering** (HEGIS Code 0999, CIP Code 141401) with an option in **forest engineering** and areas of study in environmental management or mapping sciences.  
Division of Engineering, [Department of Environmental Resources Engineering](#)
- **Environmental and Resource Engineering** (HEGIS Code 0999, CIP Code 141401) with an option in **paper and bioprocess engineering** and areas of study in process and environmental systems engineering or pulp and paper technology.  
Division of Engineering, [Department of Paper and Bioprocess Engineering](#)
- **Environmental Science** (HEGIS Code 0420, CIP Code 030104) with areas of study in environmental and community land planning, environmental communication and participatory processes, environmental policy and democratic processes, environmental systems and risk management, or water and wetland resource studies.  
[Division of Environmental Science](#)
- **Environmental Studies** (HEGIS Code 0201, CIP Code 030101) with options in biological science applications; environmental policy, planning and law; or environmental communication, culture and writing.  
[Department of Environmental Studies](#)
- **Forest Resources Management** (HEGIS Code 0115, CIP Code 030506) with areas of study in environmental and natural resources policy, forest ecosystem science and applications, natural resources management, quantitative methods in forest science and management, recreation and resources management, or watershed management and forest hydrology.  
[Department of Forest and Natural Resources Management](#)

## Master of Science (M.S.)

- **Environmental and Forest Biology** (HEGIS Code 0499, CIP Code 261305) with areas of study in chemical ecology, conservation biology, ecology, entomology, environmental interpretation, environmental physiology, fish and wildlife biology and management, forest pathology and mycology, or plant science and biotechnology.  
[Department of Environmental and Forest Biology](#)
- **Environmental and Forest Chemistry** (HEGIS Code 1905, CIP Code 400599) with areas of study in biochemistry, environmental chemistry, organic chemistry of natural products, or polymer chemistry.  
[Department of Chemistry](#)
- **Environmental and Resource Engineering** (HEGIS Code 0999, CIP Code 141401) with an option in **construction management and wood products engineering** and areas of study in construction and construction management, engineered wood products and structures (timber structure design), tropical timbers, wood science and technology, wood anatomy and ultrastructure, or wood treatments.  
Division of Engineering, [Department of Sustainable Construction Management and Engineering](#)
- **Environmental and Resource Engineering** (HEGIS Code 0999, CIP Code 141401) with an option in **forest engineering** and areas of study in ecological engineering, forest engineering, geospatial information science and engineering, or water resources engineering.  
Division of Engineering, [Department of Environmental Resources Engineering](#)
- **Environmental and Resource Engineering** (HEGIS Code 0999, CIP Code 141401) with an option in **paper and bioprocess engineering** and areas of study in chemistry of pulping and bleaching, colloid chemistry and fiber flocculation, fiber and paper mechanics, renewable energy and bioprocess engineering, process and environmental systems engineering, or pulp and paper technology.  
Division of Engineering, [Department of Paper and Bioprocess Engineering](#)
- **Environmental Science** (HEGIS Code 0420, CIP Code 030104) with areas of study in environmental and community land planning, environmental communication and participatory processes, environmental policy and democratic processes, environmental systems and risk management, or water and wetland resource studies.  
[Division of Environmental Science](#)
- **Environmental Studies** (HEGIS Code 0201, CIP Code 030101)  
[Department of Environmental Studies](#)
- **Forest Resources Management** (HEGIS Code 0115, CIP Code 030506) with areas of study in environmental and natural resources policy, forest ecosystem science and applications, natural resources management, quantitative methods in forest science and management, recreation and resources management, or watershed management and forest hydrology.  
[Department of Forest and Natural Resources Management](#)
- **Landscape Architecture** (HEGIS Code 0204, CIP Code 040601) with areas of study in community design and planning, cultural landscape studies and conservation, or landscape and urban ecology.  
[Department of Landscape Architecture](#)

## Doctor of Philosophy (Ph.D.)

- **Environmental and Natural Resources Policy** (HEGIS Codes 0115 and 0420, CIP Codes 030506 and 030104)  
[Division of Environmental Science, Department of Forest and Natural Resources Management](#)
- **Environmental and Forest Biology** (HEGIS Code 0499, CIP Codes 261305) with areas of study in chemical ecology, conservation biology, ecology, entomology, environmental interpretation, environmental physiology, fish and wildlife biology and management, forest pathology and mycology, or plant science and biotechnology.  
[Department of Environmental and Forest Biology](#)
- **Environmental and Forest Chemistry** (HEGIS Code 1905, CIP Code 400599) with areas of study in biochemistry, environmental chemistry, organic chemistry of natural products, or polymer chemistry.  
[Department of Chemistry](#)
- **Environmental and Resource Engineering** (HEGIS Code 0999, CIP Code 141401) with an option in **construction management and wood products engineering** and areas of study in construction and construction management, engineered wood products and structures (timber structure design), tropical timbers, wood science and technology, wood anatomy and ultrastructure, or wood treatments.  
Division of Engineering, [Department of Sustainable Construction Management and Engineering](#)
- **Environmental and Resource Engineering** (HEGIS Code 0999, CIP Code 141401) with an option in **forest engineering** and areas of study in ecological engineering, forest engineering, geospatial information science and engineering, or water resources engineering.  
Division of Engineering, [Department of Environmental Resources Engineering](#)
- **Environmental and Resource Engineering** (HEGIS Code 0999, CIP Code 141401) with an option in **paper and bioprocess engineering** and areas of study in chemistry of pulping and bleaching, colloid chemistry and fiber flocculation, fiber and paper mechanics, renewable energy and bioprocess engineering, process and environmental systems engineering, pulp and paper technology.  
Division of Engineering, [Department of Paper and Bioprocess Engineering](#)
- **Environmental Science** (HEGIS Code 0420, CIP Code 030104) with areas of study in environmental and community land planning, environmental communication and participatory processes, environmental systems and risk management, or water and wetland

resource studies.

[Division of Environmental Science](#)

- **Forest Resources Management** (HEGIS Code 0115, CIP Code 030506) with areas of study in forest ecosystem science and applications, natural resources management, quantitative methods in forest science and management, recreation and resources management, or watershed management and forest hydrology.

[Department of Forest and Natural Resources Management](#)

## Graduation Rate

The College of Environmental Science and Forestry provides graduation rate information based on a six-year period of study (12 semesters) to comply with state and federal reporting requirements and to properly allow for the extended five-year period of undergraduate study required by the Department of Landscape Architecture for the BLA degree. The six-year graduation rates for first-year freshman students entering ESF in the fall 2003, 2004, and 2005 semesters were 64, 65, and 65 percent respectively. The average six-year graduation rate for these three entering classes was 65 percent, one of the highest graduation rates in the State University of New York system.

Transfer students enter ESF at a variety of class levels and require different amounts of time to complete their degree programs. A review of registration and graduation records indicates that 67 percent of transfer students entering ESF in the fall 2005 semester had graduated by the spring 2011 semester. The average six-year graduation rate for transfer students entering in the fall 2003, 2004 and 2005 semesters was 68 percent.

Further information on student retention is available from the Director of Government Relations and Institutional Planning, 225 Bray Hall. Graduation rate data is also published annually on the federal government's College Navigator website.

## Undergraduate Education

### General Education

The State University of New York requires graduates of bachelor degree (B.S.) programs to successfully complete 27 credit hours of coursework distributed among nine knowledge and skill areas, collectively referred to as general education. The core of the curricula for all ESF undergraduate degree programs satisfy several of the requirements, including those for the natural science, basic communications, mathematics, and humanities general education knowledge and skill areas. For the remaining general education knowledge and skill area requirements, students must complete an additional 15 credit hours distributed among courses chosen from at least three of the five remaining knowledge and skill areas, or as specifically designated by their degree programs.

The courses listed below may be chosen to satisfy SUNY general education requirements in each of the nine knowledge and skill areas. Please note that more than 40 of these courses are taught in the College of Arts and Sciences at Syracuse University. General education courses listed with the prefix APM, EFB, FOR, LSA, or PSE are taught at SUNY-ESF and can be found in the Course Descriptions section of this catalog. Course descriptions for Syracuse University courses can be found online at <http://coursecatalog.syr.edu/>.

### Mathematics

APM	104	College Algebra and Precalculus	3
APM	105	Survey of Calculus and Its Applications I	4
APM	106	Survey of Calculus and Its Applications II	4
APM	391	Introduction to Probability and Statistics	3
MAT	111	Basic Algebra	3
MAT	112	Algebraic Operations and Functions	3
MAT	117	Foundational Mathematics via Problem Solving I	3
MAT	118	Foundational Mathematics via Problem Solving II	3
MAT	121	Probability and Statistics for the Liberal Arts I	3
MAT	122	Probability and Statistics for the Liberal Arts II	3
MAT	194	Precalculus	3
MAT	295	Calculus I	4
MAT	296	Calculus II	4

### Natural Sciences

EFB	120	The Global Environment & the Evolution of Human Society	3
EFB	101	General Biology I	3
EFB	102	General Biology Laboratory I	1

EFB	103	General Biology II	3
EFB	104	General Biology Laboratory II	1
EFB	320	General Ecology	4
EFB	321	Fundamentals of Ecology for Designers and Planners	3
FCH	150	General Chemistry I	3
FCH	151	General Chemistry I Laboratory	1
FCH	152	General Chemistry II	3
FCH	153	General Chemistry II Laboratory	1
FCH	210	Elements of Organic Chemistry	3
FCH	221	Organic Chemistry I	3
FCH	222	Organic Chemistry I Laboratory	1
FCH	223	Organic Chemistry II	3
FCH	224	Organic Chemistry II Laboratory	1
GOL	101	Dynamic Earth	4
PHY	211	General Physics I	3
PHY	221	General Physics I Laboratory	1
PHY	212	General Physics II	3
PHY	222	General Physics II Laboratory	1

### Social Sciences

EFB	120	The Global Environment & the Evolution of Human Society	3
EST	221	Introduction to American Government	3
EST	366	Attitudes, Values and the Environment	3
EST	390	Social Processes and the Environment	3
FOR	202	Introduction to Sociology	3
FOR	207	Introduction to Economics	3
GEO	103	America and the Global Environment	3
MAX	132	Global Community	3
PAF	101	An Introduction to the Analysis of Public Policy	3
PSC	123	Comparative Government and Politics	3
PSC	124	International Relations	3
PSC	125	Political Theory	3
PSY	205	Foundations of Human Behavior	3
SOC	248	Ethnic Inequalities and Intergroup Relations	3
SOC	281	Sociology of Families	3

### American History

For all students:

EST	201	American History: Reconstruction to Present	3
FOR	204	Natural Resources in American History	3
HST	101	American History to 1865	3
HST	102	American History Since 1865	3

For students scoring above 84 on the U.S. History Regents examination:

EST	361	History of the American Environmental Movement	3
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### Western Civilization

ETS	211	Early European Literary History	3
FIA	105	Arts and Ideas I	3
FIA	106	Arts and Ideas II	3
FOR	203	Western Civilization and the Environment	3
HST	111	Early Modern Europe, 1350-1815	3
HST	210	The Ancient World	3
HST	211	Medieval and Reformation Europe	3
LIT	203	Greek and Roman Epic in English Translation	3
LIT	211	Greek and Roman Drama in Translation	3
LSA	205	Art, Culture and Landscape I	3
LSA	206	Art, Culture and Landscape II	3
LSA	405	History of Landscape Architecture	3
PSC	125	Political Theory	3
REL/JSP	114	The Bible	3
REL	205	Ancient Greek Religion	3
REL	206	Greco-Roman Religion	3
REL/JSP	215	Hebrew Bible	3

### Other World Civilizations

AAS	241	African Religions: An Introduction	3
ANT	121	Peoples and Cultures of the World	3
ANT	185	Global Encounters: Comparing World Views and Values Cross-Culturally	3
ANT/SAS/ WSP	324	Modern South Asian Cultures	3
ANT	326	Africa Through the Novel	3
EFB	217	Peoples, Plagues, and Pests	3
EST	200	Cultural Ecology	3
GEO	272	World Cultures	3
HST	320	Traditional China	3
HST	321	Modern China	3
REL	101	Religions of the World	3
REL/SAS	185	Hinduism	3
REL/SAS	186	Buddhism	3

### Humanities

AAS	231	African American Literature to 1900: An Introduction	3
AAS	235	African American Drama	3
EWP	290	Perspectives on the Environment	3
EST	245	Nature and Popular Culture	3
ETS	107	Living Writers	3
ETS	141	Readings and Interpretation I: From Language to Discourse	3

ETS	151	Interpretation of Poetry	3
ETS	153	Interpretation of Fiction	3
ETS	192	Gender and Literary Texts	3
LIN	201	The Nature and Study of Language	3
LIT	203	Greek and Roman Epic in English Translation	3
PHI	107	Theories of Knowledge and Reality	3
PHI	111	Plato's Republic	3
REL	217	New Testament	3
REL	231	Judaic Literature	3
REL	235	Judaism	3
REL	248	American Religious Thought	3
REL	252	Religious Ethics and Social Issues	3
REL	256	Christianity	3

### The Arts

APH	241	Art Photography, Introduction	3
EFB	215	Interpreting Science through Art	3
ETS	215	Sophomore Poetry Workshop	3
ETS	217	Sophomore Fiction Workshop	3
FIA	105	Arts and Ideas I	3
FIA	106	Arts and Ideas II	3
FIA	115	The Visual Arts in North America	3
FIA	125	Introduction to Music Theory	3
FIA	165	Understanding Music I	3
FIA	166	Understanding Music II	3
FIA	301	Masterpieces of Art	3
FIA	317	Nineteenth-Century American Art	3
LSA	182	Drawing Studio	3
LSA	205	Art, Culture and Landscape I	3
LSA	206	Art, Culture and Landscape II	3
PSE	201	The Art and Early History of Papermaking	3

### Basic Communication

EWP	190	Writing and The Environment	3
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### Dual Majors

Students who are pursuing undergraduate degrees may pursue dual majors. Program requirements must be satisfied concurrently (i.e., a student cannot graduate from ESF and return later to complete coursework for a second major). The diploma will state the completion of a single degree. The transcript will state the completion of two majors.

Admission to a dual major will be accomplished by petition to the primary degree department or academic unit that has been endorsed (approved) by the secondary degree department.

#### **Inter-department dual majors:**

Students must satisfy requirements of both majors.

#### **Permissible intra-department dual majors:**

SCME: Construction Management and Wood Products Engineering allowed with each other;  
PBE: Bioprocess Engineering allowed with either Paper Engineering or Paper Science;  
FNRM: no dual majors between the three majors (FRM, NRM, and FES); forest technology and surveying technology and environmental and natural resources conservation degrees allowed for A.A.S. degrees;  
EFB: Only Biotechnology with other EFB majors **except environmental biology**.

Students may petition for admission to a dual major A.A.S. degree after completing 18 credits and before 45 credits with an unambiguous GPA of 2.0 or greater (no grades of incomplete or missing grades).

Students pursuing the B.S. degree may petition admission to a dual major after completing 30 credits and before completing 90 credits in the primary major with an unambiguous GPA of 2.000 or greater (no grades of incomplete or missing grades).

## Undergraduate Minors

Admission to undergraduate minors for ESF students is via petition, with additional application requirements as noted in the descriptions of the minors below. Successful completion of a minor will be noted on the transcript of each student.

### Bioprocess Science Minor

The bioprocess science minor gives students an understanding of the rapidly developing bioprocessing industry, which uses the chemical, physical and biological processes developed by living organisms or their cellular components in a type of advanced manufacturing of specialty commercial products. Bioprocess science will influence diverse fields as it becomes widely used, such as for producing energy from sustainable sources.

The bioprocess science minor is available to all ESF undergraduate students (**except students in the bioprocess engineering program**) who maintain a minimum cumulative grade point average of 2.8, and who desire to develop greater knowledge of bioprocess science and its related fields. Interested students must submit a petition and application form, with courses listed, to their academic advisor and the chair of their department, with final approval from the dean of Instruction and Graduate Studies. Students should declare the minor by the end of the sophomore year, but may petition to their home department for enrollment at any time after that. Successful completion of the minor will be noted on the student's transcript.

Eighteen credit hours (6 courses) are required to satisfy the minor. Specified courses: PSE 370 Principles of Mass and Energy Balance (3); BPE 310 Colloid and Interface Science (3); BPE 420 Bioseparations (3); and at least three directed elective courses available from both ESF and Syracuse University including biology, forestry, chemical engineering, chemistry, paper science and engineering, bioprocess engineering, and environmental and biological engineering. Students are required to complete at least one course from a list of biological and chemistry electives and at least one course from a list of engineering electives. The complete list of courses is available from faculty advisors.

### Chemistry Minor

The Department of Chemistry offers a minor in chemistry to students who wish to enhance their degrees with a strong concentration in this area. The chemistry minor is open to any student. A minor is an excellent credential in the eyes of future employers and enhances the students' records. The chemistry minor provides a broad and general exposure to the traditional areas of the chemical sciences and specialized areas of modern chemistry. The minor provides sufficient concentration of courses for the student to understand a wide range of chemical phenomena and appreciate the impact of chemical phenomena on both professional and life experiences.

Admission to the chemistry minor requires sophomore, or higher, status. Students should have completed the following prerequisite coursework: one year of General Chemistry (I and II) with lab (8 credits) and one year of Organic Chemistry (I and II) with lab (8 credits). Fifteen credit hours of upper division chemistry credits (300 level or above) are required to satisfy the minor; suggested courses are available from the Chemistry department website.

Required Coursework (15 credits in upper division chemistry from among the following):

FCH 325 Organic Chemistry III (4)  
FCH 360 Physical Chemistry I (3)  
FCH 380 Analytical Chemistry I (3)  
FCH 361 Physical Chemistry II (3)  
FCH 381 Analytical Chemistry II (3)  
FCH 384 Spectrometric Identification of Organic Compounds (2)  
FCH 410 Inorganic Chemistry (3)  
FCH 530 Biochemistry I (3)  
FCH 531 Biochemistry Laboratory (3)  
FCH 532 Biochemistry II (3)  
FCH 510 Environmental Chemistry I (3)  
FCH 511 Environmental Chemistry II (3)  
FCH 515 Methods of Environmental Chemical Analysis (3)  
FCH 550 Polymer Science: Synthesis and Mechanisms (3)  
FCH 551 Polymer Techniques (3)  
FCH 552 Polymer Science: Properties and Technology (3)

Suggested upper division courses are available at [www.esf.edu/chemistry/minor/](http://www.esf.edu/chemistry/minor/).



### **Computer and Information Technology Minor**

The computer and information technology minor is available to all ESF undergraduates who want to develop greater skill in computer science and information technology applications. By understanding the basic principles behind software development, students can more effectively use these tools in their chosen fields. To be eligible for this minor, a student must have a cumulative grade point average of 2.8 or better by the end of the sophomore year. Interested students must submit a petition form, with courses listed, to their academic advisor and undergraduate coordinator, with final approval from the dean of Instruction and Graduate Studies.

Eighteen credit hours (6 courses) in computer science and information technology courses are required. Required courses: APM 153 Computing Methods for Engineers and Physical Scientists (3) *or* APM 360 Introduction to Computer Programming (3); ESF 200 Information Literacy (1); CIS 252 Introduction to Computer Science (4); CIS 351 Data Structures (4). Elective courses: at least two courses (6 credits) chosen from among courses available from both ESF and Syracuse University including Applied Mathematics (APM), Environmental Resource Engineering, Forestry, Wood Products Engineering, Computer and Information Science, Computer Engineering, and Computational Science. The complete list is available from faculty advisors.

### **Construction Management Minor**

The construction management minor is available to all ESF undergraduates (**except students in construction management or wood products engineering programs**) and prepares students for management careers in the construction industry. The basic objective of the minor is to provide a fundamental understanding of the various methods used to take a design into the field and build a quality structure in the most efficient and effective manner with minimal environmental impact. Eighteen credit hours (6 courses) are required to complete the minor. Four courses are specified, with an additional two courses selected from the list of six courses given below. A cumulative grade point average of 2.000 or higher is required for the construction management courses.

Admission to the minor requires sophomore status, a cumulative grade point average of 2.500 or higher, and permission of the chair of the Department of Sustainable Construction Management and Engineering. Interested students must submit a petition form, with courses listed, to their academic advisor and the chair of the Department of Sustainable Construction Management and Engineering, with final approval from the dean of Instruction and Graduate Studies.

Eighteen credit hours (6 courses) are required. Specified courses: CME 342 Light Construction (3); CME 343 Construction Estimating (3); CME 453 Construction Planning and Scheduling; CME 454 Construction Project Management; and two additional courses chosen from the following: CME 330 Building Codes and Zoning Practices (3); CME 331 Construction Safety (3); CME 335 Cost Engineering (3); CME 350 Construction Methods and Equipment (3); CME 444 Materials Marketing (3); CME 455 Construction Contracts and Specifications (3).

### **Environmental Writing and Rhetoric Minor**

This minor encourages students to develop fluency and expertise in expressing purposeful ideas in the age of 21st century literacies. The minor will engage students in a rhetorical approach to writing, reading, and communicating, preparing them to be active participants in academic, professional, civic, and cultural life. The minor in Environmental Writing & Rhetoric is open to all undergraduates at SUNY-ESF.

Twelve credits are required for the minor. Required course: EWP 300 Survey of Environmental Writing (3). Three credits must be chosen from among the following directed electives: EWP 311 Urban Environmental Literature (3), EWP 390 Introduction to the Literature of Nature (3), EWP 490 Literature of Nature (3), EWP 220 Public Presentation Skills for Environmental Professionals (3). Three credits must be chosen from among the following advanced/professional writing courses: EWP 405 Writing for Science Professionals (3), EWP 410 Writing for Environmental Professionals (3), EWP 494/694 Creative Non-Fiction for the Sciences (3), EWP 495/EST 695 Environmental Journalism (1-3), EWP 420 Advanced Public Presentation Skills (3). Students must earn three experience credits from either EWP 498 Internship or EWP 498 Independent Study (1-3).

Each student will create a portfolio of work, including writing samples and digital recordings of oral presentations. The portfolio serves a dual purpose: It provides students with a representation of their abilities and may be used as evidence when the student applies to graduate school and/or enters the workplace; and it informs and contributes to the assessment process for the minor.

Prerequisites: In order to declare this minor, students must have received credit for EWP 190 and EWP 290. Students may begin the minor before completing EWP 290.

### **Forestry Minor**

The minor in forestry draws from the biological, physical, social, and managerial sciences. The curriculum aids in understanding the biological complexities of the forest and the interactions between the forest and social and economic demands. The minor is designed to provide students with an appreciation of forest resources management. Course themes include forest measurements, forest ecology, forest management and silviculture, and forest policy and economics.

Admission to the minor requires students to have a cumulative grade point average of 2.750 or better after one semester at ESF (or as a transfer student with same standing), and permission of the Department of Forest & Natural Resources Management chair and Undergraduate Education Coordinator (via petition).

The minor in Forestry requires 16 credits. It is the responsibility of the student to meet any prerequisites associated with courses in the minor. Required courses are FOR 322 Forest Mensuration (3) (prerequisite of FOR 304 or equivalent); FOR 332 Forest Ecology (3) (prerequisite of FOR 232 or EFB 320 or equivalent); FOR 334 Silviculture (4); FOR 370 Forest Management Decision Making and Planning (3) or FOR 373 Forest Operations (3) (prerequisites for FOR 370: FOR 322 and FOR 334; prerequisites for FOR 373: FOR 322 and FOR 334); FOR 333 Natural Resource Managerial Economics (3) or FOR 465 Natural Resources Policy (3) (prerequisite for FOR 333: FOR 207 or equivalent; no prerequisites for FOR 465).

## Information Management and Technology Minor

In collaboration with the Syracuse University School of Information Studies, ESF also offers an undergraduate minor in Information Management and Technology for ESF students. This minor is designed to give students knowledge of information technology and an understanding of information and communications problems. It complements many majors because all organizations need people who understand information resources and information technology. To be eligible for this minor, students must have a cumulative grade point average of 2.750 or better and apply for the minor after completing at least one semester at ESF, but as soon after that as possible to ensure all courses can be completed. Normally, students are allowed to take only one information management course per semester, with one semester of two management courses, so careful planning is required. It is preferable students begin the minor during their sophomore year.

The following 18 credits of courses are required: ITS 195 Information Technologies (3); 9 credits of ITS elective coursework; and one course from each of the following two general areas of study:

Technology:

- IST 233 Introduction to Computer Networking (3)
- IST 352 Applications of Information Systems (3)
- IST 459 Introduction to Database Management Systems (3)

Management:

- IST 335 Introduction to Information-based Organizations (3)
- IST 352 Information Analysis of Organizational Systems (3)
- IST 445 Managing Information Systems Projects (3)

For questions regarding the selection of elective coursework, please contact Elaine Morgan with the I-School at 443-1830 or [emmorgan@syrr.edu](mailto:emmorgan@syrr.edu)

## Management Minors

In collaboration with the Syracuse University School of Management, undergraduate minors in entrepreneurship, general management studies, and marketing are available for ESF students. To be eligible for any of these minors, students must have a cumulative grade point average of 2.750 or better and apply for the minor after completing at least one semester at ESF, but as soon after that as possible to ensure all courses can be completed. Normally, students are allowed to take only one management course per semester, with one semester of two management courses, so careful planning is required. It is preferable students begin the minor during their sophomore year.

- **Entrepreneurship Minor:** The following 18 credits of courses are required: ACC 201 Introduction to Accounting for Non-Management Students (3); FIN 301 Finance for Non-Management Students (3); EEE 370 Introduction to Entrepreneurship and Emerging Enterprises (3). Three additional courses chosen from among the following: EEE 375 Entrepreneurial and Family Business Management (3); EEE 400 Special ics (3); EEE 442 Emerging Enterprise Law (3); EEE 443 Consulting in Entrepreneurial Practice (3); EEE 451 Finance for Emerging Enterprises (3); FOR 360 Principles of Management (3); PSE 456 Management in the Paper Industry (3); or CME 444 Materials Marketing (3).
- **General Management Studies Minor:** The following 18 credits of courses are required: ACC 201 Financial Accounting for Non-Management Students (3); EEE 370 Introduction to Entrepreneurship and Emerging Enterprises (3); FIN 301 Finance for Non-Management Students (3); LPP 225 Introduction to the Legal System (3) or FOR 488 Natural Resources Agencies and Administration (3); MAR 255 Principles of Marketing (3); SHR 355 Strategic Human Resource Management (3). The following courses may be substituted for SHR 355, EEE 370, or MAR 255: FOR 360 Principles of Management (3); PSE 456 Management in the Paper Industry (3); CME 444 Materials Marketing (3).
- **Marketing Minor:** The following 18 credits of courses are required: ACC 201 Financial Accounting for Non-Management Students (3); EEE 370 Introduction to Entrepreneurship and Emerging Enterprises (3); FIN 301 Finance for Non-Management Students (3); MAR 255 Principles of Marketing (3). Two additional courses chosen from among the following: MAR 356 Marketing Research (3); MAR 400 Special ics (3); MAR 455 Marketing Communications (3); MAR 456 Global Marketing Strategy (3); FOR 360 Principles of Management (3); PSE 456 Management in the Paper Industry (3); CME 444 Materials Marketing (3).

## Paper Science Minor

The paper and related industries (including pulp, mineral, chemical and machinery suppliers) continually seek knowledgeable and skilled employees. Each year, companies hire numerous graduates of chemical, mechanical and environmental engineering programs as well as chemists and other environmental professionals in addition to paper science and engineering graduates. Salaries for new hires are among the highest for all fields of study at the bachelor's degree level. This minor gives students a thorough understanding of the paper industry that will allow them to apply their major field of study to this growth industry.

The paper science minor is available to all ESF undergraduate students (**except students in the paper science and paper engineering programs**) who maintain a minimum cumulative grade point average of 2.800 and who desire to develop greater knowledge of paper science and its related fields. Students will elect the minor by submitting a petition form with courses listed to their faculty advisor and the undergraduate coordinator of their home department. The petition and application will then be sent to the dean of Instruction and Graduate Studies for final approval. A student should declare the minor by the end of the sophomore year, but may petition to his/her own department for enrollment at any time after that. Successful completion of the minor will be noted on the student's transcript.

Eighteen credit hours (6 courses) in paper science courses are required. Specified courses: PSE 300 Introduction to Papermaking (3); PSE 302 Pulp and Paper Laboratory Skills (1); PSE 370 Principles of Mass and Energy Balance (3); and directed electives courses (at least 11 credits): PSE 350 Pulping and Bleaching Processes (3); PSE 351 Pulping and Bleaching Laboratory (2); PSE 465 Paper Properties (4); PSE 466 Paper Coating and Converting (2); PSE 467 Papermaking Wet End Chemistry (3); PSE 468 Papermaking Processes (3).

### **Recreation Resource and Protected Area Management Minor**

This minor provides students with the opportunity to combine visitor management with protected area management. Understanding the need to balance the opportunity for visitor experiences with protecting and stewarding protected areas provides professional insight into planning and managing those areas for limited visitor access. Understanding the motivations, preferences, and behavior of recreational users is necessary to integrate the human dimensions into protected area management with consideration of the social and environmental factors related to such management. Protected area managers need to be able to manage both the resource itself as well as a wide variety of users, such as campers, hikers, bird watchers, boaters, nature photographers and others who enjoy nature-based experiences in extensive protected area environments owned by public agencies, private landowners, or NGOs.

Admission to the minor requires students to have completed a general ecology course (e.g., EFB 320 General Ecology, which is a prerequisite for EFB 416), a cumulative grade point average of 2.750 or better after one semester at ESF (or as a transfer student with same standing), and permission of the Forest & Natural Resources Management chair and undergraduate education coordinator (via petition).

Fifteen credit hours of courses are specified: EFB 416 Introduction to Environmental Interpretation (3); FOR 372 Fundamentals of Outdoor Recreation (3); FOR 475 Human Behavior and Recreation Visitor Management (3); FOR 476 Ecotourism and Nature Tourism (3); FOR 478 Wilderness and Wildlands Management (3).

### **Renewable Energy Minor**

The development of sustainable sources of energy has become a critical national and global issue due to concerns about the quality and quantity of the different potential resources, energy security, and potential impacts of each on the environment and human health. It is essential that our society and energy professionals gain an understanding of production and conversion of different forms of energy, their current and future supplies, the markets and policy mechanisms that regulate their supply, and the associated impacts on the environment for each fuel. In the past both traditional and renewable energy sources have been studied one resource at a time and usually from the perspective of a single discipline. This minor will provide students an opportunity to examine different sources of traditional and renewable energy simultaneously in the context of our total energy use using a systems perspective. Students will be exposed to views from a variety of disciplines as they wrestle with a wide array of issues related to current and future energy supply and use.

The understanding and development of renewable energy requires expertise from a wide range of disciplines. This minor will be interdisciplinary in nature with instructors from different disciplines teaching the core courses. The Renewable Energy minor is available to all ESF undergraduate students (**except students who are in the renewable energy option in environmental science**) who have taken EFB 120 Global Environment & the Evolution of Human Society which is a prerequisite for ESC 325 Energy Systems, and have a GPA of 2.750 or better by the end of their sophomore year. Interested students must submit a petition and application form, with courses listed, to their faculty advisor and the undergraduate coordinator of their home department. The petition and application will then be sent to the dean of Instruction and Graduate Studies for final approval. The minor will require a minimum of 15 credits, 12 of which are required courses. The remaining 3 credits can be selected from a list of suggested courses.

Fifteen credit hours of courses are required. Specified courses: ESC 325 Energy Systems (3); ESC 335 Renewable Energy Systems (3); ESC 422 Energy Markets and Regulation (3); ESC 450 Renewable Energy Capstone Planning (1); ESC 460 Renewable Energy Capstone Seminar (2) and a minimum of three credits from the following list of suggested courses: BPE 441 Biomass Energy (3); EFB 516 Ecosystems (3); EFB 518 Systems Ecology (4); ERE 351 Basic Engineering Thermodynamics (2); ERE 519 Green Entrepreneurship (3); FCH 360 Physical Chemistry I (3); FCH 571 Wood Chemistry I: General Wood Chemistry (2); FOR 415 Forestry Consulting and Wood Procurement (3); PSE 361 Engineering Thermodynamics (3); PSE 370 Principles of Mass and Energy Balance (3).

### **Sustainable Construction Management Minor**

The sustainable construction minor is available to all ESF undergraduates (except students in construction management) and prepares students for careers related to sustainable construction. The basic objective of the minor is to provide a fundamental understanding of the sustainable concepts and methods used to take a design into the field and build a quality sustainable structure in the most efficient and effective manner with minimal environmental impact. Fifteen credit hours (5 courses) taken in residence are required to complete the minor. Five courses (15 credit hours) are selected from the list below. A cumulative grade point average of 2.000 or higher is required for the sustainable construction management courses in order to obtain the minor.

Admission to the minor requires sophomore status, a cumulative grade point average of 2.500 or higher, and permission of the chair or curriculum coordinator of the Department of Sustainable Construction Management and Engineering. Interested students must submit a petition form, with courses listed, to their academic advisor and the curriculum coordinator or the chair of the Department of Sustainable Construction Management and Engineering, with final approval from the dean of Instruction and Graduate Studies.

Fifteen credit hours are required to satisfy the minor.

Choose 5 courses (15 credits) from the following:

CME 215 Sustainable Construction (3)  
CME 387 Renewable Materials for Sustainable Construction (3)  
CME 305 Sustainable Energy Systems for Buildings (3)  
CME 306 Engineering Materials for Sustainable Construction (3)  
CME 304 Environmental Performance Measures for Buildings (3)  
CME 343 Construction Estimating (3)

CME 405 Building Information Modeling (3)  
CME 422 Composite Materials for Sustainable Construction (3)  
CME 565 Sustainable Innovations in Residential Construction (3)  
CME 444 Materials Marketing (3)  
CME 453 Planning and Scheduling (3)  
CME 454 Project Management (3)  
EST 426 Community Planning and Sustainability (3)  
EST 427 Environmental & Energy Auditing (3)  
EST 460 Land Use Law (3)  
EST 550 Environmental Impact Analysis (3)

### **Urban Environmental Science Minor**

While many people often associate the environment with wild lands and linked rural areas, many of the most important environmental and quality-of-life issues of the coming decades will be related to the urban environment. ESF, under its Urban Initiative, offers a campuswide minor in urban environmental science. All students, but perhaps especially those with an intimate knowledge of the challenges facing city inhabitants, will find this program stimulating and provocative and will find professors interested in working with them to learn about and develop improved urban environments. Graduates of the program can make important professional contributions on issues ranging from urban forestry and urban wildlife, to urban air and water quality, population growth and urban sprawl, and environmental justice and equity. Successful completion of the minor will be noted on the student's transcript.

Twelve credit hours (4 courses) of urban concentration courses are required to satisfy the minor. Required courses: EST/EFB 220 Urban Ecology (3) and a Capstone Experience (3). A student enrolled in the minor, will present to the advisory committee in the sixth week of the semester prior to engagement in the learning endeavor, a plan for a "capstone" experience, which will be undertaken working in conjunction with a faculty member(s) who will oversee an off-campus internship (courses numbered 499), independent-study project (courses numbered 498), or completion of a final project undertaken in a special ic (courses numbered 496) or established 3-credit course. All students will present their completed projects to the advisory committee and their peers in the last week of classes, depending on the semester of completion (fall or spring). All students currently enrolled in the minor are expected to attend capstone presentations.

Elective courses: At least two courses (6 credits) of urban environmental science minor advisory committee-approved courses other than courses in, or required by, the student's major. The complete list of approved elective courses is available from department advisory committee representatives.

### **Urban Forestry Minor**

The Urban Forestry minor will provide students with the opportunity to better understand complex human-dominated ecosystems where trees and people coexist in close proximity. Understanding and attempting to manage this complexity requires a basic knowledge of plant physiology, nutrition, and tending at the individual tree level (arboriculture). In addition, the urban forester also must understand the changing dynamic of groups of trees and the effects of those trees on numerous ecosystem services and human health and well-being in a city (urban forestry). Because human activity is so dominant in the urban ecosystem, it is essential that the urban forester have some understanding of ecological interactions and human motivations for sustaining and maintaining existing trees (urban ecology). The courses listed below will provide the professional knowledge required for careers in these and related fields.

Fifteen credit hours are required: FOR 480 Urban Forestry (3), FOR 481 Introduction to Arboriculture (3), EST 220 Urban Ecology (3), ESF 300 Introduction to Geospatial Information Technologies (3) and LSA 480 Seminar in Urban Design (3).

The interdisciplinary minor includes courses taught in the Departments of Forest and Natural Resources Management, Environmental Studies, and Landscape Architecture. Admission to this minor requires students to have (1) completed a general ecology course (e.g. EFB 320 General Ecology), (2) a cumulative grade point average of 2.750 or greater after one semester at ESF (or as a transfer student with the same GPA), and (3) permission of the Forest and Natural Resources Management chair and the undergraduate education coordinator (via petition).

### **Water Resources Minor**

Water resources is a multidisciplinary field that integrates the physical, geochemical and biological processes of the water cycle and their application to management of water resources.

Although study in water resources has traditionally been distributed among different disciplines, such as natural resources management, engineering, biology and chemistry, the most compelling issues in water resources lie at the interface between these traditional disciplines. It is critical for students to have a solid foundation of coursework in linkages between hydrology and physical, geochemical and biological sciences and water resources management. The interdisciplinary minor in water resources provides an opportunity for students to study and integrate principles of physical hydrology, geochemistry, aquatic and terrestrial ecology, and natural resources management.

This interdisciplinary minor includes courses taught at SUNY-ESF in the Departments of Forest and Natural Resources Management, Environmental Resources Engineering, Environmental and Forest Biology, and Chemistry. The minor also includes the option of taking courses at Syracuse University, in relevant departments including Geology, Geography, Civil and Environmental Engineering, and Biology.

The water resources minor is available to all undergraduate ESF students who maintain a cumulative grade point average of 2.750 or better after one semester at ESF (or as a transfer student with same standing), has permission of the Department of Forest and Natural Resources Management chair and undergraduate education coordinator using a standard petition, and lists the specified and thematic courses planned for completion of the minor in the petition.

Fifteen credit hours of courses are required. Specified course are FOR 340 Watershed Hydrology (3) and FOR 442 Watershed Ecology and Management (3). Also required are three additional courses (9 credits total) that are 300-level or above, one course each in the following three

thematic subject areas\*: physical processes, geochemical processes and biological/ecological processes. Most thematic courses have one or more prerequisite(s) (such as introductory chemistry, biology, physics, calculus or other) which will not count toward the minor.

\* Approved thematic courses are listed for each year in the Student Handbook for Undergraduate Studies in the Department of Forest and Natural Resources Management, which is available in hardcopy from 320 Bray Hall or online through the FNRM department website.

## Honors Programs

The **Lower-Division Honors Program** provides first- and second-year students with value-added educational experiences that engage students in unique challenges. Academic components of the program strengthen exploration and communication skills through interdisciplinary assignments. Lower-Division Honors students often have an opportunity to initiate their thesis research or projects during their first or second years in residence.

Admission to the program is extremely selective. Primary consideration is given to a student's academic record with a minimum expectation of combined reading and mathematics SAT score of 1250 or higher, or an ACT equivalent composite score of 28 or higher, a high school grade point average of 92 percent or higher, and high school class rank in the top 20 percent (where rankings are available).

Students are admitted as first-year students (fall admission) by invitation from the vice president for enrollment management and marketing, and are expected to maintain a cumulative grade point average of at least 3.500 and complete the following coursework during the freshman year: Freshman Honors Seminar in Environmental Science and Forestry (ESF 109, 1 credit) and Writing, Humanities and the Environment — Honors (EWP 291, 3 credits). The student and advisor may substitute another EWP course for EWP 291, e.g., EWP 405 (Writing for the Science Professional) and EWP 410 (Writing for Environmental Professionals). Lower-Division Honors students may take ESF 209 (Sophomore Honors Seminar, 1 credit) during the fall of their sophomore year.

ESF students not invited during the admissions process to join the Lower-Division Honors Program may join after earning a minimum of 24 credits of ESF coursework and a minimum GPA of 3.500. These students, if interested, should contact their department's representative to the Honors Council to officially join the Program; the department representative will then notify the director of the Honors Program who will inform the registrar.

Students who maintain good standing in honors will have early registration privileges and access to honors sections of courses offered at Syracuse University and ESF. Honors students will be deemed "in good standing in honors" when they demonstrate steady progress in fulfilling honors requirements and a **cumulative GPA** of 3.500 or higher. After each semester, the honors program administrator will assess the student's progress and inform any who are not in good standing. Students must be in good standing to be eligible for early registration and to have access to honors sections of courses.

The **Upper-Division Thesis Honors Program** provides opportunities for students to complete intensive research or creative projects under the guidance of faculty mentors during their careers. ESF students enrolled in all academic departments or programs are eligible to participate in the ESF Honors Program.

The subject matter and type of thesis or project is intentionally left open to students and their advisers. While the college emphasizes and encourages holistic and multidisciplinary awareness of the problems and opportunities associated with the natural and built environment, any topic is eligible for study.

To be accepted into the Upper Division Honors Program, students must meet the minimum cumulative grade point requirement of at least a 3.500 and have earned a minimum of 60 credits of lower-division preparation. These credits include any courses taken while matriculated at ESF and any transfer courses accepted toward the ESF degree. Prospective honors students can initiate entry into the Upper-Division Honors Program with the agreement of a thesis advisor in the appropriate discipline.

Any student who plans to engage in appropriate research or projects, even if sponsored by other programs (e.g., Undergraduate Mentoring in Environmental Biology or Cranberry Lake Biological Station Fellowships) may choose to present the final product as an honors thesis or project, if his or her faculty mentor agrees. These students should contact their department's representative to the Honors Council to officially join the program early in their junior year. The department representative will then notify the director of the Honors Program who will inform the registrar. No later than the beginning of the second semester of a student's junior year the student must find a faculty advisor to guide him or her on the thesis or project. Honors students, through their faculty advisors, can receive a maximum of \$500 for expenses related to their research during each of their junior and senior years.

Students in the thesis program must complete degree requirements with a cumulative grade point average of at least 3.500 for all upper division courses and complete two courses that contribute directly to the honors thesis/project. These courses must be either (a) in the student's major or a related area at the 400, 500, or 600 level and must not be a requirement for all students in that major (students admitted to the ESF Honors Program are eligible to enroll by petition in appropriate courses numbered 600 to 699); or (b) an enhanced or graduate-level version of a required upper-division course. Additionally, a student must earn three to five credits of honors thesis/project (ESF 499, 1-5 credits) with a grade of B or better.

Students must supplement their work with an honors thesis and a poster or oral presentation at the annual College Spotlight on Student Research or at a scientific or professional meeting by the spring of their senior year. Students receive an Honors Degree by satisfactory completion of their course requirements and thesis, as determined by their thesis advisor, and earn a minimum cumulative GPA of 3.500.

The Honors Programs receive oversight from the Honors Faculty Council. The director of the Honors Programs identifies, admits, and counsels honors students in matters pertaining to program requirements. The best honors thesis or project completed each year, as judged by members of the Honors Faculty Council, may be recognized with a cash award, plaque, and acknowledgment at ESF's May Convocation.

## Coordinated Programs with SUNY Upstate Medical University

### Transfer Articulation Agreement

Students seeking admittance to the upper-division bachelor of science programs offered by the College of Health Professions at SUNY Upstate Medical University (UMU) in Syracuse may prepare for curricula in cardiovascular perfusion, cytotechnology, medical imaging sciences, medical technology, physical therapy, or respiratory care by taking lower-division coursework at SUNY-ESF. Prospective students must apply to both ESF and UMU. For further details, contact the dean of Instruction and Graduate Studies.

### Entry Level Doctor of Physical Therapy Program (DPT 3+3)

In collaboration with SUNY Upstate Medical University (UMU), ESF students may apply to an entry-level doctor of physical therapy program (DPT 3+3). ESF undergraduates who are completing bachelor of science degrees within the [Department of Environmental and Forest Biology](#) are eligible for admission.

Students apply for admission to ESF and UMU simultaneously, with the first three years of the program completed at ESF and the final three years completed at UMU. Admission to the DPT 3+3 program is based on academic achievement and personal qualifications that are considered essential for the successful practice of physical therapy.

Prior to matriculation at UMU, students must submit GRE scores, demonstrate familiarity in the demands of physical therapy via volunteer or work experience, and complete 53 credits of prerequisite coursework (completed with grades of C- or better) as follows:

Courses	Credits
Anatomy and Physiology I and II (or one semester each of Anatomy and Physiology)	8
General Biology I and II	8
General Chemistry I and II	8
General Physics I and II	8
English (including Composition)	6
Mathematics (College Trigonometry, Precalculus or Calculus)	3
Statistics	3
Psychology (including Child or Developmental Psychology)	9

Additional information about the DPT 3+3 Program is available from the Office of Undergraduate Admissions or the dean of Instruction and Graduate Studies.

## Pre-Professional Advising

### Pre-health advising

ESF students interested in medicine, dentistry, and veterinary medicine are encouraged to participate in the Health Professions Advisory Program (HPAP) offered through Syracuse University. Students should begin the program as early in their academic programs as possible, attend seminars and participate in the preparatory workshops to ensure their success in the professional school admissions process.

Most health professions schools require at least one year in each of the following subjects: English, general biology (botany and zoology), general physics, general chemistry and organic chemistry; calculus is recommended. ESF majors in environmental biology, biotechnology, or environmental science are well-suited to prepare students for health professions.

In addition to the general science background, colleges of veterinary medicine require coursework in bacteriology or microbiology, and at least one summer of practical experience in the management of poultry, pigs, cattle or horses. Regardless of the specific prerequisites of a school of medicine, dentistry or veterinary medicine, coursework available at ESF has proven to be valuable to applicants to those professional programs.

All students applying to medical school are required to provide letters of recommendation from a health advisory committee, evidence of public service, and evidence of previous experience (volunteer or paid) working in an area of health professions. The Health Professions Advisory Program assists students in making decisions about health careers and matches students with appropriate professional schools. The Health Professions Advisory Program is located in 323 Hall of Languages, College of Arts and Sciences, Syracuse University, Syracuse, N.Y. 13244 and may be contacted at 315-443-2321 or <http://hpap.syr.edu>.

### Pre-law advising and pre-public administration advising

ESF offers pre-professional advising to students interested in pursuing law or public administration as a profession. Unlike some other professional programs, law and public administration (PA) schools do not require or recommend a specific program of study or specific coursework. Instead, the Law School Admissions Council advises students who are interested in the legal profession to pursue undergraduate education that demonstrates success in intellectually challenging curricula that enhance students' critical thinking skills. Schools of public administration suggest similar advice. ESF's programs provide students with such an education.

ESF's pre-law and pre-public administration advisor, Dr. Robert Malmshemer, counsels students regarding selection of elective courses, the Law School Admission Test (LSAT), GRE exam, law and PA school application procedures, and other matters of importance. Brochures and application forms for the LSAT and the Law School Data Assembly Service are available from the College's pre-law advisor. Each year, Syracuse University and the College's pre-law programs offer a variety of workshops and seminars to introduce students to law school and legal topics. Similarly, Syracuse University's Maxwell School and the resources of their top-rated MPA program are readily available to ESF students. Students considering law school or graduate studies in public administration are encouraged to meet with ESF's pre-law/pre-PA advisor as early in their academic careers as possible to take advantage of these services.

In addition, ESF has a pre-MPA articulation agreement with SUNY's Binghamton University for ESF undergraduates wishing to pursue graduate work in public administration. ESF undergraduate students earning a 3.300 GPA and completing one course each from the following table of core competency areas are assured entry into Binghamton's Master of Public Administration program.

MPA Competency	ESF Course(s) Providing Foundation in Competency
Management and Administration	FOR 360: Principles of Management
Statistics	APM 391: Intro. to Probability and Statistics
Economics	FOR 333: Managerial Economics for Env. Professionals
Government Policy	FOR 465: Natural Resources Policy or EST 321: Government and the Environment
Accounting, Budgeting, and/or Finance	ACC 201: Introduction to Accounting or FIN 301: Finance for Non-Management Students

Please meet with the pre-PA advisor or the dean of Instruction and Graduate Studies for additional information regarding BU's ESF-MPA articulation agreement.

## Coordinated Programs with Syracuse University

### Joint Program in Science Teaching leading to Teacher Certification

ESF and the School of Education at Syracuse University offer qualified undergraduate students an opportunity to prepare for initial New York state teacher certification in biology or chemistry, and general science. This opportunity is available through the following ESF bachelor of science (B.S.) degree programs: chemistry (leading to initial certification in chemistry in grades 7-12) and environmental biology (leading to initial certification in biology in grades 7-12). Students who earned at least a 3.000 grade point average during their first semester at ESF and transfer students who maintained a 3.0 or greater cumulative grade point average at their previous college are eligible for admission to the program. Students who are interested in pursuing this opportunity should contact the assistant dean of Instruction and Graduate Studies at ESF for application materials.

### Academic Requirements

Students must complete all requirements for their academic program as listed in this catalog that include the following:

To meet the standards for general education, students must complete at least 30 semester hours (credits) in the general education core. Students who transfer into an English writing course that is substantially different in purpose from EWP 290 must complete WRT 428 to meet the education literacy requirement. Included in this standard is a foreign-language requirement: one year of college-level foreign language study, or its equivalent established through appropriate high school study (Level III).

To meet the standards in content teaching, students complete at least 30 semester hours in the content core. For biology certification, content courses include cell biology, biochemistry, anatomy and physiology, comparative anatomy, genetics and evolution, biological diversity, human biology, botany, and zoology. Courses in nutrition are acceptable if the topics are cell nutrition, organic and inorganic chemistry, or physical chemistry. For chemistry certification, content courses include matter and atomic structure, energy, chemical bonds and molecular structure, chemical reactions, and quantitative relationships.

Students must also complete:

SED 340 Participation in the Professional Development School (0-1) (also known as "The Academy") each semester. The non-credit online seminar, Child Health and Life Safety Seminar offered by the School of Education, examines six areas of concern to teachers: identifying and reporting child abuse; violence prevention/ intervention; alcohol/tobacco/drug abuse prevention; child abduction prevention; fire and arson prevention; and highway safety/traffic regulations/safety patrols.

Students are required to complete the following professional education (pedagogy) core courses at Syracuse University in preparation for the candidacy semester:

EDU 204 Principles of Learning in Inclusive Classrooms (4)  
 EDU 304 Study of Teaching (4) Prerequisite: EDU 204 or equivalent  
 RED 326 Literacy Across the Curriculum (4)  
 EDU 310 The American School (3)

Candidacy Semester (Spring only): prerequisites include a minimum 2.800 cumulative average and a minimum 2.800 average in both required education and science courses; completion of EDU 204, EDU 304, RED 326, and a significant number of science credits; successful review of the

professional portfolio by The Academy; and satisfactorily meeting the assessment standards of the School of Education. The following courses are co-requisites for the candidacy semester:

SED 409 Adapting Instruction for Diverse Student Needs (3)  
SCE 413 Methods and Curriculum in Teaching (3)  
EDU 508 Student Teaching/Secondary Candidacy (3)

Standard Student Teaching Semester (in the student's final fall semester prior to the degree conferral): prerequisites include a minimum 2.800 cumulative average and a minimum 2.800 average in both required education and science courses; successful completion of the candidacy semester and approval by The Academy; completion of a majority of the required credits on the science content area; and satisfactorily meeting the assessment standards of the School of Education. The following 12 credits are taken as co-requisites for the standard student teaching semester:

EDU 508 Student Teaching/Science (9)  
SED 415 Teacher Development/Science (3)

### **Initial Certification and Professional Certification**

The School of Education evaluates and recommends eligible candidates as having met the requirements for the certificate. Students must pay fees for certification and exam processing. Candidates for initial certification must apply for certification within two years of the completion of the degree program and they must successfully complete (a) the Liberal Arts and Sciences Test (LAST); (b) the Written Assessment of Teaching Skills (ATS-W); and (c) the Content Specialty Test (CST).

Requirements for professional certification must be met within **five** years of the date of the initial certification. To achieve professional certification, applicants must earn a master's degree that meets one of the following criteria: (a) a graduate-level teacher education program that is registered with the Department of Education; (b) a master's-level or higher program in the content core of the initial certificate or in a related content area; or (c) a master's-level or higher program in any field, provided that it includes at least 12 semester hours of graduate study in the content core of the initial certificate or in a related content area. A one-year extension may be granted by the state if a student has completed at least 24 credits of the master's degree. Application for professional certification also requires three years of teaching experience. If the teaching experience is in New York State, the first year must be mentored by the school district. Teachers with professional certification must complete 175 hours of professional development every five years.

For additional information about certification requirements and the process, visit the New York State Education Department website at [www.highered.nysed.gov/tcert/certificate/index.html](http://www.highered.nysed.gov/tcert/certificate/index.html) or the Syracuse University School of Education Coordinator of Career Services and Certification at (315) 443-4759.

### **Service Learning Program**

[www.esf.edu/students/csl](http://www.esf.edu/students/csl)

Public service is a vital component of ESF's mission, reflecting our commitment to making the world a better place. Through the College's service learning program, students can participate in this mission of service, contributing to the larger community while gaining invaluable experience and earning course credit.

Students enrolled in any of ESF's service learning courses spend time working in the community on service projects related to their field of study. Through these courses, the traditional classroom is extended beyond the bounds of our campus, offering energizing, "real-world" learning experiences. The community benefits from student help and knowledge, even as students gain inspiration and a richer understanding of the value of their work.

Students are also welcome to participate outside of class in an ESF community service project. Numerous community service opportunities are available on campus and in the greater Syracuse community. For additional information on these activities, visit the service learning website.

Service learning activities help students develop a number of academic, personal and social attributes and may aid students in career development choices. For a list of courses that have incorporated service learning in the past, please refer to the service-learning website at [www.esf.edu/students/csl](http://www.esf.edu/students/csl).

### **International Study Abroad**

ESF students who have completed 30 or more credits toward their bachelor's degree with a cumulative grade point average of 3.000 or greater are eligible to apply for study in a foreign country through the *Study Abroad Program* at Syracuse University, or through overseas study programs offered at other institutions within the SUNY system. Although some international study programs require specific language skills or may be conducted in the language of the host country, others offer study in part or entirely in English. Students who seek additional information about the requirements for study abroad should contact ESF's Office of Instruction and Graduate Studies or search the SUNY Study Abroad website at [www.suny.edu/Student/Common/studyAbroad.cfm](http://www.suny.edu/Student/Common/studyAbroad.cfm).

### **Graduate Education**

Graduate degree programs at ESF enable students to:

- think critically and independently;
- comprehend the processes of science and effectively apply scientific principles and professional procedures;
- attain proficiency in the current knowledge in their respective fields;



- develop competence in the technical skills and tools required in their disciplines;
- demonstrate high standards of performance as scientists, educators and professionals; and
- exercise ethical conduct in their relationships with colleagues, other professionals and the public.

### **Areas of Study**

The general area of study for each master's or doctoral student is implied by the title of the program in which the degree is awarded. Areas of study may be established within degree programs by individual departments that further define the student's area of specialization. The student's area of study is listed on the student's transcript if identified on the study plan.

Additionally, each department may offer minors identifying ancillary areas of study that may be appropriate for the degree program. A minor is equivalent to 12 or more graduate credits earned in the minor area. Courses in a minor area must be taken outside of the student's area of study. A minor is identified on the student's transcript. A minor professor must be appointed to the student's steering committee for each minor elected, in addition to the minimum complement of steering committee members. Each minor professor can replace an additional examiner.

### **Degrees**

Four master's degrees are offered at ESF, the master of science, master of forestry, master of landscape architecture, and master of professional studies as well as the doctor of philosophy degree. The following section describes the requirements for graduate degree programs offered by the College.

#### **Master of Science Degree**

The master of science (M.S.) degree is an academic degree offered in the following programs: environmental and forest chemistry, environmental and forest biology, environmental studies, forest resources management, environmental and resource engineering, environmental science, and landscape architecture.

To complete this degree, in addition to completion of necessary coursework, students must investigate a problem that initiates, expands, or clarifies knowledge in the field and prepare a thesis based on this study. Students are required to define an appropriate problem for investigation; review relevant information; develop a study plan incorporating investigative techniques appropriate to the problem; implement the plan; and relate the results to theory or a body of knowledge in the field.

The minimum credit-hour requirement is the successful completion of 30 graduate credits distributed between coursework and thesis. The applicable distributions will be determined by individual departments to suit program objectives, with the understanding that a minimum of 18 credits is awarded for graduate-level coursework and a minimum of six credits is awarded for the thesis. All steering committee members should sign the student's study plan (Form 3B) before the end of the last year of the student's program. The student must successfully defend the thesis for degree completion. The thesis is prepared and bound according to college standards and submitted to ProQuest.

#### **Master of Forestry Degree**

The master of forestry (M.F.) degree is intended to be a terminal degree and is offered in the [Department of Forest and Natural Resources Management](#). It is designed primarily for students whose undergraduate degree was not in a professional program in forestry. This degree requires the successful completion of a minimum of 30 credits at the graduate level, of which at least 27 must be in coursework. The student's study plan (Form 3B) must be approved by the major professor and department chair.

In addition, this program requires an integrative experience such as an internship or team project. If an examination is required, it is developed and managed by the [Department of Forest and Natural Resources Management](#).

#### **Master of Landscape Architecture Degree**

At the graduate level, the master of landscape architecture (M.L.A.) degree is the first professional degree in landscape architecture. This degree requires successful completion of a minimum of 66 credit hours of which at least 42 must be graduate coursework. The student's study plan (Form 3B) must be approved by the major professor and department chair. All steering committee members should sign the 3B form before the end of the last year of the student's program.

#### **Master of Professional Studies Degree**

The master of professional studies (M.P.S.) degree is intended to be a terminal degree. The M.P.S. is offered in the following degree programs: environmental and forest biology, environmental studies, forest resources management, environmental and resource engineering, and environmental science.

This degree requires the successful completion of a minimum of 30 credits at the graduate level, of which at least 24 must be in coursework. The student's study plan (Form 3B) must be approved by the major professor and department chair. All steering committee members should sign the student's study plan (Form 3B) before the end of the last year of the student's program.

In addition, individual programs may require an integrative experience such as an internship, team project and/or comprehensive examination. If an examination is required, it is developed and managed by the department responsible for the program.

#### **Doctor of Philosophy Degree**

The doctor of philosophy (Ph.D.) degree is an academic degree offered in the following degree programs: environmental and forest chemistry, environmental and forest biology, forest resources management, environmental and resource engineering, and environmental science. The doctor of philosophy degree requires a minimum of 60 graduate credits, of which 30 to 48 credits are for coursework and 12 to 30 credits are

awarded for dissertation. Individual departments will determine the applicable credit hour requirements within these ranges to reflect individual program requirements and emphases. The graduate credits earned for a master's degree that are applicable to a student's doctoral study plan (Form 3B) are determined on an individual basis by the steering committee. All steering committee members should sign the 3B form before the end of the last year of the student's program. Students may not use master's thesis credits to fulfill doctoral program coursework requirements.

Students must pass the doctoral candidacy examination covering selected fields of study at least one year prior to dissertation defense and successfully defend the dissertation. The dissertation must be prepared according to college standards and submitted to ProQuest.

### **Tool Requirements**

Doctoral students must demonstrate competence in at least one research tool as a requirement for graduation. Such tools include statistics, computer science, or the ability to translate technical articles in a language, other than English, commonly used in science. Tool requirements and standards for each doctorate program will be determined by the corresponding program department.

### **Student Advising and Study Plan (Form 3B)**

The student's study plan (Form 3B) includes an individualized sequence of courses and a plan for research or professional experience. The student and all steering committee members should sign the 3B form, submit it to the department chair for approval and then forward it to the dean of Instruction and Graduate Studies by the end of the third semester for the M.S., M.L.A., or Ph.D. degree; it must be submitted by the end of the first semester for the M.F. or M.P.S. degree. For all graduate degrees, the program of study must be submitted by no later than the end of the last year of the student's program. The study plan can be changed during the course of a student's program. Changes must be approved by the major professor and department chair with notification to the dean of Instruction and Graduate Studies.

### **Major Professor: Appointment and Responsibilities**

The student's major professor is appointed by the dean of Instruction and Graduate Studies upon the recommendation of the department chair. A major professor should be appointed upon the student's matriculation into a graduate program. For the graduate student accepted into a graduate program but lacking a major professor, a temporary advisor will be appointed by the department chair. However, every effort should be made to expedite appointment of a major professor.

The major professor shall be a member of the ESF faculty, except those with visiting appointments. The major professor, or at least one of the co-major professors, must hold a degree equal to or higher than the degree sought by the student. The major professor, or at least one of the co-major professors, must be a full time member of the department granting the degree sought by the student. An adjunct faculty member may also serve as a co-major professor. It is the duty of the major professor to fulfill a primary role as the student's mentor. Aided by other members of the steering committee, the major professor guides the student in the development and implementation of the student's study plan (Form 3B), including course selection, research planning, choice of the professional experience, and facilitation of the examination schedule. The major professor also guides the student in reviews of thesis or dissertation drafts, including a complete review of the thesis or dissertation before the final copy is presented for defense. It is the responsibility of the major professor to ensure that the document presented at defense is the final version, subject only to minor grammatical changes.

### **Steering Committee: Appointment and Responsibilities**

The steering committee for master of science and doctoral students is composed of the major professor and at least two faculty members or other qualified persons. The steering committee for master of forestry, master of professional studies and master of landscape architecture students is composed of the major professor and at least one other faculty member or other qualified person. Other qualified people include faculty at other institutions or other recognized professionals.

The student's steering committee is appointed by the dean of Instruction and Graduate Studies upon the recommendation of the department chair. The steering committee should be appointed within the first semester. For all students, the steering committee must be established and must have met by the end of the third semester of graduate study.

The steering committee assists the student in the development of the student's study plan (Form 3B), including the development of the student's research or professional experience. All steering committee members should sign the 3B form before the end of the last year of the student's program. The steering committee guides the development of the thesis or dissertation, including a review of the thesis or dissertation before the final copy is presented for defense.

### **Part-Time Study**

Upon completion of 12 credit hours as a matriculated student, the part-time student will request assignment of a steering committee that consists of the major professor and one other person. The steering committee will meet and agree upon a program of study (Form 3B) and specify the delimitation date according to the needs of the part-time student.

### **Communication Skills**

All students entering graduate programs at ESF are expected to be proficient in communication skills, including technical writing and library skills. Students are required to have completed at least one course in technical writing and one course in library usage, either as an undergraduate or as a graduate student. Credit for such courses taken during the graduate program are not counted towards degree requirements. Alternatively, graduate students can meet the requirement by demonstrating the equivalent in experience in writing and library skills, as determined by the steering committee.

### **Seminars**

Participation in seminars, including the preparation and presentation of technical material, is vital to the student's graduate education. All graduate students at ESF are required to participate in graduate seminars as follows:

*Topic Seminar:* Each graduate student is expected to participate in topic seminars, including presentations, as determined by the individual department. This requirement can be fulfilled, with appropriate approval, by seminars offered at Syracuse University or SUNY Upstate Medical University.

*Capstone Seminar:* Students completing the master of science degree or the Ph.D. degree are required to present a capstone seminar on their thesis or dissertation research. Other master's students may be required to present a capstone seminar on a topic chosen in consultation with the major professor and steering committee. The purpose of the capstone seminar is to provide an opportunity for the graduate student to present technical information to a critical body of professionals and peers. This seminar will be presented prior to the thesis or dissertation defense and should be attended by the student's steering committee. Each seminar is open to the college community and will be announced collegewide to encourage attendance by students and faculty.

## **Examinations**

Students who wish to complete the doctoral candidacy examination, defense of thesis or dissertation should request formation of their examining committee guided by the schedule provided by the Office of Instruction and Graduate Studies.

To ensure the integrity of the examination process, oral examinations will generally take place during the academic year and all members of the examination committee appointed by the dean of Instruction and Graduate Studies will be present at the oral examination. Students must complete the oral examination within six months from the appointment of the examination committee or the student will be required to request the assignment of a new examination committee. Exceptions may be granted by the dean of Instruction and Graduate Studies.

## **Doctoral Preliminary Examination**

The requirement for this examination is determined by individual departments. The purpose of this examination is to assess the entering student's basic knowledge in the chosen field of study. The results of this examination may be used to determine the student's suitability for the doctoral program and as a guide in selecting coursework and developing a program of study.

## **Doctoral Candidacy Examination**

The objectives of this examination are to determine the breadth and depth of knowledge in the chosen field of study and assess the student's understanding of the scientific process. The doctoral candidacy examination is taken when the majority of coursework is completed and no more than three years from the first date of matriculation has elapsed or the student may be dismissed from the doctoral program. This examination must be taken at least one year prior to the dissertation defense.

Upon the recommendation of the appropriate department chair, the dean of Instruction and Graduate Studies appoints the doctoral candidacy examination committee consisting of the student's major professor, the student's steering committee and an additional faculty member from an appropriate area. Additionally, the dean of Instruction and Graduate Studies appoints a committee chair who is not from the department of the student's degree program. The examination must have both written and oral components.

The role of the examination committee chair is to manage the examination, ensure its integrity, and represent the interests of the faculty and student. Any member of the faculty may be an observer. The student examinee may invite a silent student observer to attend the oral examination with notification of the chair of the student's exam committee.

The composition of a candidacy examination committee, once formally appointed and constituted by the dean of Instruction and Graduate Studies, may not change following the commencement of the candidacy examination. In the event of a suspension of proceedings, or a failure of the examination, the composition of the committee may only be changed in the presence of a legitimate extenuating circumstance (illness, departure from the institution, sabbatical leave, etc.) which prevents the participation of one or more of its members.

**Written Examination:** The examining committee shall convene at a planning meeting with the student. During the first part of the planning meeting, the committee determines the schedule for the process and establishes the date for the oral component. The student is then excused from the meeting and the committee develops and discusses the exam content.

There are three alternative forms for the written component, as follows:

**Form 1:** The members of the committee submit questions or problems addressing the objectives of the exam. The questions are discussed and agreed upon at the planning meeting.

The major professor administers the written examination. Usually, one-half day is allocated to questions submitted by each examiner. Upon completion by the student, the examination questions are reviewed and graded by the committee members who prepared them. The committee then reviews the entire examination.

**Form 2:** The student prepares a written report on a topic or problem assigned by the examining committee. The topic or problem must meet the objectives of this examination and its content cannot be directly related to the student's thesis research. The student has approximately one month to develop a thorough understanding of the assigned topic and prepare a written report. The report is reviewed by the committee members and committee chair.

**Form 3:** The student prepares and defends a written proposal of future research likely to be carried out during his or her Ph.D. project. This research prospectus must be presented to the examining committee two weeks prior to the candidacy exam and should include preliminary studies supporting the feasibility of the proposed research. The exam will test the candidate's understanding of concepts directly related to his or her immediate area of research, knowledge of prior related research that has been conducted by others, his or her ability to design and interpret experiments in this area, and capacity to think and write independently and to present work plans orally in a clear and rational

manner. The report is reviewed by the committee members and committee chair. **This option is available only to doctoral students in the Department of Chemistry.**

**Oral Examination:** Following the written examination under Form 1, completion of the report under Form 2, or completion of proposal under Form 3, the committee meets with the student for an oral examination usually lasting two hours. However, the duration can be longer if required. The questions may address the report or other areas appropriate to the objectives of the examination, including subject matter in allied fields. At the conclusion of the examination period, the student examinee and observers are excused from the room and the examination committee determines whether the student has passed the examination. Unanimous agreement is required to pass the student. If less than unanimous agreement is reached, the student is considered to have failed the first doctoral candidacy examination. The student can request a second examination which must take place no more than one year from the date of the first examination. A student is considered to have passed the second examination if there is not more than one negative vote. A student who has failed the second examination is terminated from the graduate program.

### **Thesis or Dissertation Defense Examination**

At the conclusion of the study and research program, each master of science and doctoral candidate must successfully defend the thesis or dissertation. The objectives of the defense examination are (1) to probe the validity and significance of the data and information presented; (2) to assess the student as a critical thinker and data analyst; (3) to evaluate the student's scientific creativity, including the student's ability to relate research results to scientific theory within the chosen field; and (4) to present the results effectively in writing.

Upon the recommendation of the appropriate department chair, the dean of Instruction and Graduate Studies appoints the defense examination committee. It consists of members of the steering committee and at least one additional faculty member for the master's degree examination and two additional faculty members or other qualified persons for the doctoral degree examination. Additionally, the dean of Instruction and Graduate Studies appoints a committee chair who is not from the student's degree program.

This oral examination principally covers the material in the thesis or dissertation, as well as literature and information relating to it. At least 14 days prior to the date of the oral examination, the student is required to submit a final document to all members of the examination committee. Within five days of the oral exam, the major professor confirms with the chair of the examining committee that the oral examination should proceed as scheduled. If the major professor determines that the written document does not meet the standards established for the thesis or dissertation exam, the exam may be postponed by the dean of Instruction and Graduate Studies at the recommendation of the chair of the student's exam committee.

The role of the examination committee chair is to manage the defense, ensure its integrity, and represent the interests of the faculty and student. Any member of the faculty may be an observer. The student examinee may invite a silent student observer to attend the examination. The composition of a defense examination committee, once formally appointed and constituted by the dean of Instruction and Graduate Studies, may not change following the commencement of the defense examination. In the event of a suspension of proceedings, or a failure on the first attempt of the defense examination, the composition of the committee may only be changed in the presence of a legitimate extenuating circumstance (illness, departure from the institution, sabbatical leave, etc.) which prevents the participation of one or more of its members.

The defense examination usually lasts two hours, although this time period may be extended as required. At the completion of the examination, the candidate and observers are excused from the room and the examination committee determines whether the candidate has successfully defended the thesis or dissertation. The committee chair has the option to vote. Unanimous agreement is required to pass the student. If less than unanimous agreement is reached, the student is considered to have failed the first defense examination. A student who fails the first defense may request a second defense which must take place no more than one year from the date of the first examination. At the second defense, the student has passed the defense if there is not more than one negative vote. A student who has failed the second defense is terminated from the graduate program.

### **Standards for Theses, Dissertations and Professional Experience Reports**

Collegewide standards for theses and dissertations are developed and specified by the Moon Library faculty in consultation with the various departments and are available on-line at [www.esf.edu/graduate/graddegre.htm](http://www.esf.edu/graduate/graddegre.htm).

### **Concurrent Graduate Degrees with Syracuse University**

ESF and Syracuse University provide opportunities for graduate students to complete degrees concurrently at ESF and SU. Concurrent degrees are offered in the master of public administration program in the Maxwell School of Citizenship and Public Affairs, the master of arts or master of science programs in the S.I. Newhouse School of Public Communications, the master of science degree program in the School of Education, and the master of business administration program in the School of Management. Other concurrent degree programs may be developed with approval by the assistant dean of Instruction and Graduate Studies.

To be eligible for admission to concurrent degree programs, matriculated students must complete at least one full-time semester of graduate-level coursework or the equivalent, and earn a 3.500 grade point average or better at ESF. Students who are interested in any of these programs must complete an application process through the ESF Office of Instruction and Graduate Studies within their first year of study.

### **Concurrent Programs for Syracuse University Students**

The joint Juris Doctor (J.D.) and Forest and Natural Resources Management (FNRM) Master of Professional Studies (M.P.S.) degree is designed for Syracuse University students who are interested in legal careers involved with forest, natural, and environmental resources. As human demands on the environment increase, society needs attorneys who understand the economic, demographic, social, and political issues that drive resource use allocation. Students learn the complexities of managing both resources and people recognizing that resource and environmental decisions involve value-driven conflicts. The degree provides a comprehensive foundation in forest, natural, and environmental resources issues and an understanding of both biophysical and social science.

Students enrolled in the joint JD/FNRM degree program must earn a minimum of ninety-six (96) credits at both the College of Law and ESF. The J.D. normally requires eighty-seven (87) credits, but joint-degree students must take at least seventy-two (72) Law School credits. Students can transfer fifteen (15) credits from ESF to the College of Law. The M.P.S. degree requires thirty (30) credits, a minimum of twenty-four (24) of which must be ESF courses and six (6) of which may be applied by transfer from coursework at the College of Law.

Students can apply to the joint J.D./FNRM degree program at two points: 1) simultaneously, before entering the College of Law, or 2) after completing the fall semester of study at the College of Law. Applicants applying simultaneously must complete a College of Law application and an ESF graduate application. Applicants applying after enrolling at the College of Law must complete an "internal" College of Law application and ESF graduate application.

Graduate students at Syracuse University may also consider the certificate of graduate studies in environmental decision-making offered through the Department of Environmental Studies.

### **Cooperative Programs at Cornell University and SUNY Upstate Medical University**

ESF and the New York State College of Agriculture and Life Sciences at Cornell University provide exchange opportunities so that graduate students can take advantage of special courses, faculty, and research facilities found at the two institutions. Cornell University is in Ithaca, N.Y., about 50 miles southwest of Syracuse.

ESF and the SUNY Upstate Medical University provide opportunities for graduate students at each institution to enroll in graduate coursework or pursue coordinated M.D./Ph.D. degrees in environmental medicine. SUNY Upstate Medical University is located within walking distance of ESF.

Graduate students interested in these opportunities should contact the ESF Office of Instruction and Graduate Studies.

### **Intra-ESF Concurrent Degree Programs**

ESF graduate students have engaged in concurrent degree programs with Syracuse University for three decades. As of 2009, ESF graduate students may now undertake formal concurrent graduate degrees in two different departments or academic units within the College.

Concurrent degrees magnify the strengths of academic program offerings within ESF. Pairing an academic degree (Ph.D. or M.S.) with a professional degree (M.L.A., M.P.S., M.F.), or pairing two professional degrees (M.L.A., M.P.S., M.F.) are attractive choices for ESF students. Please consult with individual departments for details regarding specific degree or program combinations. Concurrent degrees require a minimum of 80 percent of the credit hour requirements of each of the paired degrees. Students may apply for admission to both degrees at matriculation, or they may apply to add the second degree following completion of at least 12 credit hours of coursework with a minimum GPA of 3.5. Graduate students interested in these opportunities should contact the ESF Office of Instruction and Graduate Studies.

# Academic Policies

## Statement of Academic Integrity

The College of Environmental Science and Forestry is an institution of higher learning where growth and development are fostered, excellence is pursued and the highest standards of academic integrity are expected. The Code of Student Conduct ("the Code") outlines the behaviors that are expected of all students at the College. As a condition of enrollment, all students are required to acknowledge that they have (a) received a copy of the Code; (b) read the Code; (c) understand the provisions of the Code; and (d) agree to abide by the provisions of the Code.

The ESF Student Judicial Handbook and Code of Student Conduct are available on-line at [www.esf.edu/students/handbook/](http://www.esf.edu/students/handbook/).

## College-wide Policies

### Requirements and Policies

A student seeking a degree must be in matriculated status. All degree requirements must be completed through a combination of formally accepted transfer credits and/or courses taken at ESF and Syracuse University.

### Attendance

Students are expected to adhere to the attendance policy stated by each course instructor. Instructors may make attendance part of the course requirement.

### Course Numbering System

Courses at ESF are numbered according to the following system:

- 100-499 Undergraduate courses for which no graduate credit may be given.
- 500-599 Graduate courses designed expressly for areas of specialization in post-baccalaureate programs. Qualified undergraduate students may enroll with permission of the instructor.
- 600-699 Graduate courses designed expressly for advanced levels of specialization. Undergraduate students with a cumulative grade point average of 3.000 or better may enroll in these courses with an approved petition.
- 700-999 Advanced graduate level courses for which no undergraduate students may register.

Shared resources courses, designated as 400/500 or 400/600, are designed when the topic coverage of both courses is the same. Separate course syllabi are developed expressly differentiating the requirements and evaluative criteria between the undergraduate course and the graduate course. No type of cross listing may be offered unless approved by the ESF faculty.

Courses listed are offered subject to the availability of instructional faculty and sufficient student enrollment. Students and advisors should consult the actual schedule of courses published each semester to determine the availability and time of courses.

### Dropping or Adding Courses

For those students receiving financial support through the College, dropping courses that result in the student being less than full time will have an impact on support received. Contact the Office of Financial Aid and Scholarships for more detailed information.

Students may add courses with the approval of both their academic advisor and the course instructor, and may drop courses with their advisor/major professor's approval and notification to the course instructor using an appropriate drop/add form until the last day for program adjustments as listed in the ESF academic calendar. Courses dropped during this time will not appear on the student's transcript. Courses that begin after the published add date may be added prior to the start of the course. Courses that last for less than one semester may be dropped no later than halfway through the course. In either case, the student must submit a completed drop/add form.

Before requesting exemption from academic deadlines, students should refer to the Registrar's FAQ site, "What if I miss the deadline?," at [www.esf.edu/registrar/faq.htm](http://www.esf.edu/registrar/faq.htm).

### Incomplete and missing grades

A temporary grade of I may be assigned by an instructor only when the student is passing and has nearly completed the course but because of circumstances beyond the student's control the work is not completed. A temporary grade of NR may be assigned by the college registrar when the course grade is not received from the course instructor by the grade deadline. Grades of I or NR must be resolved prior to the end of the semester following that in which the grade was received. At the request of the instructor and under extraordinary conditions, an I grade may be extended for one additional semester. If the incomplete is not resolved by the appropriate deadline, it will be changed to a grade of I/F or I/U. If the NR grade is not resolved by the appropriate deadline, it will be changed to a grade of NR/F or NR/U. No degree will be conferred until all the grades of I or NR have been resolved.

### Exceptions to Curriculum and Academic Policy Requirements

Exceptions to academic policies stated in this document and curriculum requirements may be made by the Faculty Subcommittee on Academic Standards, which also may delegate this authority. Exceptions may not violate standards established by the State University of New York or the New York State Education Department.

Exceptions must be requested on a petition form and must have a recommendation from the student's advisor and department chair or designee. In those cases where an action is requested involving a specific course, the petition must also have a recommendation from the course instructor.

## Withdrawal from ESF

Students who withdraw on or before the deadline to drop a class for a semester will have their records marked: "Withdrew on (date)." Courses will appear for that semester with the grade of W.

Students who withdraw after the drop deadline for a semester, but on or before the last class day before the final examination period, will have either WP (withdraw passing) or WF (withdraw failing) listed after each uncompleted course. Students who do not withdraw on or before the last class day will have a grade on a scale of A-F, an I (incomplete), or I/F (unresolved incomplete) assigned by the instructor for each registered course.

Students who wish to withdraw from ESF schedule an interview in the Office of Student Life and Experiential Learning with the Senior Counselor in the Office of Counseling and Disabilities Services. [www.esf.edu/students/counseling/services.htm](http://www.esf.edu/students/counseling/services.htm)

## Readmission to ESF

Students wishing to return to ESF **must** apply for Readmission by scheduling an interview with the Senior Counselor in the Office of Counseling and Disabilities Services. Readmission applies to those students returning from a leave of absence (medical or military), change in educational plan, or academic and/or disciplinary dismissal. [www.esf.edu/students/counseling/services.htm](http://www.esf.edu/students/counseling/services.htm)

## Statement of Good Academic Standing

The term "in good academic standing" means that a student is maintaining satisfactory progress toward a degree with a Cumulative Grade Point Average (Cum GPA) of at least 2.000. Students earning less than a 2.000 Cum GPA shall be placed on Academic Probation.

## Syracuse University Courses

Courses offered at ESF should be taken at Syracuse University only under extraordinary conditions authorized by the department chair or designee. Students who propose to register for Syracuse University courses and no courses at ESF during any semester may do so only upon acceptance to special ESF-SU cooperative programs that require block registration. Students who are in their final semester may register for no more than six credits of Syracuse University courses beyond those necessary to meet ESF requirements.

Syracuse University courses may be audited only under extraordinary conditions that must be approved by the department chair or designee. Physical education courses, when taken, must always be for credit and never audited. Students may not retake Syracuse University courses in which credit has been previously earned.

Upper-division undergraduate students are normally expected to take upper-division courses and graduate students are normally expected to take graduate level courses at Syracuse University.

## Religious Beliefs Law

Students unable, because of religious beliefs, to attend classes on certain days are guided by Section 224a of the New York State Education Law, which is as follows:

- No person shall be expelled from or be refused admission as a student to an institution of higher education for the reason that one is unable, because of religious beliefs, to attend classes or to participate in any examination, study or work requirements on a particular day or days.
- Any student in an institution of higher education who is unable, because of religious beliefs, to attend classes on a particular day or days shall, because of such absence on the particular day or days, be excused from any examination or any study or work requirements.
- It shall be the responsibility of the faculty and of the administrative officials of each institution of higher education to make available to each student who is absent from school because of religious beliefs, an equivalent opportunity to make up any examination, study or work requirements which may have been missed because of such absence on any particular day or days. No fees of any kind shall be charged by the institution for making available to the said student such equivalent opportunity.
- If classes, examinations, study or work requirements are held on Friday after four o'clock post meridian or on Saturday, similar or makeup classes, examinations, study or work requirements shall be made available on other days, where it is possible and practicable to do so. No special fees shall be charged to the student for these classes, examinations, study or work requirements held on other days.
- In effectuating the provisions of this section, it shall be the duty of the faculty and of the administrative officials of each institution of higher education to exercise the fullest measure of good faith. No adverse or prejudicial effects shall result to any student because of implementation of the provisions of this section.
- Any student, who is aggrieved by the alleged failure of any faculty or administrative officials to comply in good faith with the provisions of this section, shall be entitled to maintain an action or proceeding in the supreme court of the county in which such institution of higher education is located for the enforcement of rights under this section.

## Undergraduate Academic Policies

### General Requirements

While a student is matriculated at ESF, all courses taken at ESF and Syracuse University to meet degree requirements must be graded on a scale of A-F, and the grades will be computed in the grade point average. As an exception, at the discretion of the instructor, courses numbered 132, 496 and 497 may be graded on a Satisfactory/ Unsatisfactory basis. This must be announced on the first day of class and will apply to all students enrolled in that course section.

## Curriculum Requirements

The development and administration of course offerings, prerequisites, sequencing and program requirements are primarily the responsibility of each program with the approval of the ESF faculty.

Students must satisfy the requirements for graduation presented in the catalog in effect as of the date they first matriculated at ESF. Students may graduate under the requirements stated in any catalog issued subsequent to the one in effect the date they matriculated, but they may not use a prior catalog.

Supplementary courses are available to ESF students at Syracuse University. However, these courses may be limited only to those specifically required by a particular program.

Students who change majors are required to submit a completed change of curriculum form approved by representatives of both programs and must complete all the requirements of their new major.

## Dual Majors

Students who are pursuing undergraduate degrees may pursue dual majors. Program requirements must be satisfied concurrently (i.e., a student cannot graduate from ESF and return later to complete coursework for a second major). The diploma will state the completion of a single degree. The transcript will state the completion of two majors. Admission to a dual major will be accomplished by petition to the primary degree department or academic unit that has been endorsed (approved) by the secondary degree department.

### Inter-department dual majors:

Students must satisfy requirements of both majors.

### Intra-department dual majors:

SCME: Construction Management and Wood Products Engineering allowed with each other;

PBE: Bioprocess Engineering allowed with either Paper Engineering or Paper Science;

FNRM: no dual majors between the three majors (FRM, NRM, and FES); forest technology and surveying technology degrees allowed for A.A.S. degrees;

EFB: Only Biotechnology with other EFB majors **except environmental biology**.

Students may petition for admission to a dual major A.A.S. degree after completing 18 credits and before 45 credits with an unambiguous GPA of 2.000 or greater (no grades of incomplete or missing grades).

Students pursuing the B.S. degree may petition admission to a dual major after completing 30 credits and before completing 90 credits in the primary major with an unambiguous GPA of 2.000 or greater (no grades of incomplete or missing grades).

## Physical Education and ROTC

Physical Education and ROTC course credits may be used to satisfy elective requirements with the permission of the student's academic advisor.

## General Education

Resolution 98-241 (December 1998) of the State University Board of Trustees requires general education coursework for all University baccalaureate candidates in specific knowledge and skill areas and in two competencies. Each ESF undergraduate program meets or exceeds the general education requirements. These general education requirements are in effect for all students who began college courses during or after the fall semester 2000, exclusive of any courses taken while in high school. A complete listing of ESF and Syracuse University courses that meet the general education standards established by SUNY is available on the Internet at [www.suny.edu/provost/generaleducation/courselist/coursefiles/ESFGERCourses.pdf](http://www.suny.edu/provost/generaleducation/courselist/coursefiles/ESFGERCourses.pdf)

## Credit-Hour Load

To be classified as full time, a student must register for at least 12 credit hours during a semester. A student may not register for more than 18 credits during a semester unless permission from the student's advisor is obtained.

## Audits

Students may audit ESF courses informally with the permission of the course instructor. No record will be maintained of the informal audit nor will any grade be assigned. No fee is required for informal audits.

Students may audit courses formally with the permission of their academic advisor and the course instructor. Formally audited courses may not be used to satisfy any graduation requirements. They will appear on a student's transcript and will be graded either SAU (satisfactory audit) or UAU (unsatisfactory audit). The grade will be assigned based on the criteria for audit established by the course instructor. Registration guidelines for audited courses are the same as for courses taken for credit.

## Repeating Courses

Students may repeat any course previously taken, either to earn a higher grade or because of a previous failure.

Any course taken at SUNY-ESF may be repeated. Any course taken at Syracuse University in which a grade of F was assigned may be repeated. Upon successful completion of the repeated course, the grade earned will be included in the semester and cumulative grade point averages, but the original grade in that course will revert to a grade of R (course that was repeated) on the transcript and will not be included in the current cumulative grade point average. The original grade received in the course will be shown in parentheses following the R [e.g. R (C)]. The cumulative grade point average will reflect the grade for the second time the course was taken if the course was repeated once. Grades for all subsequent times that the course is taken will be included in calculations of grade point average. Semester and cumulative grade point averages will be calculated in accordance with SUNY and college policies. The course's credits can count only once toward degree requirements. The "R" grade may be applied to replace initial course grades higher than "F" only if the initial course was taken in the Fall 2009 semester or later.



For state-based financial aid, repeated courses in which students have received a passing grade will not count toward full-time status. Students retaking courses may find their financial aid reduced if they fall below 12 credits when the retaken courses are not included. The Financial Aid Office and students' advisors can help counsel students on the impact of retaking courses on their financial aid.

## Evaluation

For each course completed, one of the following grades will be awarded:

Grade	Definition	Grade Points
A	Excellent	4.000
A-		3.700
B+		3.300
B	Good	3.000
B-		2.700
C+		2.300
C	Passing	2.000
C-		1.700
D	Minimum Passing	1.000
F	Failure	0.000
I/F	Unresolved Incomplete	0.000

In order to receive a bachelor's degree, a student must complete all courses taken as a matriculated student at ESF with a cumulative grade point average of at least 2.0.

Under conditions defined elsewhere, the following grades may be assigned, none of which yield grade points:

Grade	Definition
S	Satisfactory (equal to C or better)
U	Unsatisfactory (equal to below C)
W	Withdraw
WP	Withdraw Passing
WF	Withdraw Failing
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete
R	Failed course which was repeated
NR	[Grade] Not Received

## Grade Point Averages

Semester and cumulative averages are computed by dividing the total grade points earned by the total credit hours completed for all courses graded A-F.

## Academic Advising

Each undergraduate student is assigned a faculty academic advisor in the student's major. The advisor assists the student in developing a program of study and approves course registration each semester. The advisor serves as a mentor and counselor and makes referrals to appropriate offices and resources as needed. The curriculum coordinator of each of the departments also assists the student by clarifying program and course requirements and providing additional advising and career-planning information.

## Academic Honors

### Dean's List

Students who carried 12 or more credits of coursework graded on a scale of A-F, with no grades of I or F in that semester, with a minimum grade point average of 3.500 will be placed on the Dean's List for that semester. Any grade changes, resolution of grades, or repeated courses after Dean's List Honors are awarded do not qualify a student to be placed on the Dean's List retroactively. A commendation is sent by the Dean to the student.

### President's List

Students who carried 12 or more credits of coursework graded on a scale of A-F with no grades of I or F in that semester, with a grade point average of 3.850 or better will be placed on the President's List for that semester. Any grade changes, resolution of grades, or repeated courses after President's List Honors are awarded do not qualify a student to be placed on the President's List retroactively. A commendation is sent by the President to the student.

Students who carried 12 or more credits of coursework graded on a scale of A-F with no grades of I or F in that semester, with a grade point average of 4.000 will receive an additional commendation from the President.

### Graduation Requirements

Students are responsible for meeting the following requirements for graduation:

- Matriculated status as an undergraduate student;
- All program requirements must be satisfied;
- A minimum cumulative grade point average of 2.000 (4.000=A) for all courses taken as a matriculated student at ESF;
- At least 24 of the last 30 credits must be registered for through ESF;
- Successful completion of a total of at least 120 appropriate college-level credits.

### Graduation Honors

Students will be graduated with the appropriate honor if the following criteria have been met:

- Students have completed a minimum of 30 credits of ESF and Syracuse University courses as a matriculated, upper-division student, and
- Students have earned a cumulative grade point average of 3.000-3.333 (*cum laude*); 3.334-3.829 (*magna cum laude*); or 3.830-4.000 (*summa cum laude*).

### Academic Performance

Students who earn less than a 2.000 cumulative grade point average are placed on academic probation and are subject to suspension from ESF. A student may be academically suspended only after having been placed on academic probation for at least one semester\*. Students will be suspended if they have been on academic probation for two successive semesters without achieving a 2.000 cumulative grade point average, or when their cumulative grade point average falls below the minimum values in the following index:

Total Hours applied Toward Degree [1]	Minimum Cumulative Grade Point Average [2]
0-30	1.700
31-60	1.850
61-120 or more	2.000

[1] Includes credit hours accepted for transfer to ESF degree program and courses taken while matriculated at ESF.

[2] Credit earned while matriculated at ESF, including SU courses.

Each student suspended will be given the opportunity to appeal this action based on any extraordinary conditions that may have contributed to the unsatisfactory performance. This appeal must be made in writing and submitted within the stated time limit in accordance with guidelines provided by the Office of Instruction and Graduate Studies. Every appeal will be reviewed by the Faculty Subcommittee on Academic Standards, which will recommend to the dean of Instruction and Graduate Studies either to accept the appeal or sustain the suspension. The dean of Instruction and Graduate Studies will inform the student in writing of the Subcommittee action. There is no appeal beyond this process.

Students who have been suspended for unsatisfactory academic performance may not enroll in any courses at ESF or Syracuse University until at least one semester has elapsed. If suspension occurs following the spring semester, suspended students may not enroll in a summer program at ESF or SU. Suspended students who wish to be reinstated must apply for readmission through the Office of Career and Counseling Services.

Students suspended a second time for unsatisfactory academic performance without successful appeal will be dismissed from the College and may not normally be considered again for readmission. If, however, after a period of not less than 10 years has elapsed, a previously dismissed student should desire to return to ESF, they may then apply for readmission. Candidates for readmission under these unusual conditions will be considered on a limited, case-by-case basis, and may be required to provide substantial additional justification for readmission.

ESF students who receive Federal, State and/or ESF financial aid must be achieving Satisfactory Academic Progress towards their degree completion. The standards review a student's Grade Point Average as well as successful completion of credit hours attempted. These standards can be found in the Financial Aid section of the College catalog.

Students who fall below these standards will be reviewed by the Associate Provost for of Instruction and the Financial Aid Director. Students who are in jeopardy of losing their financial aid due to poor academic performance will be notified by the college.

\*\*Due to the unique accelerated nature of programs offered at The Ranger School in Wanakena, students matriculated in these programs are not subject to these policies and may be placed on probation or suspended at any time their Cum GPA falls below 2.000.

### Graduate Academic Policies

## General Requirements

While a student is matriculated at ESF, all coursework taken at ESF and Syracuse University to meet degree requirements must be graded on a scale of A-F, and the grades will be computed in the grade point average. As an exception, at the discretion of the instructor, courses numbered 796 and 797 may be graded on a Satisfactory/Unsatisfactory basis. This must be announced on the first day of class and will apply to all students enrolled in that course section. Courses numbered 898, 899 and 999 are graded on a Satisfactory/Unsatisfactory basis.

## Curriculum Requirements

The development and administration of course offerings, prerequisites, sequencing and program requirements are primarily the responsibility of each program with the approval of the ESF faculty.

Students must satisfy the requirements for graduation presented in the catalog in effect as of the date they first matriculated at ESF. Students may graduate under the requirements stated in any catalog issued subsequent to the one in effect the date they matriculated, but they may not use a prior catalog.

## Transfer Credit

Credit hours appropriate to the graduate degree in which a minimum grade of B was earned from an accredited institution can be transferred to the College, but grades and grade points cannot be transferred.

Up to six credits of graduate coursework not used to complete another degree may be accepted toward completion of a master's or doctoral degree as approved by the steering committee.

Up to 30 credits of graduate level coursework earned as part of a conferred master's degree may be transferred (by petition) to a doctoral degree with approval of the steering committee.

Students may transfer no more than nine credits of credit-bearing non-degree ESF coursework to graduate degree programs.

All transfer credit will remain tentative until official, final transcripts are received. It is the student's responsibility to ensure that official, final transcripts are sent to and received by the College.

## Credit-Hour Load

To meet academic requirements, graduate students must be registered for at least one credit each semester, excluding summers, from the first semester of matriculation until all degree requirements have been completed. Failure to register for each semester will result in the student being withdrawn from graduate study and, if the student wishes to return in the future, a new application must be filed and reviewed prior to readmission. Students are required to register for at least one credit of thesis/dissertation research, professional experience, or independent study in the summer if they will complete all requirements during that time. Graduate students who hold an assistantship and/or a tuition scholarship must be in full-time status each semester while holding such an award. Registration for nine credits usually equates to full-time status for a student holding an assistantship. Graduate students not holding an assistantship are considered full-time if they are registered for at least 12 credits each semester. To maintain valid F-1 or J-1 student status in compliance with SEVIS, international students are required to maintain the institutional equivalent of full-time enrollment status during all required academic semesters. Audited courses may not be used to satisfy full-time status. Undergraduate courses may not be used to satisfy full-time status requirements for federal and state financial aid (TAP), but may be applied toward full-time status requirements for SEVIS. Student loan deferrals may be maintained by achieving half-time status for graduate students, or approximately 6 credit hours, if full-time status is not required for other reasons.

Doctoral candidates (i.e., those who have successfully completed their doctoral candidacy examination), master's students (M.P.S., M.L.A., and M.F.) who have met all academic coursework requirements, and master of science (M.S.) students who have requested the appointment of a defense committee and intend to defend a thesis may be considered full time if registered for at least one credit of thesis/dissertation research, professional experience, or independent study and submit a "Request for Full-time Certification Form" to the Office of Instruction and Graduate Studies.

## Part-Time Study

During any semester, students who are enrolled in part-time graduate degree programs (M.F. or M.P.S.) may register for the equivalent of full-time study. Graduate students who are enrolled in part-time degree programs are held to the policy for continuous registration, but not to the policy for time to degree (delimitation).

## Audits

ESF Courses may be audited formally or informally, and informally with special audit status. Each is defined as follows:

- **Formal Course Audit:** A course may be audited formally by registering for a course using the standard course registration process. Formally audited courses do not carry course credit and may not be used to satisfy any graduation requirements. They will appear on a student's transcript and will be graded either SAU (satisfactory audit) or UAU (unsatisfactory audit). The grade will be assigned based on the criteria for audit established by the course instructor. Both matriculated and non-matriculated students may formally audit courses.
- **Informal Course Audit:** A course may be informally audited by gaining permission of the instructor. No record will be maintained of the informal audit nor will any grade be assigned. No fee is required for informal audits. Only matriculated ESF students may informally audit courses.
- **Special Informal Course Audit:** "Special audit status" is granted to all New York state citizens of age 60 and over. Courses may be audited informally with special audit status by requesting confirmation of available space from the Office of Outreach and Instructional Quality. A record of the number of special auditors participating in each course is kept, however, no individual transcript is maintained of special informal audits nor will any grade be assigned. No fee is required for informal special audits.

## Evaluation

For each course completed, one of the following grades will be awarded:

Grade	Definition	Grade Points
A	Excellent	4.000
A-		3.700
B+		3.300
B	Satisfactory	3.000
B-		2.700
C+		2.300
C		2.000
C-	Minimum Passing	1.700
F	Failure	0.000
I/F, I/U	Unresolved Incomplete	0.000

Under conditions defined elsewhere, the following grades may be assigned, none of which yield grade points:

Grade	Definition
W	Withdraw
WP	Withdraw Passing
WF	Withdraw Failing
S	Satisfactory (equal to B or better)
U	Unsatisfactory (equal to below B)
SAU	Audit (Satisfactory)
UAU	Audit (Unsatisfactory)
I	Incomplete
NR	[Grade] Not Received

### Grade Point Average

Semester and cumulative averages are based on graduate-level courses only and are computed by dividing the grade points earned by the credit hours completed in all courses graded A-F.

### Time Limits

Graduate students must complete all requirements for the master of forestry, master of professional studies and master of science degree within three years, and the master of landscape architecture within four years of the first date of matriculation or they may be withdrawn from graduate study. For the doctoral degree, students must complete the candidacy exam within three years of the first date of matriculation. Students must pass the doctoral candidacy examination covering selected fields of study at least one year prior to dissertation defense and successfully defend the dissertation. Doctoral candidates must complete all degree requirements within three years of passing the doctoral candidacy examination, or they will be required to retake the candidacy examination

### Graduation Requirements

Students are responsible for meeting the following requirements for graduation:

- Matriculated status as a graduate student;
- All requirements for the appropriate program and degree level must be satisfied, and
- A minimum cumulative grade point average of 3.000 (4.000 = A) for all courses taken as a matriculated student at ESF.

### Academic Performance

Students who earn less than a 3.000 cumulative grade point average for graduate-level courses, or who receive two or more grades of Unsatisfactory (U) for work on their thesis or dissertation shall have their records reviewed by the dean of Instruction and Graduate Studies. These students shall be either placed on academic probation or suspended from ESF. The action taken will be based on recommendations from the students' major professors, department chairs and other appropriate faculty and staff. The dean of Instruction and Graduate Studies will inform each student in writing of actions taken.

Each student suspended will be given the opportunity to appeal this action based on any extraordinary conditions which may have contributed to the unsatisfactory performance. This appeal must be made in writing and submitted to the Office of Instruction and Graduate Studies within the stated time limit. Each appeal will be reviewed by the Faculty Subcommittee on Academic Standards which will recommend to the dean of

Instruction and Graduate Studies either to sustain the suspension or place the student on probation. The dean of Instruction and Graduate Studies will inform each student in writing of the Subcommittee action. There is no appeal beyond this process.

Students who have been suspended for unsatisfactory academic performance may not reapply until at least one semester has elapsed. Students may not take any courses at ESF or Syracuse University during this first semester following suspension. Suspended graduate students who wish to be readmitted must apply for readmission through the Office of Instruction and Graduate Studies.

Students suspended from a graduate degree program for a second time for unsatisfactory academic performance may not be considered for readmission.

# Admission

## Undergraduate Admission

[www.esf.edu/admissions/](http://www.esf.edu/admissions/)

The College is widely known for the high quality of its undergraduate instruction and unique teaching facilities and admits well-qualified students at the freshman, sophomore and junior levels. Several factors are considered before students are accepted for admission at any level. These factors include their academic preparation, personal motivation and reasons for wanting to study at ESF.

## Campus Visits

- For High School students: [www.esf.edu/admissions/freshman/visit.asp](http://www.esf.edu/admissions/freshman/visit.asp)
- For Transfer students: [www.esf.edu/admissions/transfer/visit.asp](http://www.esf.edu/admissions/transfer/visit.asp)
- For The Ranger School: [www.esf.edu/admissions/rsvisit.asp](http://www.esf.edu/admissions/rsvisit.asp)

The College welcomes visitors to its campuses. High school students who wish to visit the Syracuse campus should contact the Office of Undergraduate Admissions to schedule participation in a college information session, which includes a campus tour. Prospective transfer students who wish to visit the Syracuse campus to meet with a member of the admissions staff, including a review of potential transfer credit, and take a campus tour are asked to make an appointment through Undergraduate Admissions. Transfer applicants will find the interview more useful if they bring college transcripts with them. Campus tours, conducted by ESF Student Ambassadors, are also provided. Students interested in visiting The Ranger School should make arrangements directly with that campus by calling 315-848-2566. Please consult the Office of Undergraduate Admissions or our website for the calendar of open houses and special visitation events.

## Applying for Admission

[www.esf.edu/admission.htm](http://www.esf.edu/admission.htm)

Students seeking admission to undergraduate degree programs must file their application under one of the following processes. High school students may apply for:

- Early Decision freshman admission (commitment to enroll required if admitted)
- Regular freshman admission
- Guaranteed transfer admission

Students who have already attended another college must apply under the regular transfer admission process.

Each entrance category requires the applicant to have a specific academic background and to have maintained satisfactory academic progress at his or her previous educational institution.

Application to SUNY-ESF may be made through the State University of New York Application or The Common Application. Students are encouraged to review the information about the application process, obtain all application materials and apply online from the ESF website. Questions regarding the application process should be directed to the SUNY-ESF Office of Undergraduate Admissions.

## Application Filing Dates

### High School Students:

Enrollment Option	Filing Deadlines
Fall enrollment, Early Decision (freshmen only)	December 1
Fall enrollment, Regular freshman admission	January 15

### Transfer Students:

Enrollment Option	Filing Deadlines
Fall enrollment	March 1
Spring enrollment	November 1*

\*NOTE: Applications received after these dates will be considered on a space-available basis.

## Required Application Materials

All applicants for freshman or transfer entry are required to submit official documentation of high school graduation (or equivalent) and any college-level coursework (or equivalent) completed, even if it does not pertain to their intended program of study at ESF. Failure to submit this documentation by the stated deadlines may result in the withdrawal of the application or denial of admission.

Prospective students are strongly urged to submit their applications earlier than the recommended date to reduce the possibility they will be placed on an admissions waiting list.

Each new student on the Syracuse campus is required to submit a medical history and physical examination report on a form that will be sent to the student after the initial acceptance notice.

## Admission Information for High School Students

Please go to [www.esf.edu/admissions/freshman/](http://www.esf.edu/admissions/freshman/) for detailed information on the application process for high school students.

### Early Decision Freshman Admission

Outstanding high school seniors who have selected SUNY-ESF as their first-choice institution may apply for Early Decision admission and, if admitted, must commit to enroll at SUNY-ESF. Early Decision students may apply to other institutions under Regular consideration, and if admitted to SUNY-ESF, must withdraw their other applications and commit to enroll at SUNY-ESF no later than March 15. Early Decision candidates must have a completed application on file by December 1. This must include submission of either the SUNY Application or The Common Application, official high school transcripts (including 12th-year first-quarter grades), results of either the SAT I or ACT, supplemental application, ESF essay question response and academic recommendation. Please refer to the next section, "Regular Freshman Admission," for additional information on the freshman application process.

Early Decision applicants who wish to apply for Financial Aid from SUNY-ESF must have submitted the Free Application for Federal Student Aid (FAFSA) and any supporting information requested by the Office of Financial Aid and Scholarships by February 15. Please refer to the Financial Aid section of this catalog for more information on financial support.

Should a student who applies for financial aid not be offered an award that makes attendance possible, the student may decline the offer of admission and be released from the Early Decision commitment.

### Regular Freshman Admission

High school seniors may apply for Regular Freshman admission. This freshman enrollment option is available for students who meet the admission standards for bachelor's degree programs. High school seniors who are not offered freshman entry may be offered Guaranteed Transfer. Please refer to the next section, *Guaranteed Transfer*, which explains this process.

Freshman applicants should present strong academic credentials in a college preparatory high school curriculum. A minimum of three units each of college preparatory mathematics and science are required for all majors. For most programs of study completion of additional units of math and science, or design or art sequences for Landscape Architecture applicants, as well as advanced level coursework (honors or college level) indicates strong preparation for the academic rigor students will experience at ESF. An official high school transcript, including 12th-year first-quarter grades, must be submitted as part of the student's application credentials. Applicants are required to forward the results of either the SAT I or ACT examination. SAT II tests are not required, but in some cases they may highlight the special talents of an applicant. Freshman applicants are also required to submit a supplemental application, ESF essay question response and an academic recommendation.

### Guaranteed Transfer

The College recognizes that some students have made arrangements to spend a portion of their first two years of college at other institutions and will transfer to ESF in either their sophomore or junior year. To facilitate this process and reduce difficulties associated with transferring, ESF has established a Guaranteed Transfer option.

Under this option, admitted students are guaranteed admission to ESF for either their sophomore or junior year provided they meet the conditions specified in the offer of Guaranteed Transfer. Students benefit from long-term academic advising to ensure they meet all academic requirements for transferring to the College. Guaranteed Transfer applicants may file the SUNY application or The Common Application indicating on their supplemental form the entry semester for which they wish to be considered. Applicants must submit the same credentials as outlined under "Regular Freshman Admission" (see preceding section). Successful applicants for this option must present a strong academic background including at least three years each of college preparatory mathematics and science. To satisfy the guarantee of admission, students must satisfactorily complete, with a minimum cumulative grade point average of 2.500 (A=4.000), any of the lower-division requirements, which are part of their program of study. Only coursework with grades of C or higher will transfer to meet ESF degree requirements.

## Admission Information for College Students

- Please go to [www.esf.edu/admissions/transfer/](http://www.esf.edu/admissions/transfer/) for detailed information on the transfer student application process.

### Regular Transfer Admission

Approximately half of the students who enroll at the College each year transfer to ESF after completing at least one semester at another college following high school graduation. ESF recognizes the unique interests and needs of transfer students.

Transfer students' admissibility is based on how much of their previous coursework applies to the requirements of their intended major at ESF, overall academic performance at their previous colleges, and specific interest in ESF programs. For most programs, a significant emphasis is placed on students' backgrounds in mathematics and science. Transfer applicants must submit official transcripts from all colleges attended, an official high school transcript or results of the GED (for verification of high school graduation or equivalent), a supplemental application, essay question response and an academic recommendation. Students who have completed less than 30 semester hours at their previous college are required to submit copies of their high school transcript and SAT I or ACT test scores as part of the admissions process.

Students who apply as transfers to ESF are expected to have successfully completed some portion of the established required sequence of courses appropriate to their intended major at the College. Students attending one of our pre-ESF cooperative transfer colleges (see below) will find information on course equivalencies for all of our programs of study on our Web page. Printed copies of this information may be obtained from the Office of Undergraduate Admissions. Transfer students applying for bachelor degree programs at the Syracuse campus should have a 2.50 (A=4.00) or higher cumulative grade point average at the last institution they attended in full-time status. Those applying for associate degree programs at The Ranger School campus should have a 2.30 or higher cumulative grade point average at the last institution they attended in full-time status. Applicants with cumulative grade point averages below these thresholds will be considered on a case-by-case basis. Students with cumulative grade point averages less than 2.00 will not be considered for transfer admission to SUNY-ESF. Only coursework with grades of C or higher will transfer to meet ESF degree requirements.

## **Cooperative Transfer Option**

The College has developed pre-environmental science and forestry transfer options with other colleges both in and out of New York state. These partnerships offer students a wide selection of colleges from which they can obtain the necessary courses and appropriate advice on how to prepare for transfer to ESF. Information on ESF cooperative transfer colleges and associated Transfer Articulation Guidelines may be found on our Web page.

Students who attend these colleges and follow the academic program prescribed by ESF will share a common academic background with other students who transfer to the College.

The cooperative colleges are:

### **New York State Colleges**

- Adirondack Community College, Glens Falls
- Alfred State College, Alfred
- Broome County Community College, Binghamton
- Cayuga County Community College, Auburn
- Clinton Community College, Plattsburgh
- Columbia-Greene Community College, Hudson
- Corning Community College, Corning
- Dutchess County Community College, Poughkeepsie
- Erie County Community College, Buffalo
- Finger Lakes Community College, Canandaigua
- Fulton-Montgomery Community College, Johnstown
- Genesee Community College, Batavia
- Herkimer County Community College, Herkimer
- Hudson Valley Community College, Troy
- Jamestown Community College, Jamestown
- Jefferson County Community College, Watertown
- Mohawk Valley Community College, Utica
- Monroe County Community College, Rochester
- Morrisville State College, Morrisville
- Nassau County Community College, Garden City
- Niagara County Community College, Sanborn
- North Country Community College, Saranac Lake
- Onondaga County Community College, Syracuse
- Orange County Community College, Middletown
- Rockland County Community College, Suffern
- Schenectady Community College, Schenectady
- Suffolk County Community College, Selden
- Sullivan County Community College, Loch Sheldrake
- SUNY College of Agriculture and Technology at Cobleskill
- SUNY College of Technology at Canton
- SUNY College of Technology at Delhi
- Syracuse University
- Tompkins-Cortland Community College, Dryden
- Ulster County Community College, Stone Ridge
- Westchester County Community College, Valhalla

### **Out-of-State Colleges**

- Berkshire Community College, Pittsfield, MA



- Bucks County Community College, Newtown, PA
- Holyoke Community College, Holyoke, MA
- Northampton Community College, Bethlehem, PA

### **Transfer Credit**

Course work appropriate to the ESF curriculum can be transferred to the College, but grades and grade points cannot be transferred. Courses to be transferred to meet graduation requirements for any curriculum must be acceptable in content, and credit will be awarded only for those completed with a grade of C or higher (a C- is not acceptable).

All transfer credit will remain tentative until official, final transcripts are received. It is the student's responsibility to ensure that official, final transcripts are sent to and received by the College.

Only coursework completed at institutions that are fully accredited by one of six regional accrediting agencies will be considered for possible transfer credit toward ESF degree requirements. These agencies are the Middle States Association of Colleges and Schools, New England Association of Schools and Colleges, North Central Association of Colleges and Schools, Northwest Association of Schools and Colleges, Southern Association of Colleges and Schools, and Western Association of Schools and Colleges.

### **Policy for Students Transferring from Syracuse University to SUNY-ESF**

*Because of the special relationship between the SUNY College of Environmental Science and Forestry and Syracuse University (SU), SUNY-ESF students may take Syracuse University courses, and SU students may take SUNY-ESF courses, with the approval of the home institution and subject to availability.*

For Syracuse University students, Syracuse University is the college of record. SUNY-ESF does not maintain a transcript record of ESF courses taken by Syracuse University students. A student previously matriculated at Syracuse University, who is subsequently admitted to SUNY-ESF, except graduate students admitted to concurrent master's degree programs between the universities, will have all coursework taken while a Syracuse University student, including SUNY-ESF courses, treated and evaluated as transfer credit from Syracuse University. Such Syracuse University courses will not appear or calculate on the SUNY-ESF transcript, except as they are included in a block of transfer credits, i.e., total credit hours, accepted from Syracuse University. However, such Syracuse University courses do not count toward the SUNY-ESF residency requirement. Departments at their discretion include such courses in manual calculations, e.g., for determination of subsequent intra-university transfer eligibility.

Syracuse University courses taken by matriculated ESF students appear on the SUNY-ESF transcript and calculate in the same way as ESF courses, except for graduate students admitted to concurrent master's degree programs between the institutions. Syracuse University courses do not count toward the SUNY-ESF undergraduate residency requirement.

The ESF transfer credit policy requiring a minimum grade of C will be waived for Syracuse University students only and any coursework taken at Syracuse University with a passing grade will be treated as if it was taken at SUNY-ESF.

### **Advanced Placement**

The College will consider for advanced standing credit the results of examinations from standardized testing agencies such as the College Entrance Examination Board's Advanced Placement Program (AP) or the College Level Examination Programs (CLEP) as well as the Higher Level Exams of the International Baccalaureate (IB) program. Additional information on these programs may be found on the College website.

### **Ranger School Admission**

[www.esf.edu/rangerschool/](http://www.esf.edu/rangerschool/)

The SUNY-ESF Ranger School, located in Wanakena in the Adirondack Mountains, offers A.A.S. degrees in forest technology, land surveying technology and environmental and natural resources conservation, but does not enroll freshmen. Students complete their freshman year requirements at ESF's Syracuse campus or at the college of their choice. They complete the sophomore year of their A.A.S. program in residence at The Ranger School campus. Candidates may apply for acceptance into these programs under the guaranteed transfer option or as a regular transfer admission student.

High school students who wish to enroll in these programs should apply during their senior year to receive a guaranteed entry date one year later. A limited number of freshman applicants will be offered admission to the Syracuse campus for the first year of the A.A.S. program, if desired, and eventual completion of the bachelor degree, usually in a program of study in the Department of Forest and Natural Resources Management. Transfer students apply for sophomore year entry during the academic year prior to their intended fall semester entry at The Ranger School (spring admission is not available). For further information on The Ranger School, visit the website or refer to The Ranger School section of this catalog.

Please note that international students are *not* eligible for admission to programs at The Ranger School, however we encourage international students to inquire about ESF's bachelor degree programs in Forest and Natural Resources Management.

### **Educational Opportunity Program**

[www.esf.edu/admissions/special.htm](http://www.esf.edu/admissions/special.htm)

The State University of New York's Educational Opportunity Program (EOP) provides academic support and financial aid to students who show promise for mastering college-level work, but who may otherwise not be admissible under regular admission criteria. Offered only to full-time students who are New York state residents, freshmen and transfer students who qualify, both academically and economically, may be eligible for the EOP program. Students cannot apply for both EOP and Early Decision programs.

The goal of the EOP program at ESF is to provide qualified students with a college education and the opportunity for personal growth and professional development in career fields related to the College's mission. Counseling, financial assistance and tutoring are provided on an individual basis.

High school seniors who wish to apply for freshman enrollment and EOP status at the College must file a SUNY application or The Common Application and on the Supplemental Application indicate they want to be considered for EOP. In addition, they must submit a copy of the Free Application for Federal Student Aid (FAFSA), indicating ESF as a receiving institution.

In order for transfer students to participate in the program at the College, they must have been enrolled in or qualified for EOP, Higher Education Opportunity Program (HEOP), Search for Education Elevation and Knowledge (SEEK) or similar program at their prior college. Therefore, students who are applying to ESF as high school seniors through the Guaranteed Transfer option should also apply for EOP, HEOP or SEEK at their lower-division college, and must enroll in or be qualified for such a program in order to continue in EOP at ESF.

All EOP applicants must file applications for undergraduate admission and financial aid as described in those two sections of this catalog. For further information, contact the director of the Office of Financial Aid and Scholarships, 315-470-6670.

## Deferred Admission

[www.esf.edu/admissions/special.htm](http://www.esf.edu/admissions/special.htm)

Students accepted to ESF who wish to defer their enrollment for one or two semesters beyond their original entry date must make this request in writing directly to the Office of Undergraduate Admissions. Students will receive written notification if their request has been approved.

High school students admitted for freshman entry may defer admission to pursue non-academic activities. High school students admitted for freshman entry, who plan to attend another college prior to enrollment at ESF, will have their offer of admission changed to Guaranteed Transfer.

## International Student Admission

[www.esf.edu/international/](http://www.esf.edu/international/)

The College enrolls international students as undergraduates if they satisfy the admission requirements outlined throughout this section of the catalog.

In addition to the requirements that all prospective students must meet, international students must provide evidence of the [following](#):

- **Proficiency in the English language** that meets one of the following standards (minimum score in parentheses):
  - TOEFL: Test of English as a Foreign Language [Paper-based] (550)
  - TOEFL: [Computer-based] (213)
  - TOEFL: [Internet-based] (> 79)
  - IELTS: International English Language Testing System (Total: 6, with no less than 5 in Writing)
  - STEP EIKEN: Society for Testing English Proficiency (Grade pre-1)
  - ELS: (Level 112)
  - Completion of at least one year of college at an institution where the language of instruction was English; or
  - Successful completion of at least one semester at SUNY-ESF.
- Ability to meet all of the financial obligations that will be incurred while attending the College. In order to obtain an I-20 or DS-2019 from ESF, a prospective international student must complete the "[FSA-4 - Foreign Student Financial Statement Form](#)" and submit credible documentary evidence that s/he has enough readily available funds to meet all **expenses** (tuition, fees, and living expenses) for the entire first year of study. Additional information is available online at: [www.esf.edu/international/expenses.htm](http://www.esf.edu/international/expenses.htm).
- International freshman applicants are required to demonstrate the completion of a college preparatory secondary school program by submitting academic credentials translated into English. This evaluation must be completed by an approved international credentials evaluation agency. A list of *approved* agencies is available through the Office of Undergraduate Admissions.
- International transfer applicants are required to submit a detailed course-by-course evaluation of all international academic credentials in English. This evaluation must be completed by an approved international credentials evaluation agency. A list of *approved* agencies is available through the Office of Undergraduate Admissions.
- International students in active F-1 or J-1 student status who are currently enrolled at American colleges or universities or engaging in Practical or Academic Training experiences must complete the SEVIS transfer-in process. Additional information is available online at: [www.esf.edu/international/transfer-in.htm](http://www.esf.edu/international/transfer-in.htm).

ESF students who are not U.S. citizens or permanent residents are required by SUNY policies to maintain comprehensive health insurance with medical evacuation and repatriation coverage for themselves (and their dependents in the United States) for the duration of their ESF program of study. International students are automatically enrolled in the [SUNY Health Insurance Plan \(\\$1,144.75 for 2011-2012 academic year\)](#) **unless proof of comparable health insurance is provided to the Bursar's Office within 30 days of the start of each semester**. Additional information about the insurance policy is available online at: [www.esf.edu/international/health.htm](http://www.esf.edu/international/health.htm).

Please note that international students are *not* eligible for admission to programs at The Ranger School, however we encourage international students to inquire about ESF's bachelor degree programs in Forest and Natural Resources Management.

## Graduate Student Admission

[www.esf.edu/graduate/admission.htm](http://www.esf.edu/graduate/admission.htm)

Admission to graduate study is conditional upon review and acceptance of the applicant's credentials by appropriate faculty members and upon the recommendation of the appropriate department chair to the dean of Instruction and Graduate Studies. Employees of the College who carry faculty status in accordance with ESF faculty bylaws and are at or above the rank of assistant professor or equivalent may not be in a matriculated status at the College.

Required for admission are, at minimum, a bachelor's degree from a recognized institution, and generally an academic record showing at least a B average for junior and senior years of the baccalaureate program or for the master's program.

Also required are Graduate Record Examination (GRE) scores and for some degree programs, subject (advanced) test scores; supporting letters of recommendation; and a statement of educational and professional goals.

The Graduate Record Examination may be waived by a department chair or graduate coordinator on an individual basis. This waiver can only be granted by the graduate coordinator and/or chair.

A nonrefundable \$60 application fee is charged.

### Applying for Admission

Faculty seek graduate students who are well prepared for rigorous study, responsive and receptive to constructive feedback, and a good fit with their programs. The most effective way for applicants to demonstrate these qualities is to communicate with faculty prior to applying and to understand the programs ESF has to offer. Therefore, individuals who are interested in applying for graduate study should contact ESF faculty to discuss degree programs and learn about specific opportunities for study and research at ESF. Faculty Web pages provide contact information and additional insights about ESF degree programs. We also encourage applicants to visit campus and meet with faculty and current graduate students.

Online applications are preferred and are accessible at [www.esf.edu/graduate/admission.htm](http://www.esf.edu/graduate/admission.htm).

Application forms may be printed from the Internet or requested in paper form from the Office of Instruction and Graduate Studies, 227 Bray Hall, SUNY-ESF, Syracuse, N.Y. 13210.

Application Deadlines [Applications completed after these deadlines will be processed on a rolling basis]:

Semester	Deadline
Fall	January 15
Spring	October 15

Only applications completed by these dates will be guaranteed consideration for financial assistantships and tuition scholarships. Normally, applicants will receive decisions by mid-March for fall matriculation and by early December for spring matriculation.

### Graduate Record Exam Subject Tests

Subject tests are required or recommended by the following programs:

Graduate Program	Subject Test
Environmental and forest chemistry	Chemistry - required
Biochemistry area of study within environmental and forest chemistry	Chemistry or Biology - required
Environmental and forest biology	Biology - recommended

### Transfer Credit

Credit hours appropriate to the graduate degree in which a minimum grade of B was earned from an accredited institution can be transferred to the College, but grades and grade points cannot be transferred.

Up to six credits of graduate coursework **not used to complete another degree** may be accepted toward completion of a master's or doctoral degree as approved by the steering committee.

Up to 30 credits of graduate level coursework **earned as part of a conferred master's degree** may be transferred (by petition) to a doctoral degree with approval of the steering committee.

Students may transfer no more than nine credits of credit-bearing **non-degree ESF** coursework to graduate degree programs.

All transfer credit will remain tentative until official, final transcripts are received. It is the student's responsibility to ensure that official, final transcripts are sent to and received by the College.

### Part-time Study

Part-time study at the graduate level provides an excellent opportunity for working professionals to extend their educational credentials or broaden their general knowledge by enrolling for courses on a part-time basis. The M.P.S. or M.F. professional degrees are available for students who are initially matriculated on a part-time basis. Part-time students apply, matriculate and register through the same processes that all ESF graduate students complete. During any semester, students who enroll in part-time programs may register for the equivalent of full-time study, which is at least 12 credit hours. Part-time students are held to the policy for continuous registration, but not to the policy for time to degree (delimitation).

## Deferred Admission

Students accepted to graduate programs at ESF who wish to defer their enrollment beyond their original entry date must make this request in writing directly to the Office of Instruction and Graduate Studies.

## International Students

The College enrolls international students on the graduate level if they satisfy the admission requirements outlined throughout this section of the Catalog.

In addition to the requirements that all prospective students must meet, international students must provide evidence of the following:

- **Proficiency in the English language** that meets one of the following standards (minimum score in parentheses):
  - TOEFL: Test of English as a Foreign Language [Paper-based] (550)
  - TOEFL: [Computer-based] (213)
  - TOEFL: [Internet-based] (> 80 with no individual component score < 17)
  - IELTS: International English Language Testing System (Total: 6, with no less than 5 in Writing)
  - STEP EIKEN: Society for Testing English Proficiency (Grade 1)
  - ELS: (Level 112)
  - Completion of at least two years of college at an institution where the language of instruction was English; or
  - Successful completion of at least one semester at SUNY-ESF

In submitting test scores to the College (**institutional number 2530**), request they be sent to the Graduate School.

- Ability to meet all of the financial obligations that will be incurred while attending the College. In order to obtain an I-20 or DS-2019 from ESF, a prospective international student must complete the "[FSA-4 - Foreign Student Financial Statement Form](#)" and submit credible documentary evidence that s/he has enough readily available funds to meet all **expenses** (tuition, fees, and living expenses) for the entire first year of study. Additional information is available online at: [www.esf.edu/international/expenses.htm](http://www.esf.edu/international/expenses.htm).
- **Complete translations into English of all transcripts required by the admissions application** without any additions or deletions by the translators. Translations of documents by the applicant will not be accepted. Credential evaluator and translation services for academic documents may be found through the [National Association of Credential Evaluation Services \(NACES\)](#).
- International students must also file the [State University of New York Foreign Student Admission forms](#). No fee is required for processing these forms.
- International students in active F-1 or J-1 student status who are currently enrolled at American colleges or universities or engaging in Practical or Academic Training experiences must complete the SEVIS transfer-in process. Additional information is available online at: [www.esf.edu/international/transfer-in.htm](http://www.esf.edu/international/transfer-in.htm).

ESF students who are not U.S. citizens or permanent residents are required by SUNY policies to maintain comprehensive health insurance with medical evacuation and repatriation coverage for themselves (and their dependents in the United States) for the duration of their ESF program of study. International students are automatically enrolled in the [SUNY Health Insurance Plan \(\\$1,089.75 for 2010-2011 academic year\)](#) **unless proof of comparable health insurance is provided to the Bursar's Office within 30 days of the start of each semester.** Additional information about the insurance policy is available online at: [www.esf.edu/international/health.htm](http://www.esf.edu/international/health.htm).

International students will be considered for merit-based assistantships and fellowships but are not eligible for need-based student financial assistance.

# Expenses

The ESF tuition and college fee structure is set by the State University of New York Board of Trustees and generally covers the costs associated with instruction and the use of facilities and services at the College.

## Tuition

The tuition schedule *per semester* and the fees listed below are **subject to change**.

	NYS Resident Students	Out-of-State Students
<b>Undergraduate Matriculated</b>		
Full-time	\$2,635.00	\$7,160.00
Part-time	\$220/credit hour	\$597/credit hour
<b>Graduate Matriculated</b>		
Full-time	\$4,435.00	\$7,580.00
Part-time	\$370/credit hour	\$632/credit hour
<b>Maximum Total Tuition for 12 Credit Hours or More</b>		
Undergraduate	\$2,635	\$7,160
Graduate	\$4,435	\$7,160

## Residency

For purposes of tuition, “residence” refers to the principal or permanent home to which the student returns. Students who believe they qualify as New York residents may apply for a change in residency after they are accepted by ESF. Application forms are available in the Office of Business Affairs.

## Fees

### Application

Students who apply for admission to an undergraduate program at any State University of New York campus are charged a non-refundable application fee of \$50. For more information about the fee, and guidelines for exemptions, contact the Office of Undergraduate Admissions at SUNY-ESF.

Students who apply for admission to a graduate program at ESF are charged a non-refundable application fee of \$60.

### College Fee

The College fee is \$12.50 per semester for full-time students and 85 cents per credit hour for part-time students. For tuition purposes, students are considered full-time when they are enrolled in 12 credit hours or more.

### Student Activities

Each full-time undergraduate student is charged \$147 per year (\$73.50 per semester) to cover the cost of student activities at the College and part-time matriculated students are charged \$6.15 per credit hour.

Full-time graduate students are charged an activity fee of \$50 in the fall only. Part-time matriculated graduate students are charged \$10 per semester. Full-time graduate students who enter ESF in the spring semester are charged a \$10 student activities fee.

Students also pay an annual fee to Syracuse University to cover university-sponsored activities and services that are available to ESF students, but not duplicated at the College. These fees are \$36 for full-time undergraduate students and \$15 for full-time graduate students and are charged in the fall only.

Part-time matriculated undergraduate students are charged \$19.10 per year and part-time matriculated graduate students are charged \$10 per year at fall registration only.

Syracuse University does not charge an activities fee for non-matriculated undergraduate or graduate students.

### Intercollegiate Athletics Fee

All full-time undergraduate students enrolled at the Syracuse campus are charged \$30 per semester to partially offset the costs of the College’s intercollegiate athletics program. Part-time matriculated undergraduates are charged the prorated fee of \$2.50 per credit hour.

### Orientation Program

New students will be charged a fee to cover the cost of a college orientation program. The fee is \$60 for undergraduates and \$25 for graduates. This is a voluntary activity and students who choose not to attend may request a refund.

## **Student Support Services**

All full-time students are charged \$203.50 per semester to partially offset the cost of academic and other support services provided by Syracuse University, while part-time students are charged \$17.60 per credit hour.

## **Final Year**

Undergraduate students pay a commencement fee of \$60 that is required at the beginning of the semester in which a student is expected to obtain a degree.

All undergraduates are also charged \$30 for a school yearbook in the fall semester and a \$10 senior gift charge the semester they are expected to graduate.

Graduate students incur additional costs for the binding and archiving of theses and dissertations. Fees for these services are determined in the semester of degree completion. Students will be charged a \$35 commencement activity fee upon matriculation.

## **Field Trip Fees**

A transportation fee of \$40 is charged for each course that has a field trip component to cover costs of transporting students to off-campus sites.

## **Drop/Add Fee**

A fee of \$20 is assessed for each drop and each add transaction after the drop or add deadlines. See the "Academic Calendar" for the dates.

## **International Student Health Insurance**

ESF students who are not U.S. citizens or permanent residents are required by SUNY policies to maintain comprehensive health insurance with medical evacuation and repatriation coverage for themselves (and their dependents in the United States) for the duration of their ESF program of study. International students are automatically enrolled in the [SUNY Health Insurance Plan](#) (\$1089.75 for 2010-2011 academic year) unless proof of comparable health insurance is provided to the Bursar's Office within 30 days of the start of each semester.

## **Technology Fee**

A fee of \$13.10 per credit hour up to a maximum of \$157 per semester is assessed to maintain and enhance the College's computer infrastructure and online services provided to students.

## **Official Transcript Fee**

All students, including matriculated, non-matriculated, full time and part time, are assessed a fee of \$5 per semester. This guarantees students access to unlimited lifetime transcripts.

## **Terms of Payment**

### **Undergraduate Deposit**

New undergraduate students pay an advance payment deposit of up to \$400 after they are admitted to the College. Information on when the deposit is due, as well as refund guidelines, is sent to students at the time they are offered admission. The deposit is credited to the student's first semester tuition or housing charges. There is no advance payment deposit required for students accepted for graduate study.

### **Billing**

Beginning with the fall 2011 semester, SUNY-ESF will no longer provide paper semester bills. All billing and payment information (including the Monthly Payment Plan) will be accessible through [www.esf.edu/bursar/](http://www.esf.edu/bursar/). The semester bills will be available on July 1 for the fall semester (pending final approval of annual tuition charges); December 1 for the spring semester and May 1 for the summer semester. Payment is due within 30 days from the first access date of the bill. The College will send the student an e-mail telling him or her to access his or her bill online. ESF will bill tuition and fees for all students and room charges for Centennial Hall for students who reside there. Students housed in Syracuse University residence halls will be billed by the University. All students who contract for a Syracuse University meal plan (including students housed in Centennial Hall) will be billed by the University.

### **Late Payment Fee**

A late payment fee ranging from \$30 to \$50 will be charged each time a monthly statement is issued. The maximum will not exceed four late payment fees.

### **Insufficient Funds**

Individuals will be assessed a charge of \$20 for checks returned unpaid due to insufficient funds.

### **Refunds**

A student who is given permission to cancel registration is liable for payment of tuition in accordance with the following schedule:

#### **Liability During Semester**

- 1st week: 0%
- 2nd week: 30%
- 3rd week: 50%

- 4th week: 70%
- 5th week: 100%

In order to receive a refund of amounts paid over the liability, individuals must apply within one year after the end of the semester for which the tuition was paid. The first day that classes are offered, as scheduled by the College, shall be considered the first day of the semester, and the first week of classes for purposes of refunds shall be deemed to have ended when seven calendar days, including the first day of scheduled classes, have elapsed.

There is no tuition or fee liability for a student who withdraws to enter military service prior to the end of a semester for those courses for which the student does not receive academic credit.

A student who is dismissed for academic or disciplinary reasons prior to the end of a semester is liable for all tuition and fees due for that semester.

A student who cancels registration at a unit of the State University of New York and within the same semester registers at another unit of the state system is entitled to full credit for tuition and fees paid for that semester.

In situations where a student must withdraw from the College under circumstances in which the denial of a refund would create serious hardship, the College president or the vice president for administration can waive the normal refund schedule. Such action can be taken if the student has completed no more than one-half of the semester and will not receive academic credit for the semester. A written request for relief from the provisions of the refund schedule, including the reasons for the student's withdrawal, must be submitted to the College president or the vice president for administration.

## Other Costs

### Room Costs

Centennial Hall is a 452-bed residence hall owned and operated by the ESF College Foundation to provide student housing for undergraduate students enrolled at SUNY-ESF. All full-time students entering the College as freshmen are assigned housing in Centennial Hall and must reside there for their first year, unless they qualify for a commuter housing waiver (as determined by the Office of Undergraduate Admissions).

New students entering the College as undergraduate transfer students may also apply for student housing through the Office of Undergraduate Admissions. Housing will be provided on a space available basis, and transfer students may be offered housing in Centennial Hall or in a Syracuse University residence hall, depending upon availability.

Students continuing their enrollment as sophomores, juniors, or seniors at ESF may apply for housing in Centennial Hall by contacting the Centennial Hall Management Office.

For the 2011-12 academic year, the room charges (per student) in Centennial Hall are:

- 2 student/1bedroom/1bathroom (new students): \$3,689 per semester
- 2 student/2bedroom/1bathroom suite: \$4,071 per semester
- 4 student/4 bedroom/2bathroom apartment: \$852 per month (12-month leases required)

Entering transfer students housed on the Syracuse University campus are normally assigned housing in the South Campus Skyhalls residence hall complex. Room charges (per person) for a double room in the Skyhalls for 2011-12 totals \$3,535 per semester (including required communications fee). Continuing ESF upperclassmen may qualify for additional residence hall or apartment housing options at Syracuse University and should contact the Office of Housing, Meal Plan and I.D. Card Services at 315-443-2721 to request additional information about costs and availability.

Students housed in Centennial Hall will receive a bill from the ESF Bursar's Office for their charges. Students housed at Syracuse University will receive a bill from the University for their housing charges.

### Board (Meal Plan) Costs

All meal plans for ESF students are provided through Syracuse University. Students with a meal plan are able to eat in any of six dining halls at SU. The Sadler Dining Hall is located very close to Centennial Hall and the ESF Campus.

Freshmen-year students living in Centennial Hall are required to contract with SU Dining Services for a 14-, 19-, or 21-meals-per-week plan. The most popular choice is the 14-meal plan, which costs \$3,120 per semester for the 2011-12 academic year. Students living in two-bedroom suites in Centennial Hall are required to contract for a minimum of seven meals per week (\$2,230 per semester for 2011-12) but may contract for a larger plan. Students living in Centennial Hall apartments (with kitchens) are not required to have a meal plan.

Additional information about meal plans and costs is available from the SU Office of Housing, Meal Plan and I.D. Card Services at <http://housingmealplans.syr.edu/>. Students contracting for meal plans will receive a bill directly from Syracuse University.

### Program Expenses

The cost of books and supplies is approximately \$1,200 per year. Additional costs for personal expenses, clothing and transportation vary greatly from student to student, but are estimated to range from \$900 to \$1,600 per year.

Several programs at ESF include additional costs. Students majoring in forest resources management attend a seven-week Summer Session in Field Forestry at the Wanakena campus between the sophomore and junior years. Environmental and forest biology majors attend the summer field experience at the Cranberry Lake Biological Station at the end of their junior year.

The Summer Session in Field Forestry costs approximately \$1,820, while the program at Cranberry Lake costs \$465 a week, plus travel and personal expenses.

Field trips for landscape architecture students range between \$300 and \$400. In addition, students enrolled in landscape architecture are required to spend one semester off campus. This is a self-designed and student-budgeted program. Costs do not necessarily exceed those of a semester on campus, but additional costs are often incurred depending upon the location chosen. These additional costs are the responsibility of the student and are not covered by financial aid.

Additional course fees for labs provided by Syracuse University will be billed separately by SU. They are typically \$20/semester for chemistry labs and \$40/semester for physics labs.

### **The Ranger School Expenses**

Please see the [Ranger School](#) page for detailed expenses for The Ranger School at the Wanakena campus.



# Financial Aid

[www.esf.edu/financialaid](http://www.esf.edu/financialaid)

The College offers these basic forms of student financial assistance: scholarships or grants; part-time employment; educational loans; diversity student scholarships and fellowships; assistantships, tuition scholarships, and fellowships for graduate students; a deferred tuition payment plan; and sources of non-need loans to students and parents.

Federal and state financial aid programs are for United States citizens, permanent residents, or holders of I-151 cards. International students will be considered for academic merit-based scholarships, assistantships and fellowships, but are not eligible for need-based student financial assistance. Aid programs are coordinated to supplement parental support, summer work, savings, and assistance from other sources. The sources of funds for financial assistance programs, the guidelines for determining the recipients, the procedures for applying, and the method of disbursement of funds vary from one program to another. This information is presented in detail in the *ESF Financial Aid and Scholarships Guide*, which is a separate publication that is mailed to all applicants and is available through the Office of Financial Aid and Scholarships. It is also available at the financial aid website, listed above.

Financial aid is awarded primarily on the basis of financial need. Some scholarships and fellowships, however, are based on other criteria, such as academic achievement or minority status. Assistantships, tuition scholarships and fellowships for graduate students are awarded based upon academic achievement.

In order for students to receive aid, they must be making satisfactory academic progress toward a degree. Please refer to the appropriate sections under New York State Awards and Federal Awards later in this chapter for satisfactory academic progress requirements.

Financial aid advisors are aware of the many problems associated with financing higher education and meeting living expenses for both undergraduate and graduate students and are available to discuss individual problems. All students are encouraged to apply for financial aid.

## Applying For and Receiving Aid

### How to Apply

Students interested in receiving financial assistance, with the exception of graduate student assistantships, tuition scholarships and fellowships, must complete the application process each year.

After January 1, students must complete the Free Application for Federal Student Aid (FAFSA), and submit it to the Federal Student Aid Processor. The web-based version of the FAFSA is filed electronically at [www.fafsa.gov](http://www.fafsa.gov)

The priority application deadline for first consideration is March 1 for entering freshmen and March 15 for transfer students.

Applications will be accepted after March 1, but available funds may already be committed to other students. Prospective students do not need to receive notification of acceptance to ESF before applying for financial aid; however, they must be accepted to the College before a financial aid decision is rendered.

All students and parents are encouraged to visit our Financial Aid and Scholarships home page on the Internet at [www.esf.edu/financialaid/](http://www.esf.edu/financialaid/).

The paper version of the FAFSA is available for download at [www.fafsa.gov](http://www.fafsa.gov) or at your high school guidance office.

Students are invited to discuss with the Financial Aid staff any problems they may have in financing their education. Applicants are also urged to contact the office for the latest information and requirements pertaining to financial assistance because financial aid systems and forms frequently change.

### Selection of Recipients

The primary consideration in determining which students will receive awards is comparative financial need. However, academic achievement, citizenship and potential contribution to the College community are also considered in making certain award decisions.

### Verification of Information

All students who request financial assistance will be required to submit information about their family and/or personal financial situation prior to aid disbursement. The College will request copies of parents' and/or students' federal tax forms, along with other statements to verify other sources of income, family size, number of dependents in college and other pertinent information.

**Failure to comply with a request to verify pertinent information will result in the cancellation of any aid offered, and the possibility of legal action being taken by the U.S. Department of Education.**

### Appeal, Probation, Reinstatement

Students who fall below the minimum College, state and federal academic progress standards may appeal to the dean of Instruction and Graduate Studies to retain their academic eligibility to receive Title IV Federal Student Assistance. The minimum academic progress standards are presented below.

Appeals will be evaluated for mitigating circumstances such as injury or illness, and the likelihood that the student will be able to return to the appropriate standard. If the dean of Instruction and Graduate Studies places a student on "academic probation," the student remains eligible for Title IV aid as defined by the [Statement of Good Academic Standing](#).

The Office of Financial Aid and Scholarships will notify students via certified mail if they are in danger of losing financial assistance because they have fallen below academic standards.

## New York State Awards

All students who are awarded financial assistance will be required to maintain satisfactory academic progress each semester in order to keep their awards. Academic progress standards for all awards provided by New York are listed below. Recipients of a New York state award must adhere to the following state requirements:

- Academic Progress: Students must meet the minimum standards listed in the following charts to be eligible for an award the next semester.
- Program Pursuit: Students must complete a minimum number of credit hours each semester based on a full-time course load of 12 credit hours.
  - Associate in applied science degree students must complete 75 percent of the full-time credit load. Therefore, they must receive at least nine credits per semester (.75 x 12 = 9).
  - Bachelor's degree students must complete 100 percent of a full-time credit load (12 credit hours) each semester.
  - Graduate degree students must complete 100 percent of a full-time credit load (12 credit hours) unless they have an assistantship. Graduate students with an assistantship should see the section on credit hour load in the graduate academic policies section of this catalog for the definition of full-time status.
  - C Average: Students having completed their second academic year (or 24 payment points) *must have* a cumulative C (2.000) grade point average to retain their New York State Tuition Assistance Program (TAP) Award.

## Waivers for New York State Awards

Students who fall below the credit or grade point average requirements listed on the following charts may apply for a waiver to continue their eligibility for financial aid. Students are allowed only one waiver during undergraduate work and only one waiver during graduate work. A waiver will be granted only after the student and College officials agree that a waiver is in the best interest of the student. The waiver is *not* automatic. The waiver must be filed within the academic period it should cover. Requests are made through the director of Financial Aid and Scholarships.

Waivers for the cumulative grade point average requirement may be granted only when failure to meet this requirement is due to:

- the death of a relative of the student;
- the personal injury or illness of the student;
- other extenuating circumstances.

Requests for a waiver are made through the director of Financial Aid and Scholarships.

## Standard of Satisfactory Academic Progress for Purpose of Determining Eligibility for New York State Student Aid

The charts below list the credit hours a student must complete and the grade point average a student must maintain to receive the award payment.

### For students pursuing an associate degree program at ESF:

Payment	Credit Hours	Grade Point Average
#1	0	.000
#2	6	1.300
#3	15	1.500
#4	27	1.800
#5	39	2.000
#6	51	2.000

Noncredit remedial instruction can be counted toward a full-time academic load as set forth in 145-2.1 of the Commissioner's Regulations. The number of credits in this chart refers to work completed toward the degree.

### For students pursuing a bachelor's degree program at ESF:

Payment	Credit Hours	Grade Point Average
#1	0	.000
#2	1	1.500
#3	15	1.800
#4	27	1.800
#5	39	2.000
#6	51	2.000
#7	66	2.000

#8	81	2.000
#9	96	2.000
#10	111	2.000

Noncredit remedial instruction can be counted toward a full-time academic load as set forth in 145-2.1 of the Commissioner’s Regulations. The number of credits in this chart refers to work completed toward the degree.

**For students pursuing any graduate degree program at ESF:**

Payment	Credit Hours	Grade Point Average
#1	0	.000
#2	6	2.000
#3	12	2.500
#4	21	2.750
#5	30	3.000
#6	45	3.000
#7	60	3.000
#8	75	3.000

**Federal Awards**

Undergraduate and graduate students must meet specified criteria in order to be eligible for Title IV Federal Student Assistance, which includes Federal Pell Grants, Federal Supplemental Educational Opportunity Grants, Federal Perkins Student Loans, Federal William D. Ford Direct Loans, the Federal College Work-Study Program, and the Federal William D. Ford Direct Parent Loan for Undergraduate Students.

The criteria students must meet to be eligible for Title IV student aid are the same criteria all ESF students must adhere to in terms of institutional academic policies and academic progress toward a degree. The evaluation criteria are the following:

- an appropriate grade point average to ensure satisfactory academic progress;
- the successful accumulation of credits toward a degree (Pursuit of Program);
- receipt of a degree within the prescribed time limit for that program. Limits vary for individual programs; see below for the standard.

Students receiving federal student aid funds (Title IV aid) must make steady academic progress toward their degrees. While most students pursue their degrees on a full-time basis, others do not. In order to allow for maximum flexibility to complete a degree, federal regulations state that students' maximum time to be eligible for federal aid shall not exceed 150 percent of the published length of time it takes to complete that degree on a full-time basis.

Additionally, federal student aid (Title IV) eligibility is related to the successful completion of credit hours earned versus attempted. This component of eligibility is referred to as Pursuit of Program. Pursuit of Program is defined as: The number of credit hours attempted divided by the number of credit hours earned. This equation is tied back into the overall credits needed to be earned to graduate for any of our degrees. Generally, the number of credits a student must earn each semester and year to remain fully eligible is 67 percent (.67).

This measurement is reviewed each semester and again at the end of each academic year. Students receiving federal student aid from Title IV programs must be making progress towards their degree at a rate of .67 earned out of hours attempted. An example is:

Fall Semester Credits Attempted = 15

Fall Semester Credits Earned = 12

Pursuit of Program = 12 divided by 15 = .80

The earned credits exceed .67 and the student is eligible for continuing to receive Title IV aid by successfully meeting the Pursuit of Program component.

An example of an unsuccessful attempt is:

Fall Semester Credits Attempted = 15

Fall Semester Credits Earned = 6

Pursuit of Program = 6 divided by 15 = .40

The credits earned fall below the standard of .67 and therefore the student does not meet the Pursuit of Program standard and will be reviewed by the Financial Aid office and Academic Standards Committee to determine if the student can be placed on probation or given a warning in order to continue to receive Title IV aid.

In severe cases the student may indeed lose eligibility for all Title IV aid.

## Title IV Aid: Warning – Probation – Suspension and Appeals

Students receiving Federal Title IV aid will be reviewed by the College as stated above in order to comply with our responsibility with the regulations. This review will monitor progress towards a student's degree as well as their overall grade point average. As a result of this semester or annual review, the student may receive a warning that indicates they are in danger of not making progress. Some students may be placed on probation yet allowed to receive aid. Students in this category will receive a suggested academic path to ensure their continued progress toward the degree. Students will remain eligible as long as they stay on target with the recommendation provided.

Some students may have their eligibility for Title IV aid revoked. If that occurs, the student can appeal that decision. Students who make an appeal of their loss of Title IV aid must contact the director of Financial Aid in written form. The appeal must contain information regarding:

- Why the student failed to make progress toward the degree
- What has changed for the student that will allow the student to make progress
- What corrective action the student has taken to ensure successful completion toward the degree?

The following chart lists the maximum number of credit hours a student may take and still receive federal student aid. These figures are based on 150 percent of the credit hours required to complete each of the degrees offered by the College regardless of the time it takes to complete that degree.

### Standard of Satisfactory Academic Progress for Purpose of Determining Eligibility for Federal Aid

Degree	Credit Hours Required	Maximum Hours Allowed
Associate in Applied Science		
Environmental and Natural Resources Conservation	75	112
Forest Technology	78	117
Land Surveying Technology	78	117
Bachelor of Science	125	187
Aquatic and Fisheries Science	126	189
Bioprocess Engineering	127	190
Biotechnology	123	184
Chemistry	121	181
Conservation Biology	126	189
Construction Management	128	192
Environmental Biology	126	189
Environmental Resources Engineering	125	187
Environmental Science	125	187
Environmental Studies	121-124	186
Forest Ecosystems Science	128	192
Forest Engineering	125	187
Forest Health	126	189
Forest Resources Management	129	193
Natural History and Interpretation	126	189
Natural Resources Management	122	183
Paper Engineering	136	204
Paper Science	126	189
Wildlife Science	126	189
Wood Products Engineering	128	192
Bachelor of Landscape Architecture	150	225
Bachelor of Landscape Architecture/Master of Science	150/30	225
Master of Forestry	30	45
Master of Landscape Architecture	66	99

Master of Professional Studies (unless otherwise noted)	30	45
Chemistry	33	49
Environmental and Forest Biology	42	63
Environmental Science	39	58
Master of Science	30	45
Environmental Studies	37	55
Doctor of Philosophy	60	90

## **Types of Available Awards**

### **Scholarship, Fellowship, and Grant Programs**

#### **Federal Supplemental Educational Opportunity Grants**

The College receives Federal Supplemental Educational Opportunity Grants (FSEOG) authorized under Title IV-A of the Higher Education Act of 1965. These funds enable the College to award grants to undergraduate students who have financial need. Grants range from \$100 to \$2,000 per year.

#### **Federal Pell Grants**

The Federal Pell Grant Program was authorized in the Educational Amendments of 1972. Grants are available to eligible full-time and part-time undergraduate students and can vary from \$550 to \$5,550. Eligibility for a Pell Grant is determined by filing the FAFSA (Free Application for Federal Student Aid).

#### **Educational Opportunity Program**

Students accepted into the College's Educational Opportunity Program (EOP) may receive, in addition to other financial assistance, a special award to pay for education-related costs. Students must come from a socio-economic and academically disadvantaged background to be eligible.

Prospective EOP students must apply for financial aid when submitting their admissions applications.

#### **Tuition Assistance Program and Regents Programs**

Tuition Assistance Program (TAP) awards are available to New York residents enrolled in full-time degree programs. The awards are based on income and range from \$100 to 95 percent of full tuition.

Regents Awards for Children of Deceased or Disabled Veterans Grants are awarded to children of parents who served during specific periods of war or national emergency and who died as a result of such service, suffered a disability of at least 40 percent, was classified as missing in action or was a prisoner of war. The awards entitle state residents who qualify to \$450 per year.

Additional information and applications for these programs are available from the Office of Financial Aid and Scholarships, or from New York State Higher Education Services Corporation, Tower Building, Empire State Plaza, Albany, N.Y. 12255, [www.hesc.com](http://www.hesc.com).

#### **Vocational and Educational Services Grants**

Financial assistance and program counseling are provided by New York state for students with disabling conditions. Information is available from any New York Office of Vocational and Educational Services. VESID assistance amounts will be determined by SUNY-ESF following receipt of payment authorizations and calculation worksheets from the assigned VESID counselor.

#### **Veterans' Benefits**

The Veterans' Readjustment Benefits Act of 1966, as amended, enables veterans and children of deceased or disabled veterans to obtain financial aid for their college education.

Application forms and additional information and counseling are available from the ESF Veterans' Affairs Counselor in the Office of the Registrar, local Veterans' Administration offices, and the State Regional Office, 111 West Huron Street, Buffalo, N.Y. 14202.

#### **Diversity Student Scholarships and Fellowships**

Undergraduate students who are New York residents and Black/Non-Hispanic, Hispanic, Native American or Alaskan Native are eligible for scholarships comprising funds from both the College and SUNY. Eligible students should contact the Office of Financial Aid and Scholarships. Awards are based on need, and funds are limited.

The Graduate Diversity Fellowship Program provides tuition and stipends to graduate students who have overcome a disadvantage or other impediment to success in higher education and will contribute to the diversity of the student body. Recipients must be full-time students during the period of the award. Continuation of the award is contingent upon maintaining satisfactory progress toward the degree. Individuals should contact the director of Multicultural Affairs for application guidelines.

#### **Assistance for Native American Students**

Native American students with financial need may be eligible for scholarship and grant assistance through programs sponsored by the federal Bureau of Indian Affairs and the New York State Education Department. For more information, students should contact the Bureau of Indian

Affairs, 1951 Constitution Avenue NW, Washington, D.C., or the Native American Education Unit, State Education Department, Education Building Annex, Albany, N.Y. 12234.

### **Private Fellowships, Scholarships and Grants**

The College administers more than 200 private fellowships, scholarships and grants established by individuals, companies, organizations and foundations. These funds have varying eligibility requirements, which are described in more detail at [www.esf.edu/financialaid](http://www.esf.edu/financialaid).

A list of the private funds administered by the ESF College Foundation may be found at [www.esf.edu/development/scholarships/scholarships.htm](http://www.esf.edu/development/scholarships/scholarships.htm).

### **Syracuse Pulp and Paper Foundation Scholarships**

Scholarships from the Syracuse Pulp and Paper Foundation, Inc. are awarded to undergraduate students in paper science and paper engineering who are United States citizens or permanent residents. SPPF scholarships and awards vary based on a student's cumulative grade point average. Entering freshman students will be reviewed for scholarships based on their high school academic record. Entering freshman and transfer students and ESF continuing students in PBE, who have a 2.5 cumulative grade point average or higher, will be considered for scholarship assistance. Awards are renewed each semester subject to scholarship committee approval. Students should contact the Syracuse Pulp and Paper Foundation or see [www.esf.edu/pbe/sppf](http://www.esf.edu/pbe/sppf) for further information.

### **State University Supplemental Tuition Assistance**

The College annually awards small grants to a limited number of students with financial need as part of the State University Supplemental Tuition Assistance program.

### **Employment Opportunities**

#### **Federal College Work-Study Program**

The College participates in the Federal College Work-Study Program, which provides part-time jobs during the academic year and full-time positions during the summer to students who need financial assistance to attend the College. Wages for these positions begin at the minimum wage and increase as duties and responsibilities increase. The current wages are \$7.25 per hour during the academic year and \$8.25 per hour during the summer.

#### **Job Locator Service**

The College coordinates and maintains an active program of part-time and summer employment opportunities. Interested students should contact the student employment coordinator in the Office of Financial Aid and Scholarships for additional information. The program is open to all ESF students seeking employment.

### **Student and Parent Loans**

#### **Federal Perkins Student Loans**

Federal Perkins Student Loans are available to students with financial need who are enrolled at least half time. A total of \$4,000 can be borrowed each year for four years, up to a maximum of \$20,000. A repayment plan, including 5 percent interest, begins nine months after the student leaves college. Deferment and cancellation benefits are available in certain situations. The average loan per student totaled \$2,000 in 2010-2011.

#### **William D. Ford Federal Direct Student Loans**

The Federal Direct Student Loan program is administered by the College through the U.S. Department of Education.

These loans are available to students who are registered at least half time. Undergraduate students can borrow as follows: \$5,500 in the first year; \$6,500 in the second year; \$7,500 in the third, fourth and fifth years up to a total of \$31,000. Graduate students can borrow \$8,500 a year up to a total of \$65,500 in subsidized loans (\$138,500 subsidized and unsubsidized).

Direct loans may be subsidized or unsubsidized or a combination. A subsidized loan is such that interest does not accrue while the borrower is in school. An unsubsidized loan is such that the borrower must make interest-only payments while in school or allow interest payments to be added to the principal.

Beginning July 1, 2011, all new subsidized loans have a fixed interest rate of 3.4 percent. Unsubsidized loans have a fixed interest rate of 6.8 percent.

A repayment plan, with a variable or fixed percent interest, begins six months after the student leaves college. An additional fee of up to 1.5 percent is charged at the time the loan is received. Applications are available at [www.esf.edu/financialaid/direct.htm](http://www.esf.edu/financialaid/direct.htm). The average subsidized Stafford Student Loan was \$5,000 for undergraduates and \$8,500 for graduate students in 2010-2011. The average unsubsidized Stafford Student Loan was \$4,000 for undergraduates and \$6,500 for graduate students in 2010-2011.

#### **Federal William D. Ford Direct Parent Loan for Undergraduate Students**

Parents of undergraduate students may borrow from the U.S. Department of Education up to the cost of attendance at ESF annually at an interest rate of 7.9 percent with a Federal Parent Loan for Undergraduate Students (PLUS). A repayment plan begins 60 days after receipt of the loan.

**William D. Ford Graduate PLUS Loan**

Graduate students may borrow from the U.S. Department of Education up to the cost of attendance at ESF annually at an interest rate of 7.9 percent. Students must file a FAFSA with the school.

**Graduate Assistantships and Tuition Scholarships**

Assistantships are awarded to graduate students who have demonstrated scholarship and academic promise, and whose education and experience enable them to assist in the teaching, outreach, and/or research missions of the College. The amounts of the assistantships range from \$11,060 per academic year to as high as \$30,000 for a calendar year (for full-time awards). In addition, a tuition scholarship may be awarded. Students who hold an assistantship must be enrolled for full-time study as defined by graduate policies and be making satisfactory progress toward completing their degree.

Guidelines and criteria for awards are posted on the “Funding Opportunities for Graduate Students” website: [www.esf.edu/graduate/awards.htm](http://www.esf.edu/graduate/awards.htm).

## ESF Scholarships and Grants

Scholarship Program	Eligibility	Amount	Where to Apply
<b>ESF Presidential Scholarships</b>	Winners are selected based on academic records, recommendations, and academic program requirements.	Up to \$3,000 per year for N.Y. residents and up to \$8,000 per year for out-of-state residents.	All freshman and transfer applications submitted to ESF by February 1 will be reviewed for possible selection.
<b>ESF National Scholarships</b>	Awarded to outstanding students from outside NY State.	Up to \$8,000 per year. Renewable.	All freshman and transfer applications submitted by February 1 will be reviewed for possible selection.
<b>ESF Legacy Scholarships</b>	Children or grandchildren of ESF alumni enrolled in full-time undergraduate study. Up to five winners selected each year.	\$250 per semester for up to ten semesters. Renewable with cumulative GPA of 2.5 or higher.	Complete family question on ESF's Supplemental Application for Admission to be considered.
<b>Paper Science and Engineering Scholarships</b>	United States citizens enrolled in or admitted to the Paper Science or Paper Engineering programs.	Entering freshmen are awarded a \$1,000 scholarship for their first year. Amounts for transfer and continuing students are based on GPA.	Students must apply annually by completing the FAFSA, available at <a href="http://www.fafsa.ed.gov">www.fafsa.ed.gov</a> .
<b>ESF College Foundation Awards</b>	Students with financial need or academic merit enrolled at least half-time.	Amounts for these awards vary from \$100 - \$5,000, depending upon need.	Student must complete the FAFSA, available at <a href="http://www.fafsa.ed.gov">www.fafsa.ed.gov</a> .
<b>Haudenosaunee Scholar Awards</b>	Certified citizenship in Mohawk, Oneida, Onondaga, Cayuga, Seneca or Tuscarora nations.	\$5,000 per year (full-time study only). Two scholarships awarded each year.	Application available on Office of Financial Aid and Scholarships website: <a href="http://www.esf.edu/financialaid/">www.esf.edu/financialaid/</a> .
<b>Phi Theta Kappa Scholarships</b>	Community college transfer students who are members of PTK honor society.	\$1,500 per year. Renewable with GPA of 3.25 or higher.	Proof of PTK membership submitted with application for admission.
<b>National Merit, National Achievement, and National Hispanic Scholarships</b>	Semifinalists or finalists in any of these three national scholarship programs.	Combined ESF Presidential and Merit Scholarships totaling up to \$8,000 per year. Renewable.	High school records provided for admission must indicate student's semifinalist or finalist selection.

## State and Federal Government Grants

Need-based Grant	Eligibility	Amount	Where to Apply
<b>Federal Pell Grant</b>	Accepted or enrolled full-time, three-quarter-time, or half-time undergraduate students who demonstrate financial need.	From \$555 to \$5,550. Cannot exceed one-half the cost of college expenses.	Students must submit the FAFSA, available at <a href="http://www.fafsa.ed.gov">www.fafsa.ed.gov</a> .
<b>Federal Supplemental Educational Opportunity Grant (FSEOG)</b>	Full-time, three-quarter-time, or half-time undergraduate students with exceptional need.	Up to \$4,000, depending upon need and college expenses.	Students must submit the FAFSA, available at <a href="http://www.fafsa.ed.gov">www.fafsa.ed.gov</a> .
<b>New York State Tuition Assistance Program (TAP)</b>	Full or part-time students at any accredited college in New York State. Resident of New York State. Must demonstrate financial need.	\$500 to \$5,000 for undergraduates, depending on NYS net taxable income and dependency status.	Students must complete the FAFSA using the TAP section, available at <a href="http://www.fafsa.ed.gov">www.fafsa.ed.gov</a> .
<b>Part-Time New York State Tuition Assistance Program (TAP)</b>	TAP eligible undergraduate students who were 1st time freshmen enrolled full-time in 2010-11, and must be enrolled in 6-11 credit hours per semester for 2011-12.	\$250 to \$4,583 based on a prorated percentage of the full-time TAP grant equivalent.	Students must complete the FAFSA and the TAP application.
<b>Educational Opportunity Grant (EOP)</b>	Undergraduate students. Resident of New York State. For educationally and economically disadvantaged students.	Varies according to individual need. Applicants must submit the Federal Income Tax Form.	Guidelines are in the SUNY Application for Admission. Submit the FAFSA.
<b>Aid for Part-Time Study (APTS)</b>	Undergraduate students who have at least 6 credit hours toward degree. Must be N.Y. resident enrolled for 6-11 credit hours.	Minimum award: \$50. Maximum award: \$2,000.	Applications are available in the ESF Financial Aid Office. Contact us at 315-470-6670.



# Federal Student Loans

Loan Program	Eligibility	Amount	Where to Apply
<b>Federal Perkins Loan</b>	For all full-time, three-quarter-time, or half-time students with financial need. Students borrow from the College on their own signature (no cosigner required).	Amount varies according to student's need. The total loan limit is \$27,500 for an undergraduate program and \$60,000 for a graduate program. No interest while in school. Repayment at 5% interest begins 9 months after leaving school. Up to 10 years to repay.	Students must submit the Free Application for Federal Student Aid (FAFSA). <a href="http://www.fafsa.ed.gov">www.fafsa.ed.gov</a>
<b>Federal Direct Loan</b>	For all full-time, three-quarter-time, or half-time students. There are subsidized loans (interest-free while in school) and unsubsidized loans (student responsible for interest while in school).  Students borrow from the Federal Government. Loans are processed through the College.	<u>Dependent Students:</u> The maximum per year is \$5,500 for freshmen, with no more than \$3,500 subsidized; \$6,500 for sophomores, with no more than \$4,500 subsidized; \$7,500 for juniors and seniors, with no more than \$5,500 subsidized. The borrowing limit for dependent undergraduate students is \$31,000, with no more than \$23,000 subsidized.  <u>Independent students or students whose parents cannot borrow under the Federal Direct PLUS Loan Program:</u> The subsidized and unsubsidized maximum per year is \$9,500 for freshmen, \$10,500 for sophomores, and \$12,500 for juniors and seniors. The borrowing limit for independent undergraduate students is \$57,500, with no more than \$23,000 subsidized.  <u>Graduate or Professional Students:</u> The subsidized maximum is \$8,500 and the unsubsidized maximum is \$12,000 (borrowing limit is \$138,500). Interest subsidized loans will not be available to new borrowers after 7/1/12.	Students must submit the Free Application for Federal Student Aid (FAFSA). <a href="http://www.fafsa.ed.gov">www.fafsa.ed.gov</a>
<b>Federal Direct PLUS Loan</b>	For parents or guardians of financially dependent undergraduate students. Graduate students may also borrow Direct PLUS loans.	The maximum is the cost of education at ESF minus any estimated financial aid. Borrowers must meet established credit criteria. Loan repayment begins 60 days after the loan is fully disbursed. The interest rate is 7.9%.	Students must submit the Free Application for Federal Student Aid (FAFSA). <a href="http://www.fafsa.ed.gov">www.fafsa.ed.gov</a>

Repayment begins 6 months after you graduate or fall below half-time status. You have up to 10 years to repay the loan. There is a 1.0% origination fee (for the federal government) deducted proportionately from your loan proceeds. The interest rate is 3.4% for subsidized loans and 6.8% for unsubsidized loans.

# Student Employment

Employment Program	Eligibility	Amount	Where to Apply
<b>Federal Work-Study Program</b>	For full-time, three-quarter-time, or half-time students with financial need.	Opportunities for employment are offered during the academic year and/or summer. Students may work up to 20 hours per week when classes are in session or up to 40 hours per week during vacations. Hourly wages up to \$7.25 per hour during the academic year, or \$8.25 per hour for summer employment.	Students must submit the FAFSA application at <a href="http://www.fafsa.ed.gov">www.fafsa.ed.gov</a> , and the appropriate tax forms.
<b>Job Location and Development Program</b>	For all ESF students. Students are connected to job opportunities with local employers.	Wage and hours will vary according to job offers.	Apply by visiting the ESF job locator in the Financial Aid Office.

# Graduate Student Assistantships

Assistantships	Eligibility	Amount	Where to Apply
<b>Graduate Assistantships</b>	Assistantships sponsored by N.Y. State and various research projects are available. Students assist with instruction, research, and support operations for an assigned program area.	Graduate assistants normally work for 10–20 hours per week. The award range is generally \$11,000–\$30,000 per year, and a tuition scholarship may also be provided. Financial need is not a criterion for qualification.	The application for admission serves as the application for graduate assistantships for beginning students. Continuing students should contact their department chair.

The term "Full-Time Undergraduate Student" in this chart means one taking at least 12 credit hours per semester in a degree/ certificate program; "Three-Quarter-Time Undergraduate Student" means one taking at least 9 credit hours per semester in a degree/ certificate program; "Half-Time Undergraduate Student" means one taking at least 6 credit hours per semester in a degree/certificate program. Graduate students not holding an assistantship are considered full-time if registered for 12 credit hours each semester. Graduate students holding an assistantship and/or tuition scholarship are full-time if registered for 9 credit hours each semester. Chart information is accurate as of 8/15/11.

# Student Life

## Student Services at ESF

### Office of Academic Support Services

Our mission is to provide students with holistic academic support opportunities that assist in our students' current academic pursuits and future professional goals. The Academic Success Center (ASC) provides the following services: peer tutoring assistance, drop-in math and writing support, success resources, and a computer lab. Academic Support Services and its home base, the Academic Success Center, are located in Moon Library, Rooms 109A and 109 respectively. For additional information, please contact the office staff at (315) 470-4919 or via e-mail at [academicsupport@esf.edu](mailto:academicsupport@esf.edu).

**Peer Tutoring:** Peer tutors may be available to any ESF undergraduate student who feels a need for academic support in meeting the demands of ESF courses in which he/she is currently enrolled. Priority for tutoring is given to the lower-division undergraduate courses. Requests for tutoring in more specialized classes are dealt with on a case-by-case basis. Tutoring is offered in both drop-in large group sessions and individual/small group sessions. For additional information, please contact us via email at [tutoring@esf.edu](mailto:tutoring@esf.edu) or at (315) 470-4919.

**ESF Learning Community:** During their freshmen year at ESF students will live on common floors in ESF's new Centennial Hall complex while taking common sections of lower-division courses in chemistry, biology, and writing. This living-learning program is a great asset to our students and our institution. Through involvement with faculty and staff, students build more meaningful relationships with each other and develop a deeper sense of pride in the campus community. ESF's Learning Community establishes an academic and social integration and creates a positive environment where students are able to build community among their peers and develop a sense of independence during their transition from high school to college.

**Writing Resource Center (WRC):** Located in the Academic Success Center, the WRC offers students the opportunity to drop in for assistance with writing papers, lab reports, and written homework assignments. We will help students with all facets of the writing process, including skills such as brainstorming, outlining, organizing and overcoming writer's block.

**Math Lab:** Also located in the Academic Success Center, the Math Lab provides students with the opportunity to drop in for assistance for any math-related subject taken at ESF.

**Success Workshops and Resources:** Throughout the semester, academic support workshops are offered to help students with study skills, time management, and test preparation. Space is also available for groups to study using white boards and computers. In addition, the "Success at ESF" website offers advice about what it takes to succeed at ESF.

**Computer Lab:** Students can use computers in the Academic Success Center for heightening academic performance. These computers are available for tutoring sessions, group study, and independent academic work. Schedules for use are posted in the center.

### Career Services

The Office of Career Services provides career counseling to meet the individual needs of students at various stages of their education and employment search through a variety of materials and presentations. The career services offered include skill development workshops, job lists, on-campus recruiting visits, career websites, and reference information.

The office also conducts an annual survey to monitor the activities of ESF graduates six to nine months after graduation. The survey results are available at the Office of Career Services.

**Graduate School Preparation Resources:** Students can begin the process of searching for graduate schools using the Office's graduate school preparation materials, including test (GRE, GMAT, etc.) study guides and resources specific to the process.

**Internships:** ESF students can explore interests and career opportunities through a variety of internships on campus, in the local community, and around the country. Internship opportunities exist for students in all majors. Students should contact the Office of Career Services for more information.

### Counseling Services

The Office of Counseling Services is available to students who wish to consult with an experienced counselor and should be contacted whenever personal questions or problems arise.

The counseling services staff helps students adjust to life at ESF and successfully graduate from the College.

Syracuse University provides additional assistance for a broad range of concerns. Services are offered by the Office of Student Assistance, the Counseling Center, the Goldberg Marriage and Family Therapy Center, the Hendricks Chapel staff and denominational chaplains, the Psychological Services Center, the Office of International Services and the Campus Mediation Center.

### International Student Services and Study/Research Abroad

The Office of International Education (OIE) seeks to promote international understanding through its support of international students, study abroad, research abroad, and the exchange of international students, scholars, and faculty.

OIE is the primary on-campus immigration resource available to the ESF international student community. It assists international students with maintaining status and adhering to U.S. immigration laws by providing advice regarding immigration regulations and various immigration-related topics. OIE provides all immigration document services for current ESF F-1 and J-1 students.

OIE is also the primary on-campus resource for students interested in studying abroad during their academic program at ESF. OIE provides information regarding study abroad eligibility requirements and study abroad opportunities and assists students with completing the study abroad request approval process.

OIE serves as an emergency point of contact for all ESF students conducting research abroad, participating in ESF international programs, and for ESF faculty taking students abroad.

### **Multicultural Affairs**

Multicultural Affairs helps promote cultural growth and understanding across campus through activities and services designed to help members of the ESF community effectively interact with others in an increasingly diverse and global society.

Through an array of programs and services, Multicultural Affairs helps recruit underrepresented students and support them in their endeavors at ESF.

Multicultural Affairs provides material and information resources to help members of the College community identify and connect with others who can offer support in a variety of ways, including linguistic, ethnic, ideological, or cultural aspects of life.

### **Support for Students with Learning Disabilities**

Academic support services for students with learning disabilities as well as students requiring tutorial and remedial assistance are available. Students should contact the ESF Office of Student Life at 315-470-6660 so appropriate services and accommodations can be provided.

### **Services for Students with Disabilities**

Students who experience temporary disabilities or incapacitating injuries that require special transportation or classroom assistance should contact the Office of Student Life.

The office staff provides specialized support services and helps more permanently disabled students obtain maximum academic, social and cultural benefits within the College community. The College is also prepared to respond to disabled students' needs for personal and career counseling and job placement assistance. For further information contact the Office of Student Life or the College's 504 Coordinator in the Office of the Vice President for Administration.

The Gebbie Speech and Hearing Clinics at Syracuse University provide free remedial assistance to all regularly enrolled students who may have hearing, speech and/or voice disabilities. Syracuse University's Office of Disabilities Services can be reached at 804 University Avenue Room 309, 315-443-4498. There is a Telecommunication Device for the Deaf (TDD) at 315-443-1371.

The College maintains liaison relationships with local and state rehabilitation agencies, including the Office of Vocational and Educational Services for Individuals with Disabilities (VESID). Students should contact the proper agency for specific information about eligibility.

### **Student Housing**

Centennial Hall is an undergraduate student residence facility that is owned and operated by the ESF College Foundation. Opened in fall 2011, the facility is named Centennial Hall in celebration of this milestone in the College's history. Centennial Hall is an environmentally friendly "green" building that houses 452 ESF students in a combination of residence hall-style rooms and student apartments. It is located on the western edge of the ESF campus on Oakland Street, just a short walk down the hill from Baker Laboratory.

The east wing of the four story building houses 280 incoming freshmen, who live in double studio rooms with private baths. The west wing houses 116 upperclassmen in single-bedroom suites with private baths, and houses an additional 56 upperclassmen in 14 four-bedroom/two-bath apartments. Student lounges, laundry facilities, enclosed bicycle storage and other common areas are included. A professional resident director, eight resident advisors, office staff and building security staff assist in the management of the facility.

All ESF students enrolled as full-time freshmen are required to live in Centennial Hall. This requirement may be waived by the Office of Undergraduate Admissions for Syracuse-area residents who wish to live at home and commute to campus.

### **University Police**

ESF's University Police is a law enforcement department consisting of a staff of 15, including 10 uniformed, sworn police officers. The department is responsible for personal safety, criminal investigations, campus access, building security, parking, and enforcement of all New York vehicle and traffic laws on campus roadways 24 hours per day, seven days a week.

The Blue Light Help Phone System is a direct voice link with University Police offices. Blue help lights are located throughout the ESF campus and may be used any time assistance is needed.

University Police offices are located in the basement of Bray Hall, Room 19, and can be reached by calling 315-470-6667.

## **Student Services at Syracuse University**

### **Student Housing**

ESF transfer students and continuing undergraduates may apply for student housing at Syracuse University or in one of the many off-campus neighborhood options. Placement in Syracuse University housing is facilitated through ESF's Office of Undergraduate Admissions for entering transfer students.

Some Syracuse University housing is within walking distance of the SUNY-ESF campus, but the majority is not and students ride free shuttle buses between campus and their residence. Student resident advisors live on each floor or in each unit of residences and are available for counseling, advisement and referral services. Contracts for room and board made with Syracuse University cover a full academic year (both fall and spring semesters) and are not negotiable during that time period.

For more information about costs and availability, contact the Office of Housing, Meal Plan, and I.D. Card Services, 206 Steele Hall, Syracuse University, Syracuse, N.Y. 13244, 315-443-2721.

## Off-Campus Living

[offcampus.syr.edu](http://offcampus.syr.edu)

The Office of Off-Campus and Commuter Services (OCCS) provides students with information on finding suitable housing, exercising their rights and upholding their responsibilities as tenants and as members of the community, and identifying resources that can assist with other off-campus housing questions. In addition, the OCCS provides all students living off campus or commuting to campus from home with support, information, and resource referrals throughout their off-campus housing experience.

There are a number of rental units available in the University area and one place to begin your housing search is Orange Housing. Orange Housing maintains a website of apartment offerings in the neighborhoods adjacent to campus. The Orange Housing website is [www.orangehousing.com](http://www.orangehousing.com). It is important to keep in mind that this local company is not affiliated with Syracuse University or SUNY-ESF and there are absolutely no guarantees about the quality and reliability of the information posted on the website. Orange Housing also offers roommate searches, sublet listings, and information relevant to apartment hunters. Apartment listings can also be found at [apartmentfinder.com](http://apartmentfinder.com) and in local newspapers including the Daily Orange.

OCCS is available for in-person assistance at 754 Ostrom Ave., via phone at 315-443-5489, online at [oocp.syr.edu](http://oocp.syr.edu), and via email at [offcampus.syr.edu](mailto:offcampus.syr.edu).

## Food Services

SUNY-ESF does not operate its own food service program. Therefore SUNY-ESF students will eat within Syracuse University dining facilities. Syracuse University offers several different meal plans to help meet the various needs and interests of individual students. Students living in residence halls without full kitchen facilities are required to purchase a meal plan, while students living in university apartments, co-ops, fraternities and sororities, or off campus, may purchase a meal plan if they so desire.

Though SUNY-ESF does not operate its own program - The Gallery, located in the basement of Marshall Hall, offers snacks and light meals weekdays during the academic year.

## Health and Medical Facilities

Students may consult a physician for medical care or health advice at Syracuse University's Health Services, 111 Waverly Ave., 315-443-2666. Full-time students are entitled to unlimited visits to the out-patient clinic and 10 days of ordinary medical care and confinement in the infirmary per college year. Infirmary stays totaling more than 10 days will be charged at prevailing infirmary rates. There are separate charges for all X-rays, medications and all laboratory tests.

Student accident or health insurance plans not only supplement the usual infirmary privileges, but also can provide health protection during the summer months when students are not under the care of Health Services. Married students with dependents who are not covered by Health Services privileges are strongly urged to purchase health insurance made available to students through SU Health Services, 315-443-2668.

All international students, as well as faculty and students planning to study abroad, are *required* to carry health and accident insurance supplied by the State University of New York. Further details about this policy are available from SU's Office of International Services, 310 Walnut Place, 315-443-2457, or from the ESF Business Office, 102 Bray Hall.

## Co-curricular Activities

Students at the College can choose from co-curricular activities at both ESF and Syracuse University.

### Activities at ESF

Your ESF education will be characterized by stimulating and challenging academics. The experience you gain in the classroom will prepare you technically for your chosen career. However, an equally important element of your college education is how you spend your out-of-class time. The Office of Student Activities offers a variety of programs that promote students' education beyond the classroom. Student Activities oversees all of the student organizations, Orientation, and Convocation/Commencement. There are also other great opportunities to get involved on campus such as the Late Night Programming by Insomniacs, the Student Activities Programming Board, and Free Movie Thursdays.

ESF students have access to more than 300 student groups. These professional, recreational, service and social affiliations can help to facilitate a well-rounded education. On the ESF campus there are nearly 25 organizations and there are more than 300 at Syracuse University. The Undergraduate Student Association (USA) and the Graduate Student Association (GSA) are the official representative bodies on campus governing most student organizations. Both undergraduate and graduate students elect representatives from each academic department to the associations, which manage the affairs and respond to the concerns of their constituents.

USA sponsors a variety of events funded by student activity fees. The annual events include the All-College Welcome Back Picnic held the first week of the fall semester; the Annual Alumni and Family Fall BBQ; the December Soiree, a formal dinner dance; a week-long celebration of Earth Day; and the Spring Banquet, where students, faculty and staff are recognized for their contributions to the college community. The associations also host several graduate and all-campus "TGIFs" each semester.

Several campus organizations offer students opportunities to broaden their knowledge, gain experience and leadership skills, and meet other students with similar interests. Descriptions are on the College Web site at [www.esf.edu/students/activity/clubs.htm](http://www.esf.edu/students/activity/clubs.htm) and additional information can be obtained from the Student Activities Office in 14 Bray Hall.

## Community Service and Service-Learning

Community engagement is woven into the academic experience at ESF through community service and service-learning. Community service opportunities are integrated into first-year student orientation, the first-year experience, student organizations and countless student activities such as the Campus Day of Service.

Through service-learning, a form of structured experiential education in which students engage with the community and explore practical applications for course content, students make the world a better place by contributing to the larger community while gaining invaluable "real world" experience and earning course credit.

ESF has a strong culture of service, and invites our students to actively engage and contribute to the needs of the Syracuse community and beyond.

### **Intercollegiate Athletics**

<http://www.esf.edu/athletics/>

The intercollegiate athletics program at ESF can trace its roots all the way back to 1912, when students organized a Forestry Club on campus that has sponsored an intercollegiate timber sports competition every year since.

Today, students can compete on several ESF intercollegiate athletic teams, including soccer, golf, cross country and timber sports (Woodmen's Team), and at the club level men's basketball, with more to be added in the future. SUNY-ESF is a member of the United States Collegiate Athletic Association. The USCAA promotes quality athletic competition for small colleges and their student athletes. ESF has the opportunity to compete in national championships for soccer, golf and cross country.

The program is built upon a commitment to excellence and the development of high-achieving student athletes. Athletics complements the education you will receive at ESF. It is our goal to have all ESF student athletes realize their full personal, academic and athletic potential.

As all our varsity programs are new as of 2010, incoming student athletes have the opportunity to be pioneers in helping create great teams and traditions. Prospective student athletes should view our athletics webpage and fill out the appropriate athletics recruitment form. ESF students are also eligible to participate in club-level sports offered through Syracuse University (see [www.esf.edu/athletics](http://www.esf.edu/athletics)).

### **Activities at Syracuse University**

Students at the College enjoy the same privileges as Syracuse University students. They may participate in student government or join any of the scores of Syracuse University student groups, which include a wide variety of clubs, the International Student Association, religious and military organizations, and professional and honor societies.

College students may also perform with the Sour Citrus Society "pep" band, Hendricks Chapel Chorus, Black Celestial Chorale Ensemble, SU Marching Band and other performance/arts organizations.

The Archbold and Flanagan gymnasiums are the center of athletics and physical education at Syracuse University and are adjacent to the ESF campus. Additional indoor facilities are available at Manley Field House and the Carrier Dome, which is the site of Syracuse University's home football, basketball and lacrosse games. The Women's Building offers instructional, social and recreational facilities. Facilities on South Campus include a lodge, 22 tennis courts, and a Nautilus exercise room in the Goldstein Student Center. There is also an ice rink at South Campus.

Although students at the College can take part in Syracuse University club and intramural sports, the University does not allow ESF students to participate on its Division I intercollegiate teams due to National Collegiate Athletic Association guidelines.

### **Alumni Association**

The Office of Alumni Affairs serves as a liaison among the College, the Alumni Association Board of Directors, and ESF's more than 18,000 alumni. The association supports educational programs through scholarships, publishes a newsletter and alumni directory, and represents concerns of ESF graduates. The association also hosts numerous events in Syracuse and throughout the United States. Among its many events, the ESF Alumni Association welcomes new students with an ice cream social and a special ESF pin and congratulates graduating students with a champagne toast and class year pin.

### **ROTC Opportunities**

Many students attending the College are eligible to participate in the Army or Air Force Reserve Officer Training Corps (ROTC) programs at Syracuse University.

The ROTC programs consist of both two- and four-year programs. Students attending the College for two years can gain admission to either the Army or Air Force program through participation in summer training. Both four- and six-week camps and on-campus programs are available to suit the individual needs of students. The ROTC programs offer academic instruction, both active and reserve career opportunities, leadership experience and financial aid.

For more information contact Air Force ROTC at 303 Archbold Gymnasium, 315-443-2461, and Army ROTC at 308 Archbold Gymnasium, 315-443-1752.

### **Student Rules and Regulations**

The complete guidelines for academic and social conduct for all students attending the College are found in the ESF Code of Student Conduct and the Student Handbook. These documents are available on the College website at [www.esf.edu/students/handbook](http://www.esf.edu/students/handbook) or in hard copy in 110 Bray Hall. The guidelines pertain to all students, and it is each student's responsibility to be familiar with the regulations and to abide by them.

All students receive copies of informational materials related to prevention of sexual harassment, campus security and crime statistics, and drug-free campus programs.

# The Campuses

SUNY-ESF is a multiple campus institution that includes approximately 1 million square feet of facilities in 186 buildings on 25,000 acres of land. Facilities for education and research are provided on the main campus in Syracuse and at five regional campuses and three field stations.

## The Syracuse Campus

ESF's Syracuse campus lies on 12 acres adjacent to Syracuse University in an area traditionally known as "The Hill." Our principal instructional programs at the bachelor's, master's, and doctoral levels are offered on the Syracuse campus. In addition, the Syracuse campus houses a wide variety of important research organizations. Programs are housed in seven academic buildings: Baker Laboratory, Jahn Laboratory; Walters, Bray, Marshall, and Illick halls; and Moon Library.

## Specialized Facilities

Specialized facilities on the Syracuse campus include electron microscopes; plant growth chambers; seven climate-controlled greenhouses; a bio-acoustical laboratory; radioisotope laboratory; computing labs; and specialized instrumentation including a nuclear magnetic resonance spectrometer with both liquids and solids capability, gas chromatography, mass spectrometer, inductively coupled plasma emission spectrometer, ultracentrifuge, and X-ray and infrared spectrophotometer.

The Department of Paper and Bioprocess Engineering features a semi-commercial paper mill with accessory equipment. The Department of Sustainable Construction Management and Engineering has a strength-of-materials laboratory as well as a pilot-scale plywood laboratory and a machining laboratory. Baker Laboratory includes state-of-the-art equipment for the study of hydrology and hydraulics in the Department of Environmental and Resources Engineering.

Illick Hall's greenhouses and forest insectary are used to produce plant and insect material for instruction. Extensive collections are available for study, including wood samples from all over the world, botanical materials, insects, birds, mammals, and fishes.

## Moon Library

[www.esf.edu/moonlib](http://www.esf.edu/moonlib)

The F. Franklin Moon Library contains more than 138,000 cataloged items and receives approximately 2,400 print and online journals. The collection constitutes a specialized information source for the academic programs of the College. The collection has concentrations in such areas as botany and plant pathology, biochemistry, chemical ecology, forest chemistry, polymer chemistry, economics, entomology, environmental studies, landscape architecture, environmental design, management, paper science, photogrammetry, silviculture, soil science, water resources, world forestry, wildlife biology, wood products engineering, and zoology.

The Syracuse University libraries and the libraries at SUNY Upstate Medical University are within walking distance of ESF. Moon Library shares an online library catalog with Syracuse University, which also provides access to hundreds of Web-based databases (bibliographic and full text).

All Syracuse University library collections may be searched by using an online public access catalog located in Moon Library and through the World Wide Web. All ESF students have full borrowing privileges at the Syracuse University libraries. Other collections located throughout the United States, including those at other SUNY campuses, are readily accessible through interlibrary loan.

The library building opened in 1968 and can seat 400 people. An extensive renovation of the main floor was completed in 2007. The main reading areas are located on the upper level adjacent to the open stacks. The reference, reserve and circulation areas are located in the center of the building. The main level of the library includes computer workstations for the library catalog, databases and Internet searching; printing, scanning, photocopying and fax services; individual study carrels; a conference room; library faculty offices; a writing support center; and tutoring areas, which create a learning commons atmosphere. The archives and special collections, a computer laboratory and library processing areas are located on the lower level.

Services provided by the library faculty and staff include a one-credit course in information literacy for undergraduates (ESF 200) and graduate students (ESF 797), orientation programs, class lectures, user aids and reference desk services.

The library is a wireless environment where students may use their personal laptops for work.

The College Archives, located in Moon Library, contain historical items relevant to the College and to forestry development in New York State. The special collections area of the archives includes rare and valuable books and folios, as well as the Fletcher Steele collection on landscape architecture and a collection on papermaking donated by Thomas Cook, an ESF alumnus.

## Computing at ESF

[www.esf.edu/computing](http://www.esf.edu/computing)

The use of computing technology is essential to the educational experience at ESF. Five public computing labs are maintained by ESF Computing and Network Services (CNS) for general campus use. All labs are open seven days a week during most of the academic year and contain PCs, printers and software commonly in use by ESF academic programs. In addition to these ESF campus computing resources, ESF students can also access public computer labs managed by Syracuse University's Information Technology and Services. Several of these labs are open 24 hours a day, seven days a week.

All ESF students are assigned electronic mail accounts through Syracuse University for their e-mail needs. This e-mail address is used by both ESF and SU for all official electronic communications with students.

Software available to students includes office suite software, graphics and CAD packages, statistical packages, database management/spreadsheet applications, Geographic Information Systems/modeling (GIS) applications, various compilers, and other miscellaneous course-specific software.

Additional computing facilities on the ESF campus are provided by the individual academic programs for specialized uses such as landscape and geographic information systems. The specific descriptions of these resources are located within the department sections of this catalog.

ESF's EvergreenX wireless network is accessible from the main level of Moon Library, Marshall Hall, Baker Labs, Bray Hall rotunda, and the main lobby/classroom areas of Illick Hall and Walters Hall. Syracuse University's wireless network, AirOrangeX, can be accessed from a variety of locations around the SU campus.

ESF students living in ESF's Centennial Hall and in Syracuse University residence halls will find both wired (Ethernet) and wireless (Wi-Fi) connections in all residential facilities.

### **Geographic Information Systems (GIS)**

Geographic information systems provide capabilities for acquiring, storing, managing, manipulating, analyzing, displaying and reporting data or information which has spatial attributes. GIS has power and utility for generating fundamental knowledge about the world and for many practical environmental applications. In recognition of the importance of geospatial modeling and analysis to all programs of study and research at the College, the Council for Geospatial Modeling and Analysis (CGMA) was formed in 1991 to develop coherent programs of instruction, research and public service.

Geospatial instruction and research at ESF builds upon strengths in surveying, remote sensing, modeling, hydrology, environmental engineering, and waste management. It also builds on strengths in environmental applications, including environmental science, natural resources management, planning and design.

The College has extensive research and advanced instruction facilities and these facilities continue to expand. Additional resources exist at Syracuse University, including internationally recognized faculty in the areas of cartographic theory and geographic analysis.

Any program at ESF can include a component of GIS instruction and practice with appropriate coordination. More concentrated study, application, and research using GIS is available through many departments.

Division of Engineering faculty and students are interested in spatial data acquisition, environmental database development, environmental modeling, site selection, and facility design. The study of GIS in engineering may be coordinated with programs in remote sensing and mapping, environmental assessment and engineering, image processing and spatial analysis, and water resources.

Environmental Studies faculty and students are interested in policy issues associated with environmental information and applications within metropolitan environments. The department's academic programs offer students special opportunities to pursue an interdisciplinary program that is tailored to their needs and can include instruction in geospatial applications and research.

Forest and Natural Resources Management uses GIS to focus on forest management and planning, including inventory analysis, harvest planning and multiple use management. Since resources management is essentially spatial in nature, both undergraduate and graduate programs benefit from these technologies.

Landscape Architecture students and faculty are interested in the application of CAD, GIS, and video technologies for landscape analysis, planning and design. These technologies are integrated into required coursework, and advanced bachelor's and master's degree students may pursue additional learning in computer applications.

The Department of Environmental and Forest Biology uses geospatial modeling and analysis to study ecological interactions among and between components of spatially distributed ecosystems. These components consist of both external and internal process functions. The former include such inputs as sunlight, precipitation, temperature, and nutrients, which vary over terrain, lakes, soils, and watersheds. The latter include the energy flows and feedbacks that occur between, for example, various plant communities, and animal or fish species, which vary over the landscape as a function of their environmental gradient requirements.

### **The Regional Campuses**

[www.esf.edu/campuses](http://www.esf.edu/campuses)

Nearly 100 years ago, the College began to assemble a system of properties that would broadly represent New York's rich ecological diversity for scientific study and instruction. Today, students participate in hands-on laboratory activities on approximately 25,000 acres of forest property located on the College's five regional campuses and three field stations. By creating this system of outdoor classrooms and laboratories and making it available for long-term study and instruction SUNY-ESF supports a wide range of scientific disciplines, with current research in forest ecology, wildlife biology, ecophysiology, biogeochemistry, and silviculture. The size, scope, and ecological diversity of the College's regional campuses make it unique among institutions of higher education. When these properties are taken into account, SUNY-ESF offers its students and faculty access to one of the largest college campuses in the world.

## **Cranberry Lake Campus**

Established in 1923, the Cranberry Lake Campus consists of nearly 1,000 acres of forested property in the northwestern Adirondacks, bounded by 150,000 acres of New York forest preserve lands and Cranberry Lake itself.

Situated within the 984-acre Charles Lathrop Pack Experimental Forest, ESF's Cranberry Lake Biological Station (CLBS) is home to a 10-week summer field program in environmental biology. Six to eight courses are offered for advanced undergraduates (juniors and seniors) and graduate students in each of two sessions. Typical courses include ornithology, vertebrate ecology, behavioral ecology, phycology, limnology, vascular plants, byroecology, fish ecology, wildlife techniques, wilderness wildlife management, entomology, plant pathology, mycology, forest ecology, plant biochemical ecology, and wetland ecology. All courses stress field experience and the design and reporting of independent research. There are also opportunities for students to design a full course of independent study for credit in consultation with appropriate faculty. There are biweekly seminars by resident and visiting faculty and other researchers during each session. Use of the campus before and after the summer season varies to include individual research projects, cooperative studies with other agencies, and visits by groups from both the College and other institutions.

Major research programs in various aspects of population biology, behavioral and physiological ecology, chemical ecology, and even field biochemistry are in progress during each field season. Ongoing projects have focused on the ecology and social behavior of birds and mammals, especially the barn swallow; amphibian behavior and life history; tradeoffs between foraging and predator avoidance in stream fishes; solitary and parasitoid wasp behavior; honeybee foraging behavior; the ecology of dispersal and reproduction in bryophytes; distribution and systematics of algae; beaver chemical ecology; loon behavior and ecology; plant chemical defenses and alcohol metabolism; and forest community ecology.

## **Newcomb Campus**

[www.esf.edu/aec](http://www.esf.edu/aec)

Nestled in the heart of the Adirondack Mountains, the Newcomb Campus is the largest of the regional campuses and home to the Adirondack Ecological Center (AEC), SUNY-ESF's nationally recognized research and teaching facility where extensive studies of animal biology and ecology are conducted. This campus contains a wide variety of vegetative types and wildlife. It is the site of a year-round general research and forest management program.

Established in 1932 and comprising nearly 15,000 contiguous acres, the Huntington Wildlife Forest at the AEC is a living laboratory that provides unparalleled opportunities for research about forest and stream ecosystems. Current research at the Huntington Forest includes long-term and short-term studies on biogeochemistry, biodiversity, hydrology and climate, wildlife ecology, silviculture, and the effects of land use changes on forests and streams. The forest's vastness provides a variety of habitats for wildlife and is home to resident or transient populations of moose, grey wolf, bobcat, lynx, black bear, deer, porcupine, fisher, pine martin, snowshoe hare, goshawk, ruffed grouse, and many more species. Associated with the boreal forest biome, the trees include sugar maple, aspen, Eastern white pine, red spruce/balsam fir, paper birch, black spruce, northern white cedar, tamarack, and black cherry, among other species. The forest contains seven small bodies of water totaling more than 1,350 acres and more than 25 miles of streams.

Combining modern cafeteria, housing facilities, and meeting rooms with a remote and spectacular wilderness setting, the AEC provides a retreat-like atmosphere for education programs and meetings. Programs can be conducted any time of year and can span days to weeks. Most research, short courses, and meetings are developed by faculty at ESF but about 30 percent of program activities are conducted by scientists and professionals from other institutions and governmental agencies.

The Newcomb Campus also features the Adirondack Interpretive Center (AIC). The AIC provides an outstanding facility and staff for public programs, events, speakers, courses and other activities offered through ESF's Northern Forest Institute. The AIC serves more than 30,000 visitors annually. Many visitors take advantage of the opportunity to explore the 3.6 miles of interpretive nature trails open to the public at the AIC.

## **Tully Campus**

[www.esf.edu/campuses/heiberg/](http://www.esf.edu/campuses/heiberg/)

The Tully Campus consists of the Heiberg Memorial Forest and the Tully Field Station. Situated on the northern end of the Allegheny Plateau, the Heiberg Memorial Forest includes more than 4,000 acres of diverse terrain and forest growth. Located only 25 miles from the College's main campus in Syracuse, the forest is used intensively for field research, instruction and demonstration sites for all curricula on a year-round basis. Classroom facilities are available for scheduled course work, seminars and meetings. The property is most heavily used by students in field laboratory courses during the academic year, while research is conducted at all times of the year.

Originally one of the first of New York's state forests, the former "Tully Forest" was transferred to the College in 1948 "in order to have near Syracuse a sizable forest property on which the College could instruct students, carry on research, and provide a practical demonstration in wise use of forest land." The property was renamed the Svend O. Heiberg Memorial Forest in 1965 in honor of the late ESF Professor Svend O. Heiberg, a pioneer in American forestry research.

## **Wanakena Campus**

[www.esf.edu/rangerschool](http://www.esf.edu/rangerschool)

The Wanakena Campus is situated on the western plateau of the "Lakes Region" of the Adirondacks. Located on the Oswegatchie River about 65 miles northeast of Watertown and 35 miles west of Tupper Lake, it includes the James F. Dubuar Forest and the SUNY-ESF Ranger School.



Since 1912, the campus and its 2,811-acre James F. Dubuar Memorial Forest have supported the College's associate in applied science degree programs in forest technology, land surveying technology and environmental and natural resources conservation. The forest technology program is the oldest program of its kind in the country.

The Dubuar Forest was named in memory of James F. Dubuar, who served as director of the Ranger School for 37 years. By providing an outdoor laboratory and demonstration area for observation, measurement and practice of the concepts studied in the classroom, the forest plays an integral role in the students' learning experience.

The campus is also home to the College's Summer Session in Field Forestry, a seven-week session devoted to introductory instruction in field forestry principles and techniques. Attendance at this session is required for all students entering forest resources management and forest ecosystem science.

### **Warrensburg Campus**

The Warrensburg Campus, in the southeastern Adirondacks, consists of the Charles Lathrop Pack Demonstration Forest, an area of some 2,600 acres of heavily forested land noted for its eastern white pine stands, acid rain research, and some of the oldest experiments in forest fertilization in North America. The forest has been under intensive management since 1927 for the combined purposes of instruction, research and demonstration in forestry and allied fields.

For more than 80 years, Pack Forest has provided ESF students, faculty and scientists a forested classroom for their research and instruction. For many years, forest management undergraduates at the College spent a summer between their sophomore and junior years in residency at Pack Forest. Here they received field training and invaluable technical skills. Although this program has since moved to the Dubuar Forest, graduate students, faculty members, visiting scientists, and continuing education classes continue to use Pack Forest a day or more at a time.

Pack Forest also hosts the New York state Department of Environmental Conservation's Environmental Education Camp, offering teens who are 15 to 17 years old a chance to explore forestry, aquatic biology, wildlife management, field ecology and other environmental issues. It is also the home of the Greater Adirondack Resource Conservation and Development Council. The property includes an 85-acre lake and several miles of trails, including the Grandmother's Tree Nature Trail, one of the few nature trails in the Adirondacks that is accessible to people using wheelchairs. It traverses a 50-acre natural area that introduces visitors to the ecology of an Adirondack old-growth hemlock-white pine forest and one of New York's historic trees.

The property is open to the public and is used by thousands of visitors for day-use recreation.

### **Field Stations**

ESF operates several field stations, which directly support the instruction, research and public service programs of the institution.

The 44-acre **Lafayette Road Experiment Station** in Syracuse is located about three miles from the main campus and is used to support main campus academic and research programs. The station includes a tree nursery, four arboreta, two greenhouses and a research laboratory.

The **Genetic Field Station** in Tully has 66 acres devoted to both short- and long-term out-plantings in support of various research projects. An irrigation system and layout of level planting sites makes it an excellent facility for developing hybrids, grafting, conducting short-term experiments, and for heritability research. Both the Experiment Station and the Field Station are used extensively for public recreation such as hiking and cross-country skiing.

The College also owns an island, featuring the **Ellis International Laboratory**, in the heart of the Thousand Islands/St. Lawrence River area off the village of Clayton. Accessible only by boat, Governor's Island is home to ESF's **Thousand Islands Biological Station** and international environmental monitoring and research activities conducted in the St. Lawrence Seaway area. Additional information is provided at: [www.esf.edu/tibs/](http://www.esf.edu/tibs/)

The College has recently established a new field station for tropical studies in the Central American nation of **Costa Rica**. The 30-acre site near the Pacific coast contains a mix of dry tropical forest and pastureland, along with a wealth of vegetation and animal life. It is located on property that once operated as a farm and was donated to the College in 2007 by Arthur Sundt, a 1959 graduate of ESF, now deceased, and his wife, Mary. Additional information is provided at: [www.esf.edu/costarica/](http://www.esf.edu/costarica/)

# College Research

[www.esf.edu/research](http://www.esf.edu/research)

Research at the College of Environmental Science and Forestry is remarkably diverse, current and challenging. Contributions are being made in fields that include aquatic ecosystems, bioenergy, biotechnology, biodiversity, ecology, genetic engineering, nanotechnology, remote sensing, wildlife disease prevention, and many others. ESF is a leader in integrating the energy and excitement of research with the formal requirements of degree and certificate programs. A strong faculty, exceptional field and laboratory facilities, and a positive atmosphere encouraging research combine to make almost limitless opportunities to initiate and continue research careers. A high percentage of undergraduates and virtually all graduate students participate in research activities as part of their educational experience.

Approximately 95 percent of our faculty is engaged in more than 400 studies that attract support from federal, state, international and non-governmental sources. These include the National Science Foundation, U.S. Environmental Protection Agency, U.S. Department of Energy, U.S. Fish and Wildlife Service, U.S. Department of Agriculture and the N.Y. state Department of Environmental Conservation, and many others. In 2010-11, approximately \$13.4 million was spent on externally funded research endeavors, providing not only new results, but also unique educational and experiential opportunities. Research projects engage students of all levels, post-doctoral associates, ESF faculty and external collaborators. These projects extend from sub-molecular to global levels, and many include important innovations and new processes: More than 33 patents have been issued to ESF faculty and their students since 1983.

Our work is often carried out in [distant places](#), including Antarctica, New Zealand, Russia, Africa, Turkey, and South America, and most projects have application far beyond the borders of New York or the United States. Mentoring programs are expanding to enhance the opportunities of new and experienced faculty, staff and students, both in research practice and in identification of the financial underpinnings of research programs. The coming decade is a particularly important time in the College's research experience, as new programs and facilities in biotechnology, bioenergy, natural and environmental sciences are being planned and/or completed.

## Specialized Research Units

### Adirondack Ecological Center

[www.esf.edu/aec](http://www.esf.edu/aec)

The Adirondack Ecological Center (AEC) is the leader in ecological sciences in the Adirondack Mountains of northern New York and a major contributor to science internationally. Established in 1971, the AEC provides the science that underpins the management of the Adirondack Park as one of the world's foremost experiments in conservation and sustainability. It attracts scientists from throughout the world, providing a base of operation for research that seeks to understand the natural ecosystems of the northern forest. Together with top educators, it helps the people of New York preserve and enhance the quality of a wilderness environment while at the same time fostering a vibrant economy. The AEC is located on ESF's Huntington Wildlife Forest, (a 15,000-acre property) in the geographic center of the six-million-acre Adirondack Park wilderness. The Huntington is also host to the Adirondack Interpretive Center.

Sixty-five years of research have been incorporated into more than 30 ongoing monitoring efforts. The Adirondack Long-term Ecological Monitoring Program (ALTEMP) monitors more than 100 physical, chemical, and biological attributes to provide the long-term perspective necessary to detect changes and identify trends in the Adirondack ecosystem. The AEC is the site of more than 70 independently funded research programs. These programs represent a broad spectrum of research, from basic to applied, encompassing themes such as the social organization of deer, movement of soil ions, shelterwood silvicultural regimes, and assessing biodiversity across the Adirondack Park. Approximately 150 graduate degrees stem from studies conducted at this site.

Combining modern cafeteria, housing facilities, and meeting rooms with a remote and spectacular wilderness setting, the AEC provides a retreat-like atmosphere for education programs and meetings. Programs can be conducted any time of year and can span days to weeks. Most research, short courses, and meetings are developed by faculty at ESF, but about 30 percent of program activities are conducted by scientists and professionals from other institutions and governmental agencies.

### American Chestnut Research and Restoration Center

[www.esf.edu/chestnut](http://www.esf.edu/chestnut)

The mission of the American Chestnut Research and Restoration Center is to conduct basic and applied research leading to the development of a blight-resistant American chestnut tree and to reintroduce a population of these resistant trees back into forest ecosystems of New York and then the rest of the eastern United States. The project has evolved from basic research into identification of pathogen-resistance genes and chestnut tissue culture development to include field test plantings of tissue culture-derived chestnuts, public participation through identification of rare remnant surviving chestnut trees, collection and exchange of viable nuts and establishment of large restoration plantations throughout New York State. A milestone was achieved in the spring of 2006 when the first four transgenic American chestnut trees were established in the field. These trees were eventually to be inoculated to determine their level of resistance to chestnut blight.

Ongoing activities include basic research on various single and pyramided-resistance gene designs, gene transfer into American chestnut trees, greenhouse and field testing of putative-resistant trees, evaluation of environmental impacts of transgenic vs. non-transgenic trees, collection of rare chestnut germplasm, and establishment of germplasm archives throughout New York.

The concepts, techniques, and gene cassettes being developed for American chestnut will also have broad applicability in managing diseases affecting the productivity of other important tree species, such as Dutch-elm disease (which devastated another American heritage tree, the American elm) and Septoria leaf spot and canker disease of hybrid poplar (which is becoming a key biomass tree species).

### Analytical and Technical Services

[www.esf.edu/ats](http://www.esf.edu/ats)

Analytical and Technical Services (A&TS) was established at the College of Environmental Science and Forestry in the early 1970s. Its mission is to provide specialized, customer-focused, value-added support services contributing to the ESF missions of instruction, research and public

service in the following areas: instrumental analytical methods, scientific equipment and instrument repair/design/fabrication, computer repair/upgrading, and chemical/laboratory apparatus stockroom services. They also maintain the flexibility to develop new services in response to evolving campus needs.

The A&TS team is a technologically diverse collection of skilled professionals who provide an array of centralized analytical and support services for the benefit of ESF and its research partners. Provided services include nuclear magnetic resonance (NMR) spectro-metry, gas chromatography/mass spectrometry (GS/MS), liquid chromatography/mass spectrometry (LC/MS), microcomputer repair, instrument and equipment repair and fabrication, inductively coupled plasma-optical emission spectrometry (ICP-OES), chemical and laboratory apparatus stockroom; micromechanical repair and experimental apparatus fabrication, Syracuse University Scientific Glassblowing, and polymer rheology and mechanical properties.

In addition to serving its ESF customer base, the strategic objectives of A&TS also include an "entrepreneurial" mission to enhance interaction with external customers including regional academic institutions (SU, UMU, SUNY campuses at Oswego, Cortland, and Binghamton, Cornell, Hamilton, MIT, Clarkson), governmental agencies and local industries (Bristol-Myers Squibb, Albany Molecular). In this fashion, A&TS positively contributes to the economic development of the CNY region.

## **Cellulose Research Institute**

[www.esf.edu/cellulose](http://www.esf.edu/cellulose)

The Cellulose Research Institute's (CRI) mission is to stimulate development and dissemination of new fundamental knowledge about cellulose and related biopolymers, leading to their increased utilization.

The CRI was founded in 1957 in response to an initiative of the cellulose-utilizing chemical industries. CRI members have played major roles in areas such as the physical chemistry of polymers, lignin and wood chemistry, hemicellulose composition and determining the distribution in plant cell walls, and the molecular and supra-molecular structure of cellulose and related polymers. Several members have received the American Chemical Society's Anselme Payen Award for outstanding cellulose chemistry research.

Located in the state-of-the-art Edwin C. Jahn Laboratory, the CRI facilities, which include 600 MHz solid state NMR and laboratories for polymer molecular-weight characterization, thermal analysis and molecular modeling, offer researchers and collaborators an outstanding facility for long-range academic/industrial research and development.

Some areas of current interest include non-destructive methods of characterizing cellulosic process streams, preparation of cellulose nanocrystals for use in reinforced polymers, bioconversion of hemicellulose and cellulose into commercially useful biopolymers, and development of novel, environmentally benign cross-linking agents for cellulose. The application of structural chemistry and modeling to understanding fundamental changes in cellulose such as mercerization continues as a CRI focus. Another activity is the offering of a distance-learning course in carbohydrate and polysaccharide chemistry (FCH 540) through the SUNY Learning Network and the development of short courses in aspects of cellulose chemistry.

## **Center for Cultural Landscape Preservation**

[www.esf.edu/cclp](http://www.esf.edu/cclp)

The Center for Cultural Landscape Preservation is a resource within the SUNY-ESF Department of Landscape Architecture that supports the education of landscape architects as best stewards of the cultural environment.

The Center works in partnership with the National Park Service's Olmsted Center for Landscape Preservation and several other public and private organizations to advance expertise in preservation of our nation's landscape heritage.

## **Center for Native Peoples and the Environment**

[www.esf.edu/nativepeoples](http://www.esf.edu/nativepeoples)

Our region is the home of two great intellectual traditions regarding stewardship of the earth: traditional ecological knowledge of indigenous people and scientific ecological knowledge. The mission of the SUNY-ESF Center for Native Peoples and the Environment is to create programs that draw on the wisdom of both indigenous and scientific knowledge in support of our shared goals of environmental sustainability.

In addition to serving as a bridge between traditional ecological knowledge and western scientific approaches, the Center will incorporate indigenous perspectives and knowledge for the benefit of native students and work to educate mainstream students in a cross-cultural context.

The Center will include a significant outreach element focused on increasing educational opportunities for Native American students in environmental sciences, research collaborations, and partnerships with Native American communities to address local environmental problems.

## **Center for Community Design Research**

[www.esf.edu/CCDR](http://www.esf.edu/CCDR)

The Center for Community Design Research (CCDR) is an outreach program within SUNY-ESF's Department of Landscape Architecture. Working in partnership with communities, elected officials, agencies, not-for-profit organizations, and other academic programs, the CCDR provides technical assistance, educational programs and research projects that build community capacity to manage sustainable futures.

The CCDR activities provide educational and research opportunities for community residents, students, faculty, and staff, and promote the design and planning professions through community education, modeling new ways of working, and disseminating research findings.

The mission of the CCDR is to:

- Help communities address difficult environmental and social conditions through community-based physical design and planning;
- Develop civic capacity to manage sustainable communities;
- Increase community access to resources and information;

- Identify and investigate critical issues facing communities and offer solutions;
- Foster design literacy and develop public appreciation for the value of design and planning.

The Center works with state, regional, and national organizations and agencies to develop and deliver educational programs and materials. Programs introduce local leaders and community residents to the planning and design process to tackle regionally specific issues and opportunities through hands-on workshop projects. Workshops, training manuals and publications present planning and design issues and concepts in a visual, non-technical manner. Educational objectives may vary for specific programs; however, they generally address design literacy, leadership development, communication strategies and organizational capacity.

### **Center for the Urban Environment**

[www.esf.edu/cue/](http://www.esf.edu/cue/)

This Center integrates and highlights ecological issues in urban settings. The same principles of systems ecology apply in urban environments as in natural ones, but renewed interest exists in the United States and globally to integrate our understanding of ecological processes as influenced by humans in populated areas.

The Center is dedicated to:

- Investigating and developing novel ways to mitigate urban environmental problems;
- Educating and training the next generation of urban environmental scientists, engineers, and planners;
- Engaging urban residents in the study and improvement of the urban environment; and
- Working with communities, business, industries, and governmental and non-governmental organizations throughout New York State to achieve a more sustainable future.

### **Central New York Biotechnology Research Center**

[www.upstate.edu/biocenter](http://www.upstate.edu/biocenter)

The biotechnology industry has doubled in the past decade and is widely considered the nation's most promising vehicle for economic growth. Central New York is rich in intellectual capital, ripe for economic revitalization, and proven ground for biotechnology ventures. Central New York is currently home to nearly 3,000 jobs in the biotechnology sector and is poised to expand its reach in this promising arena.

To commercialize their extensive research findings, two cornerstones of CNY's research community, SUNY Upstate Medical University (UMU) and SUNY-ESF, have partnered with the Metropolitan Development Association of Syracuse and Central New York and the Syracuse Veterans Administration Medical Center to create the CNY Biotechnology Research Center (CNY-BRC).

These entrepreneurial SUNY institutions, with a combined force of 300 research investigators, are cultivating private partnerships to nurture biotechnical discoveries with strong commercial potential. SUNY-ESF, with research excellence in natural sciences, and SUNY Upstate Medical University, with research excellence in medicines, share strong commonalities in the biotechnology realm. Both institutions utilize many of the same molecular biology procedures and biotechnology equipment.

With the creation of the CNY-BRC, SUNY Upstate and SUNY-ESF will have access to the high-caliber technology necessary to commercialize biotechnical products and services. A key component of the center will be its world-class core facilities for DNA, proteomic, bioinformatic and tissue-engineering technologies, processes that capitalize on new genomic discoveries and fuel the explosion of the biotechnology industry.

The CNY-BRC, to be built in Syracuse, will include laboratories, greenhouses and business incubation facilities, plus customized classrooms for training the workforce required by this complex industry. Strong economic viability is an essential factor for project incubation in the CNY-BRC. Biotechnology products and services to be selected for research and development must have demonstrated market potential. Also critical is compatibility with the research strengths of SUNY Upstate and SUNY-ESF.

Corporate partnership, a key indicator of market viability, is also influential. This confluence of opportunity, expertise and corporate investment dramatically enhances the CNY-BRC's potential for generating jobs and biotechnical ventures.

### **Council on Biotechnology in Forestry**

[www.esf.edu/biotech](http://www.esf.edu/biotech)

Forest biotechnology is a growing field of study that has many potential benefits for humankind and our environment. In addition to the traditional uses of wood products, cellulose from trees is being used as a feedstock to the chemical and pharmaceutical industries, currently supplementing, but in the future possibly replacing fossil fuels. Biomass from trees will be increasingly utilized as a renewable energy source, as well as a carbon sink to help control global warming. Because many species of forest trees have extensive and perennial root systems, and transpire large amounts of water, they are excellent for use in phytoremediation (i.e. the cleanup of polluted soils). Lastly, trees are keystone species in many environments and are necessary for the maintenance of healthy forests and for restoration of damaged ecosystems. Research into their biology and into ways to use and enhance the unique qualities of tree species is essential to our future.

The mission of the council is to:

- perform cutting edge research that will enhance our understanding of forest tree biology and lead to improved productivity and biodiversity of our forested ecosystems;
- educate and train researchers at the undergraduate, graduate, and postdoctoral levels in the application of molecular biology, biochemistry, and genetic engineering techniques to the study of forest tree species and other organisms relevant to forest productivity, conservation, and ecology;
- enhance collaboration and communication among SUNY-ESF faculty, staff, and students engaged in forest biotechnology research, other academic and agency researchers, and stakeholders;

- promote the programs in forest biotechnology at SUNY-ESF across New York State, the nation, and internationally.

### **Council for Geospatial Modeling and Analysis**

[www.esf.edu/cgma](http://www.esf.edu/cgma)

Instruction in geospatial modeling and analysis (GMA) seeks to produce informed, qualified, and professional scientists, managers, decision makers, problem solvers, and designers. A diverse collection of courses and experience provides flexible approaches to learning that ranges from broad knowledge to detailed expertise.

GMA uses an interdisciplinary, problem-solving approach that includes elements of mapping sciences, geography, mathematics, information management, and system analysis. Combined with ESF's world-renowned environmental expertise, GMA generates fundamental knowledge about the world and contributes to more comprehensive management of natural and cultural resources.

GMA research at ESF is developing new ways to collect and use geospatial data. Some of the benefits of using spatial information are the ability to visualize spatial relations, study temporal changes, freeze action in dynamic processes, study global, regional and local processes, and model problems in easily understandable ways. These benefits lead to better understanding and more effective management or decisions. The most common method for exploiting geospatial data uses a geographic information system (GIS). A GIS is an automated computer hardware and software system for collecting, storing, retrieving, manipulating, managing, analyzing, and displaying spatial data. GIS is a tool that has broad relevance to environmental science, management, and monitoring at many scales of analysis. The term geospatial modeling and analysis seeks to recognize this broader context and the integrating nature of spatial approaches.

Collecting, processing, and displaying spatial data has a long tradition at ESF through fieldwork, photointerpretation, photogrammetry, and remote sensing. Powered by an explosion of relatively easy-to-use geographic information systems, integration of spatial data is increasingly efficient and effective. With GIS and other technologies, more complex analysis can occur, increasing the applicability and accessibility of GMA. As a result, GMA is integrated into the Departments of Environmental Resources Engineering, Environmental and Forest Biology, Environmental Studies, Forest and Natural Resources Management, and Landscape Architecture.

### **Council on Hydrologic Systems Science**

[www.esf.edu/hss](http://www.esf.edu/hss)

The Council on Hydrologic Systems Science conducts research and provides outreach on knowledge essential to the wise ecosystem use and sustained yield of appropriate quality water. The special focus of the Council is biogeohydrologic processes in natural forested systems, including relationships to water supply and waste-water treatment systems. This organized unit also deals with water dependent products of sustainable value in integrated water resource systems.

Having a strong interdisciplinary nature, this Council consists of faculty members from SUNY-ESF and Syracuse University from the following academic units: Chemistry and Environmental Chemistry (ESF), Environmental and Forest Biology (ESF), Environmental Resources Engineering (ESF), Forest and Natural Resources Management (ESF), Civil and Environmental Engineering (SU), and Earth Sciences (SU). Through the Council, faculty members provide workshops, conferences, publications, consultation, and advising to municipalities, state and federal agencies, corporations, regional watershed advisory groups, technical committees, and professional organizations.

The Council and its members are committed to the development of programs related to water and watershed resources. The presence of the vast diversity of watersheds and instrumentation within the region provides a unique opportunity to understand and quantify the degradation and restoration of watershed resources and services.

ESF offers a variety of degree programs related to watershed resources and is continuously moving forward by adding new faculty and courses to watershed resources-related programs. SU provides additional resources, particularly in the areas of civil and environmental engineering, earth science and the Maxwell School of Citizenship. ESF and its partner institutions have the capacity to further develop world-class faculty who can offer interdisciplinary opportunities in the area of watershed resources.

### **Council on McIntire-Stennis Forestry Research**

The council coordinates SUNY-ESF's research through the federal USDA McIntire-Stennis Cooperative Forestry Research Program, which provides knowledge essential to the efficient and effective use of the nation's forest resources. Timber production, forest land management, wood utilization, and the associated development of new products and distribution systems are the key elements of forestry research. This research deals with other products of the forest, including wildlife, recreation, water, range and environmental quality, whose production, management and distribution are an inextricable part of the long-term productivity and profitability of the integrated system of forest resources.

In addition, McIntire-Stennis research has the objective of helping to create and maintain a highly qualified cadre of forest scientists through their direct involvement in the research projects as part of their graduate education. These young men and women, educated in the sciences fundamental to forestry, will ultimately help to maintain the security and well-being of this country through service in private industry, in various levels of government, and in academic institutions as managers and scientists.

### **Empire State Paper Research Institute**

[www.esf.edu/pbe/espri.htm](http://www.esf.edu/pbe/espri.htm)

The Empire State Paper Research Institute (ESPRI) is a leading international research organization in the pulp and paper industry. Established at ESF in 1960, this renowned organization is supported jointly by SUNY-ESF and the Empire State Paper Research Associates, a consortium of leading pulp and paper companies throughout the world.

A model of industry and academic synergy, ESPRI investigates fundamental aspects of pulping, papermaking, and paper physics, including chlorine-free bleaching, properties of papermaking materials, paper structural characteristics, and printability.

The Empire State Paper Research Associates Inc. is a non-profit corporation created to foster fundamental, precompetitive research for the benefit of its member companies and other constituents. The association provides funding for ESPRI and helps steer research projects and

communications between the faculty, staff and students of ESPRI and ESPRA members. It is one of the very few associations with international membership and scope fostered toward application of academic research in the forest products industry.

ESPRAs partners with SUNY-ESF to jointly fund the research activities of ESPRI within the Department of Paper and Bioprocess Engineering (PBE). ESPRI is located in Walters Hall, the home of the PBE faculty on the SUNY-ESF campus. This building houses a modern pilot plant including two paper machines (PM1 & PM2 48" and 12" trim widths), pressurized 12" disk refiner, batch digesters, well-equipped pulping, bleaching, papermaking and paper testing laboratories. An environmental engineering laboratory and a complete deinking pilot facility are also available.

ESPRI has a worldwide reputation for leading advances in pulping chemistry and lignins, bleaching including non-chlorine based bleach processes, water drainage and fines retention, physics of paper consolidation, moisture effects and diffusion, physics of paper materials, fiber mechanics, paper formation and surface properties. Recently, ESPRI has pioneered the concept of the biorefinery and development of new forest-based materials to provide value prior to pulping of wood.

### **Office of Environment and Society: Partnerships in Interdisciplinary Research and Teaching (EnSPIRE)**

<http://enspire.syr.edu/>

EnSPIRE began as part of the Academic Plan announced in 2001 by Syracuse University. Recognizing the extraordinary breadth and depth of environmental scholarship on the Syracuse University and SUNY-ESF campuses, a vision was outlined for gaining national prominence for the two institutions through collaborative research. A committee of faculty and administrators from Syracuse University and SUNY-ESF met for two years to discuss ways to realize that vision. The Office of Environment and Society opened in July 2003 to implement the committee's recommendations.

Tasks to accomplish included:

- developing a directory of faculty at both institutions with scholarly interests in environmental issues and putting people with related interests in touch with one another;
- supporting (with seed grants, workshop grants, brain-storming and technical support) groups of faculty that wish to develop external grant proposals for interdisciplinary research;
- promoting the visibility of environmental studies on the two campuses, through lectures and other events.

The EnSPIRE committee identified fresh-water resources as an example of an important area of strength at the two campuses and a good candidate for pursuing collaborative grants. There are many other areas of strength at the two institutions, and faculty are encouraged to think broadly about interdisciplinary environmental research. Topics might include climate change, built environments, biodiversity, urban sprawl, environmental justice, tropical studies, biophysical economics, etc. In addition to scientists, engineers, and public policy specialists, we hope that humanists, social scientists, and design professionals will consider participating in collaborative research and teaching on the environment.

### **Great Lakes Research Consortium**

[www.esf.edu/glrc](http://www.esf.edu/glrc)

The Great Lakes Research Consortium is an organization of [18 colleges and universities](#) in New York, with [nine affiliate campuses](#) in Ontario, dedicated to collaborative research and education on the Great Lakes. We have nearly 400 member faculty, who are conducting research in every facet of Great Lakes science.

Our mission is to improve the understanding of the Great Lakes ecosystem, including the physical, biological, and chemical processes that shape it, as well as the social and political forces that affect human impact on the lakes and their associated economic resources. We accomplish this through research, instruction, and public service.

The Consortium's goals are to facilitate research and scholarship involving Great Lakes issues, the education of students on topics related to the Great Lakes ecosystem and the dissemination of information gathered through consortium-sponsored research and seminars. The GLRC administers cooperative grants programs, sponsors scholarly workshops and research task forces, coordinates fall and spring seminar series, maintains a database of New York Great Lakes scientific and scholarly work, and publishes a biannual newsletter, a research review and a bimonthly e-mail newsletter.

A student-faculty conference is held each year, providing a forum for students to display their research and affording the opportunity for scientists and scholars to come together to share their ideas and form new collaborations.

### **Joachim Center for Forest Industry, Economy and Environment**

[www.esf.edu/joachim/](http://www.esf.edu/joachim/)

The Joachim Center focuses on improving the understanding and resolution of environmental problems facing the pulp and paper and related forest industries. The ultimate objective is maintaining a high-quality natural environment and a profitable, vigorous, and competitive industry. The goals of the Center are achieved through four program areas:

- Objective intellectual inquiry into the key challenge: contributing to a strong economy by harvesting, processing, and manufacturing timber, a renewable natural resource, into industrial and consumer products and the maintenance of a high-quality living environment.
- Development and promotion of a research agenda that focuses on finding effective solutions to the most critical environmental issues facing the forest-based industries.
- Advancement of a better understanding by industry of the environmental issues facing the forest products industry, government, environmental organizations, and the public, with the objective of finding beneficial solutions.

- Support for resident instruction, research, and public service at ESF to address the complex management and policy issues that have an impact on profits, employment, economic growth, and the natural environment.

### **Institute for Sustainable Materials and Manufacturing**

The Institute for Sustainable Materials and Manufacturing (ISMM) was formally begun in 2011 and recognized with a major grant from the New York State Energy Research and Development Authority. The Institute will study, develop and transfer the latest technologies in sustainable materials and manufacturing. Initially, the ISMM will include two focal areas: (1) ultra-violet light, electron beam, and x-ray technologies in sustainable product development and manufacturing; and (2) development of sustainable coatings, adhesives and composites. These complementary areas will be under the ISMM and its advisory board. The goals of the ISMM and its focal areas are to facilitate and support: (1) research and development; (2) education at the national, regional and graduate and undergraduate levels through formal classes, outreach, training sessions and webinars; and (3) a pilot-plant approach that will allow end-users and manufacturers to confidentially test new formulations and equipment.

### **Michael M. Szwarc Polymer Research Institute**

[www.esf.edu/polymer](http://www.esf.edu/polymer)

The Michael M. Szwarc Polymer Research Institute is a consortium of associate members drawn from several organizations and institutions. It was established to promote the advancement of polymer science through education and research, coordinate diversified activities of polymer scientists and engineers in the Central New York area, and develop strong cooperative programs with polymer-based industries nationwide. Among its activities are sponsorship of new educational and research ventures, encouragement of individual and cooperative research programs, participation in academic programs leading to the B.S., M.S. and Ph.D. degrees, and promotion of continuing education and new developmental opportunities for scientists. The Institute will engage in all other activities necessary to maintain itself as a center of excellence in polymer science and engineering.

Polymers are the building blocks of living systems and the early research on cellulose chemistry sparked a substantial growth in research toward synthetic polymers. This, in turn, resulted in the development of many polymeric materials and also stimulated research into the structure and properties of more complex biological macromolecules such as proteins, enzymes, and DNA. The direct outcome of the State University of New York initiative to provide a program in polymer research and education is that many graduates of this program now have leading faculty positions in academic institutions in the United States and abroad or hold important managerial positions in polymer-related industries.

The ever-expanding application of polymer products in recent years means about 70 percent of all chemistry and chemical engineering graduates will be engaged in polymer research and development during their careers.

The Polymer Research Institute comprises faculty members from SUNY-ESF, SUNY Albany, and Syracuse University, as well as members from industry. Members of the Department of Chemistry at SUNY-ESF administer the institute, where an intensive curriculum of polymer science for undergraduate, as well as graduate students (M.S., Ph.D.) is provided. All the students in the polymer program participate actively in the research projects that are interwoven with the academic programs.

### **N.C. Brown Center for Ultrastructure Studies**

[www.esf.edu/scme/ncb.htm](http://www.esf.edu/scme/ncb.htm)

The N.C. Brown Center for Ultrastructure Studies, located in Walters Hall, is a central microscopy facility that provides teaching, research, and public service. It is equipped to provide students, faculty, and research staff with access to modern microscopy techniques. These techniques include light microscopy, scanning electron microscopy, transmission electron microscopy, video microscopy, digital imaging, and image analysis.

Among the major items of equipment in the center are a JEOL 2000EX 200 KV transmission electron microscope; a JEOL 5800 low-vacuum scanning electron microscope equipped with an EDAX energy dispersive x-ray analyzer; and an array of specialized light microscopes to include: Nomarski DIC, video-enhanced contrast, fluorescence, and a high-resolution digital camera. Ancillary equipment includes high-vacuum evaporators, microtomes, ultramicrotomes, and critical-point driers. The center's resources include specimen preparation rooms, photographic darkrooms, and an image analysis facility.

The primary mission of the center is teaching. Its course offerings include microscopy and image analysis, scanning electron microscopy, transmission electron microscopy, and microtechnique. Research is the second major function and the center provides support to students, research staff, and faculty who are conducting structural studies. Public service is extended to industry and regional colleges, as well as to local high school groups and technology-oriented organizations.

### **Randolph G. Pack Environmental Institute**

[www.esf.edu/es/pack.htm](http://www.esf.edu/es/pack.htm)

The purpose of the Randolph G. Pack Environmental Institute is to enhance our ability to create and disseminate knowledge about environmental concerns of high public interest. Reflecting and enlarging our graduate program themes, we particularly seek to advance the state of knowledge about environmental policy and regulation. We focus on how democratic public decisions affecting the natural environment are made, concentrating on topics such as public participation, environmental equity, and sustainable development. The Institute promotes these interests through research and service activity in community, state, national, and international venues.

The institute is located in the [Department of Environmental Studies at ESF](#).

### **Renewable Materials Institute**

The mission of the Renewable Materials Institute is to develop and promote the use of renewable materials, their associated technologies and process engineering. Core studies are on wood and wood-based materials conducted for a variety of sponsors on specific problems. Incorporated under the institute are the Salix Consortium and the Tropical Timber Information Center.

## Roosevelt Wild Life Station

[www.esf.edu/rwls/](http://www.esf.edu/rwls/)

The Roosevelt Wild Life Station is a partnership of scientists, educators, and public and private sector leaders dedicated to protecting New York's biological heritage and enhancing New York's future through science-based conservation of natural resources. The mission is to help build long-term economic vitality on environmental quality. Activities focus on predicting the impacts of regional and global economic forces on New York's natural resources, communicating this information to the public, and facilitating public policy based on intelligent conservation of those resources.

- **Research:** The goal is to provide new scientific knowledge to find creative solutions to the challenges of developing economic opportunity that is built on a base of environmental quality.
- **Education/Outreach:** The goal is to convey what we learn to the public and foster an understanding and appreciation for conservation issues through short courses and conferences, professional outreach publications, nature interpretation classes for science teachers, and web-accessible conservation information.
- **Policy:** The goal is to equip policy makers with science-based tools to make management decisions that will foster economic development while enhancing environmental quality.

The Roosevelt Wild Life Station plays a key role in developing a class of broadly trained conservation professionals. It provides fellowships to graduate students to permit them to engage in cutting-edge research on biodiversity issues under the mentorship of an ESF faculty member, and it provides summer internships to undergraduate students to allow them to participate in conservation research under the guidance of a graduate student or faculty member.

President Theodore Roosevelt was an environmental visionary whose name the Roosevelt Wild Life Station honors and whose legacy of natural resource conservation it works to perpetuate.

## Salix Consortium

[www.esf.edu/willow](http://www.esf.edu/willow)

The New York-based Salix Consortium project is a multipartner endeavor to facilitate the commercialization of willow biomass crops as a locally grown, renewable, lignocellulosic, woody feedstock for bioenergy, biofuels and bioproducts in the Northeast and Midwest regions of the United States. In the 1990s, a series of research, large-scale demonstration, and outreach and education efforts were initiated to facilitate the commercialization of willow biomass crops. This included formation of the Salix Consortium. Willows are well-suited for biomass cropping systems because they are easily propagated from cuttings, grow rapidly, coppice vigorously, currently have few pest problems, produce a uniform feedstock and have large potential for genetic improvement over a short time. The ongoing research and large-scale demonstration of willow biomass crops, supported by the USDoE, USDA and NYSEEDA; developments in the extraction and use of xylan from willow biomass; and the active participation of Consortium partners are creating new opportunities to commercialize the system. A vibrant willow biomass commercial enterprise will bolster the region's farm and forestry sectors, increase energy independence, strengthen the protection of the environment, and mitigate waste and pollution problems.

## SUNY Center for Applied Microbiology

[www.esf.edu/efb/appmicro/](http://www.esf.edu/efb/appmicro/)

The SUNY Center for Applied Microbiology was established in 2004. The Center provides funding for academic research in the broad arena of applied microbiology. The funds are managed through the ESF College Foundation, Inc. and provide support for graduate students, faculty and modest equipment needs.

Current research is directed toward the revival and maintenance of fungal cultures, mostly basidiomycetes. These cultures are also being screened for active laccase producers in conjunction with long-standing interest in the use of laccase for the removal of aromatic pollutants.

Other research continues on biodegradable thermoplastics; the production of hydrogen using photosynthetic bacteria grown on acetate derived from an autohydrolysate of the xylan component of wood; the production of a crystalline compound (not yet identified) which may function as a spore germination inhibitor; and examining fungal cultures as part of an EPA-funded allergy/asthma study.

## SUNY Center for Brownfield Studies

[www.esf.edu/sunybrownfields](http://www.esf.edu/sunybrownfields)

The State University of New York (SUNY) Center for Brownfield Studies is an educational initiative focused on environmental management and the redevelopment of brownfield properties. Brownfields are abandoned, idled, or underused properties where expansion or redevelopment is complicated by real or perceived environmental contamination. The Center focuses on three major areas:

- academic programs to deliver a holistic curriculum that encompasses skills related to remediation and redevelopment;
- community support programs to become the "go to" place for training and advice on state and federal programs for regulation and funding, and technical assistance on remediation, and economic development;
- research and development of innovative processes and technologies for cost-effective, implementable, and protective solutions to protect public health and environment at brownfield sites.

The Center provides undergraduate and graduate students with varied expertise, disciplines, and skills necessary for returning negatively impacted properties to productive use. Both public and private sectors will teach and learn at the Center and contribute to the research that will ultimately enhance society's ability to evaluate, remediate, and redevelop brownfields.



## **SUNY Center for Sustainable and Renewable Energy**

[www.esf.edu/energycenter](http://www.esf.edu/energycenter)

The SUNY chancellor designated ESF as the SUNY Center for Sustainable and Renewable Energy in 2002. This designation marks SUNY-ESF as the systemwide voice for the advancement of biofuels and energy-saving bioproducts, biomass, wind, solar, geothermal and other forms of sustainable and renewable energy.

The Center serves as a site for resources and programs for scientific research and draws on the expertise of all SUNY-ESF departments as well as the research talent throughout the SUNY system and the Syracuse Center of Excellence in Environmental and Energy Systems. SUNY-ESF's applied research agenda supports the SUNY Center's research from hydrogen storage to lignocellulosic ethanol to gasification to biomass feedstock development. The SUNY Center was an active party in the New York Public Service Commission New York Renewable Portfolio Standard development and hearing process.

Working in concert with the U.S. Departments of Energy and Agriculture, SUNY-ESF scientists have conducted more than \$20 million in research to maximize the production of woody biomass from salix (willow), develop a sustainable biorefinery based on wood biomass, including the "first of kind" wood-to-ethanol plant, and have conducted both co-firing and gasification demonstration tests.

SUNY-ESF, working with the New York Power Authority and the New York State Energy Research and Development Authority, is conducting significant fuel cell and fuel cell membrane research and has installed and operates a 250 kW carbonate fuel cell. This project will test the process' ability to provide crucial, distributive, "green" power.

SUNY-ESF has developed a biodiesel production facility and biofuel refueling station on campus. In addition, ESF's longstanding and proven successful Salix Consortium continues to provide feedstock for the co-firing, gasification, and manufacture of levulinic acid for biofuels and bioproducts like specialty and commodity biochemicals, biopharmaceuticals and bio-polymers and plastics.

## **Tropical Timber Information Center**

[www.esf.edu/scme/ttic.htm](http://www.esf.edu/scme/ttic.htm)

The Tropical Timber Information Center (TTIC) provides identification of wood samples and information about general characteristics and technical properties of the world's timbers. These services are directed toward the needs of importers and users of tropical woods.

The center, which operates under the auspices of the Department of Construction Management and Wood Products Engineering, was established in 1975 in response to requests from industry for information on tropical woods. It is one of only two such sources of information in the western hemisphere. The center carries out special studies under contract. The technical base for operation of the TTIC is the Department's 35,000-specimen H.P. Brown Memorial Wood Collection of authenticated wood samples and extensive reference materials in its C.H. deZeeuw Memorial library. Both of these resources have been built up over the past 60 years by close cooperation with institutions throughout the world. Primary efforts at the center include responding to requests for services from users of tropical woods, expanding the collection and collecting information on properties and uses of the world's timbers.

## **U.S. Department of Agriculture Forest Service Cooperative Research Unit**

The Northern Research Station of the USDA Forest Service maintains a research center at the college. Since 1978, the Cooperative Research Unit has been conducting research on urban forest effects on environmental quality. The center's efforts provide increased opportunities for faculty and students to collaborate with Forest Service scientists in studies of urban vegetation and environmental problems.

## **Wood Utilization Service**

[www.esf.edu/scme/wus/](http://www.esf.edu/scme/wus/)

The Wood Utilization Service is the oldest public service and demonstration effort of the SUNY College of Environmental Science and Forestry. It was established in 1913 to carry out activities which facilitate and encourage the most efficient ways to process, manufacture, market and use wood, the premier renewable, sustainable, economical and environmentally beneficial construction, building, and manufacturing material.

Services provided include advising, answering questions, consulting, and testing, and demonstrations and use of SUNY-ESF's unique wood-processing and testing facilities. Typical clients include the general public, business and industry, and various government agencies and professional associations. Issues and products can range from the manufacture of high quality hardwood lumber, millwork, furniture and flooring, to the manufacture of baseball bats, utility poles, and pressure-treated lumber. Examples of recent services include assistance with the following: wood shrinkage and moisture issues in furniture production; IPPC ISPM compliant international shipping; storage of kiln-dried lumber; wood identification; improvement of production processes and yields; preservative treatments and wood performance; wood deterioration; best kiln drying of maple, oak, pine and other species; and use of locally manufactured lumber.

College faculty and Wood Utilization Service staff are active in professional associations, such as the Empire State Forest Products Association, New England Kiln Drying Association, Lake Erie and Ontario Sawyers and Filers Association, Forest Products Society, Society of Wood Science and Technology, and the American Wood Protection Association. The Wood Utilization Service also organizes and sponsors an annual Kiln Drying Workshop: Drying Quality Lumber for Profit.

# College Outreach

[www.esf.edu/outreach/](http://www.esf.edu/outreach/)

The College of Environmental Science and Forestry's mission is to advance knowledge and skills and to promote the leadership necessary for the stewardship of both natural and designed environments. [Vision 2020: ESF's Strategic Plan.](#)

To support the College's mission and to realize the College's vision of A Better World through Environmental Discovery, ESF Outreach links the College's faculty, staff, students and resources to our collaborators and diverse communities in order to advance education and practice in the science, design, engineering and management of natural resources and the environment. One of nine doctoral-granting institutions in the SUNY system, ESF is dedicated to excellence in undergraduate and graduate education, research, demonstration, and outreach.

Outreach, in its many forms, is integral to the College's mission. ESF faculty and staff, along with our partners, pursue a range of programs and projects that build upon ESF's academic and research expertise. ESF's Outreach office enriches partnerships and provides planning, marketing, management, and evaluation support to these faculty-driven and faculty-partnered initiatives.

In 2001, ESF renewed and strengthened its commitment to outreach. Collaborations were initiated with schools, colleges and universities, economic and workforce development organizations, and other public, private and non-profit organizations. As a result, ESF serves and partners with more people and organizations through a broader array of programs and projects than ever before.

ESF Outreach, through the associate provost for Outreach, provides institutional leadership, consolidates educational outreach activity throughout the Academic Affairs division of the College, and coordinates outreach advancement. Representatives from constituent organizations make up the several advisory councils that help guide program strategy.

ESF Outreach links the College with our partners and constituents outside the academic community. We serve professionals; middle school, high school, and college and university educators; and middle school, high school, college and university, adult and lifelong learners – all with an aim to enhance education, leadership and practice in the science, design, engineering and management of natural resources and the environment.

To this end, we offer a rich mix of programs that include:

- Credit courses and certificates offered on campus, off campus, and online throughout the academic year and summer session: [www.esf.edu/outreach/ce/](http://www.esf.edu/outreach/ce/)
- Professional education programs, including regional, state, national and international contract trainings, seminars, workshops and conferences: [www.esf.edu/outreach/pd/](http://www.esf.edu/outreach/pd/)
- Middle and High School Education programs and projects, including ESF in the High School and ESF SCIENCE: [www.esf.edu/outreach/k12/](http://www.esf.edu/outreach/k12/)
- Collaborative Projects and Initiatives that link on- and off-campus partners and focus on outreach or integrate outreach into research grant proposals: [www.esf.edu/outreach/projects/](http://www.esf.edu/outreach/projects/)

## The Northern Forest Institute for Conservation Education and Leadership Training

The Northern Forest Institute for Conservation Education and Leadership Training (NFI) is a working partnership between SUNY-ESF, Open Space Institute, New York's Department of Environmental Conservation, the state Adirondack Park Agency, Northern Forest Center, Purdue University's Department of Organizational Leadership and others.

The NFI is an initiative designed to function as a conduit for content provided to and drawn from diverse partners. By integrating many disparate areas of academic and experiential expertise into one coordinated educational delivery system, the NFI will work to improve education, research, management and public policy in the Northern Forest.

NFI is a multitiered, interdisciplinary program focused on professional audiences, students in college and secondary curricula, and the general public. Faculty and staff from ESF and partnering organizations will bring rich experience to professional development, educational outreach and leadership training in conservation.

## Tree Pest Information Service

[www.esf.edu/lfs/treepest.htm](http://www.esf.edu/lfs/treepest.htm)

Established in 1950, the Tree Pest Information Service is one of ESF's oldest public service endeavors. The unit focuses on insects and diseases associated with urban, forest and plantation trees. Additionally, the service provides the public with information on plants, wildlife problems and a range of household pests. Personnel respond to more than 1,000 calls and site visits each year.

The Tree Pest Information Service assists commercial concerns, forest industry, government agencies, primary and secondary schools, colleges, and the general public. It also assists in basic research and collects materials for use by agencies such as the New York State Department of Environmental Conservation and the U.S. Forest Service, as well as for the College.

The service uses the College's resources and capabilities to provide identification of various organisms, pest remediation recommendations and tree health information, and to produce and distribute technical and non-technical publications.

# Division of Environmental Science

RUSSELL D. BRIGGS, Division Director  
358 Illick Hall  
315-470-6989

## Bachelor of Science in Environmental Science

RUSSELL D. BRIGGS, Undergraduate Program Coordinator  
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### Mission and Objectives Statement

The faculty members who deliver the program in environmental science perform teaching, research and public service activities to promote environmental practices to improve the lives of people within New York state and around the world.

The **objectives** of the program in environmental science are to prepare students who:

- Will engage in environmental work while employed by government agencies and industry or in private consulting jobs that specialize in public works and the inventory, management, design, use, restoration and protection of natural and cultural resources,
- Are prepared to enter advanced academic studies involved with any of the many aspects of environmental science, and
- Will continue to develop the knowledge and skills needed to adapt to changing technological, environmental and business conditions to the benefit of society, employer and self.

Program **outcomes** for the undergraduate (B.S.) program in environmental science are to produce graduates who:

- Are knowledgeable of examples of global, regional and local environmental problems and issues,
- Are competent to perform in a graduate education or entry-level work environment,
- Have a sufficient knowledge base and tools to function effectively,
- Have the ability to conceptualize environmental problems in terms of unifying principles,
- Are capable of utilizing a systems approach to problem solving, and
- Can communicate their ideas and expectations effectively.

Additionally, the undergraduate program in environmental science aims to produce graduates who exhibit the following attributes:

- Knowledge in understanding basic principles and creativity in problem solving,
- Skills in originality and methods of problem solving,
- Attitude that includes ethics, self-discipline, perseverance,
- Ability to function effectively in a multidisciplinary team/environment,
- Understanding of the need for lifelong learning.

### Undergraduate Program Requirements

The undergraduate curriculum in environmental science consists of two broad categories of courses. The general education component provides students with knowledge and skills that are useful and important for all educated persons. The professional courses provide students with direct preparation for a career.

Students may be admitted directly as first-year freshmen at ESF or through a variety of transfer options. Regardless of which way students enter ESF, they must complete both the general and professional education requirements.

#### Lower Division Course Requirements (50-51 credits)

Courses			Credits	
APM	105	Survey of Calculus and Its Applications I		4
APM	106	Survey of Calculus and Its Applications II		4
GNE	160	Computing Methods		3
EWP	190	Writing and the Environment	G	3
EWP	290	Writing, Humanities and the Environment	G	3
EWP	405	Writing for Science Professionals		3
EFB	120	The Global Environment & the Evolution of Human Society		3
EFB	101/102	General Biology I and Laboratory	G	4
EFB	103/104	General Biology II and Laboratory		4

ESC	132	Orientation Seminar: Environmental Science		1
FCH	150/151	General Chemistry I and Laboratory		4
FCH	152/153	General Chemistry II and Laboratory		4
FOR	207	Introduction to Economics	G	3
PHY	211/221	General Physics I and Laboratory		4
PHY	212/222	General Physics II and Laboratory		4

### Lower Division Electives (12 credits)

Free electives				6
General Education: American History			G	3
General Education: Western Civilization			G	3

### Professional Courses (16 credits)

APM	391	Introduction to Probability and Statistics		3
EFB	320	General Ecology		4
ESF	200	Information Literacy		1
ESF	300	Introduction to Geospatial Technology		3
ESC	494	Capstone Seminar		1
ESC	498	Research Problems in Environmental Science		4

### Environmental Science Core (9-11 credits)

Students must complete one course from each of the following environmental science core areas. Note: Courses used to complete the advanced chemistry, biology, or mathematics requirements; environmental science core requirements; or option requirements may NOT be used to satisfy more than one of these requirements.

The Physical Environment				3-4
The Living Environment				3-4
The Social Environment				3

### The Physical Environment

ERE	223	Statics and Dynamics		4
ERE	351	Basic Engineering Thermodynamics		2
FCH	210	Elements of Organic Chemistry		4
FCH	221/222	Organic Chemistry I/Organic Chemistry I Laboratory		4
FCH	360	Physical Chemistry		3
FOR	338	Meteorology		3
FOR	340	Watershed Hydrology		3
FOR	345	Introduction to Soils		3
EST	231	Environmental Geology		3

### The Living Environment

EFB	303	Introductory Environmental Microbiology		4
EFB	326	Diversity of Plants		3
EFB	336	Dendrology		3
EFB	351	Forest Entomology		3
EFB	355	Invertebrate Zoology		4
EFB	385	Comparative Vertebrate Anatomy		4

EFB	440	Mycology	3
EFB	462	Animal Physiology: Environmental and Ecological	3
EFB	483	Mammal Diversity	3
EFB	485	Herpetology	3
EFB	486	Ichthyology	3
EFB	327	Adirondack Flora	3
EFB	342	Fungal Diversity and Ecology	3
EFB	345	Forest Health	3
EFB	384	Field Herpetology	3
EFB	388	Ecology of Adirondack Fishes	3

### The Social Environment

EWP	390	Introduction to Literature of Nature	3
EFB/ EST	220	Urban Ecology	3
EST	361	History of the American Environmental Movement	3
EST	390	Social Processes and the Environment	3
FOR	312	Sociology of Natural Resources	3
FOR	465	Natural Resources Policy	3
EFB	337	Field Ethnobotany	3

### Advanced Courses in Chemistry, Biology or Mathematics (9-12 credits)

An advanced course is one that has at least one prerequisite or is numbered 300 or above. Note: Courses used to complete the advanced courses in chemistry, biology or mathematics requirement may NOT be used to complete the environmental science core or option requirements.

Advanced Course in science or mathematics	3-4
Advanced Course in science or mathematics	3-4
Advanced Course in science or mathematics	3-4

### Environmental Science Option (15-16 credits)

Students must complete at least one of the following options. Courses used to complete the advanced chemistry, biology, or mathematics requirements; environmental science core requirements; or option requirements may NOT be used to satisfy more than one of these requirements.

Environmental Information and Mapping	15
Watershed Science	15
Health and the Environment	17-18
Earth and Atmospheric Systems Science	15
Environmental Analysis	16
Renewable Energy	17

### Environmental Information and Mapping

ERE	371	Surveying for Engineers	4
ERE	365	Principles of Remote Sensing	4
GEO	381	Cartographic Design	4
ERE	551	GIS for Engineers	3
ENS	519	OR Spatial Ecology	3

### Watershed Science

EFB	415	Ecological Biogeochemistry	3
FOR	340	Watershed Hydrology	3
FOR	345	Introduction to Soils	3
FOR	441	Watershed Ecology and Management	3
EFB	423	Marine Ecology OR	3
EFB	424	Limnology OR	3
EFB	486	Ichthyology OR	3
EFB	487	Fisheries Science and Management OR	3
ERE	440	Water Pollution Engineering OR	3
FOR	338	Meteorology OR	3
GEO	316	River Environments	3

### Health and the Environment

EFB	303	Introductory Environmental Microbiology	4
EFB	307	Principles of Genetics	3
EFB	308	Principles of Genetics Laboratory	1
EFB	325	Cell Physiology	3
EFB	400	Toxic Health Hazards	3
EFB	385	Comparative Vertebrate Anatomy OR	4
EFB	462	Animal Physiology: Environmental and Ecological	3

### Earth and Atmospheric Systems Science

EFB	415	Ecological Biogeochemistry	3
EFB	524	Limnology OR	3
FCH	510	Environmental Chemistry I	3
FOR	338	Meteorology	3
FCH	399	Introduction to Atmospheric Sciences	3
FCH	496	Special Topics: Oceanography	3

### Environmental Analysis

EFB	303	Introductory Environmental Microbiology	4
FCH	380	Analytical Chemistry I: Gravimetric, Titrimetric and Potentiometric Analysis	3
FCH	381	Analytical Chemistry II: Spectroscopic, Chromatographic and Electroanalysis Techniques	3
FOR	338	Meteorology OR	3
FOR	340	Watershed Hydrology OR	3
FOR	345	Introduction to Soils	3
GEO	388	Geographic Information and Society OR	3
ERE	365	Principles of Remote Sensing	3

### Environmental Engineering Science

ERE	440	Water Pollution Engineering	3
ERE	441	Air Pollution Engineering	3

ERE	506	Hazardous Waste Management	3
PSE	370	Principles of Mass and Energy Balance	3
PSE	473	Mass Transfer	3

### Renewable Energy

BPE	441	Biomass Energy	3
ESC	325	Energy Systems	3
ESC	335	Renewable Energy Systems	3
ESC	422	Energy Markets and Regulations	3
ESC	450	Capstone Planning	1
A minimum of 3 credits from the following:			
EFB	516	Ecosystems	3
EFB	518	Systems Ecology	4
ERE	351	Basic Engineering Thermodynamics	2
ERE	519	Green Entrepreneurship	3
FCH	360	Physical Chemistry I	3
FOR	415	Forest Consulting and Wood Procurement	3
PSE	361	Engineering Thermodynamics	3
PSE	370	Principles of Mass and Energy Balance	3
EST	427	Environment and Energy Auditing	3
CME	305	Sustainable Energy Systems for Buildings	3

### Elective

Elective courses must be approved by an academic advisor. They should be related in some way to the student's area of study and are an opportunity to customize the academic experience. Free electives may be filled with any course with no approval necessary. Note: Courses used to complete the advanced courses in chemistry, biology or mathematics requirement may NOT be used to complete the environmental science core or option requirements.

Total minimum credits for the degree 125 credits.

### Prehealth Advising

The curriculum for the bachelor of science degree with an environmental science option in health and the environment prepares students for advanced degrees in health professions with a suitable plan of study. To prepare for health professions, students may access Syracuse University's broad array of relevant courses and the advising, counseling and resources of the Health Professions Advisory Program.

### UNDERGRADUATE MINORS

Students who meet the admission requirements may enroll in any of the undergraduate minors offered at ESF.

### Graduate Program in Environmental Science (GPES)

RUTH YANAI, Graduate Program Coordinator  
210 Marshall Hall  
315-470-6955/6528; FAX 315-470-6700

[www.esf.edu/environmentalscience/graduate](http://www.esf.edu/environmentalscience/graduate)

The graduate program in environmental science (GPES) offers M.S., M.P.S. and Ph.D. degrees. GPES was created in the early 1970s as a unique response to the emerging institutional and analytical challenges of developing environmental problems. The program, which draws upon faculty from throughout the College, emphasizes a multidisciplinary social and natural science approach to environmental understanding and stewardship. It maintains a strong academic orientation, facilitating student and faculty engagement of fundamental environmental challenges such as resource utilization, the uses and limits of scientific prediction, risk and sustainability.

The mission of GPES is to provide interdisciplinary education, research and public service to prepare students to comprehensively address environmental concerns and problems, investigate practical solutions to them and to foster effective environmental stewardship. The program provides for the following:

- Multidisciplinary approach: recognition of the necessity to approach environmental problems with input from several disciplines and professions,

- Holistic perspective: awareness of and deference to the interdependence of elements within broadly defined ecosystems, including physical, biological, social and economic systems,
- Topical grounding: competency to understand and apply the principles of a particular subject of environmental inquiry in sufficient depth to interact with other disciplines and professional fields,
- Realistic experience: internships, focused projects, theses and seminars provide for direct interaction of legal, economic, political and social systems which underlie decision making.

The program's internal structure incorporates a common core that provides a broad policy-oriented foundation for the focused areas of study. Students applying to GPES must select which area of study they intend to pursue.

## Requirements

The academic requirements of the graduate program in environmental science are designed to provide graduates with a sound preparation to meet the rapidly evolving challenges of the field as leading scholars and professionals. Programmatic requirements constitute a framework which includes a comprehensive core foundation emphasizing theory, issues and methods; extended knowledge within an area of study; and a synthesis experience.

Entering students should be adequately prepared to engage graduate level work in the program. The following undergraduate courses are pre- or co-requisites for all master's students: statistics, ecology and microeconomics or environmental economics. Courses in political science are strongly recommended.

In addition, students should have an academic background and/or work experience related to the selected area of study. Wherever possible, deficiencies should be made up prior to matriculation.

## Master of Science

The master of science degree is designed as a two-year experience.

### *Core Requirements*

A core of applied social science courses (credit-hour requirements vary with area of study) is required. In addition, a total of six credit hours is required in research methods. Course options which satisfy these requirements are designated by the area of study faculty.

### *Area of Study Requirements*

A minimum of 15 credit hours (excluding ENS 899) is required in the area of study, as determined by the major professor and area of study faculty. Area of study subcommittees maintain advising lists of courses pre-approved to satisfy the 15-credit area of study requirement. The student's major professor or steering committee may designate additional courses. Five study areas are available to M.S. students: environmental policy and democratic processes, environmental and community land planning, environmental systems and risk management, water and wetland resource studies, and environmental communication and participatory processes.

### *Thesis Requirements*

A minimum of six credit hours of research is required resulting in a document that clearly demonstrates graduate-level accomplishments of the student, followed by a defense examination. Students must have an approved thesis proposal.

## Master of Professional Studies

The master of professional studies degree is a 39-credit-hour experience aimed at professional applications of environmental knowledge.

### *Core Requirements*

A total of 21 credit hours is required. These must include applied social science courses in environmental policy and regulation, and democratic processes. In addition, a total of six credit hours is required in environmental science and six credit hours is required in methods courses emphasizing applications of technical knowledge.

### *Area of Study Requirements*

A minimum of 12 credit hours of coursework is required in the chosen area of study, as determined by the major professor and study area faculty. Students select a study area at the time of application for admission to the program. Five study areas are available to M.P.S. students: environmental policy and democratic processes, environmental and community land planning, environmental systems and risk management, water and wetland resource studies, and environmental communication and participatory processes.

### *Synthesis Requirements*

Students select either an internship for three to six credit hours or prepare a synthesis paper for three credit hours. All students must present a capstone seminar in their final semester. No terminal comprehensive examination is required.

Applicants with a minimum of three years of post-baccalaureate, full-time professional experience directly related to the intended area of study may apply for six credit hours of advanced standing in the program, reducing their degree requirements to 33 credit hours. Partial credit for experience cannot be awarded. When awarded for prior work experience, the six credit hours are applied toward the synthesis requirement.

## Doctor of Philosophy

The Ph.D. program provides a unique opportunity to develop environmental policy-related research within a strong college community of environmental analysts and to draw upon the expertise of scholars at Syracuse University. Entering students are required to complete the equivalent of the GPES master's core either from prior graduate study or coursework taken within the first year of residency. Environmental and natural resources policy applicants are expected to have completed a master's research thesis.



## Areas of Study

### **Environmental Communication and Participatory Processes (M.S., M.P.S., Ph.D.)**

Participating Faculty: FOLTA, KUEHN, MEISNER, MORAN, SELFA

This study area addresses the communicative dynamics of the formation of attitudes. It includes decision making, public policy, public participation, campaign development, organizational effectiveness, and conflict prevention and resolution, which all hinge on the ability of participants to communicate and use information effectively, strategically and ethically. GPES students with this option will be prepared to enter diverse arenas of industry, non-government organizations and government structures well equipped to facilitate and participate in effective interactions among individual citizens, non-government organizations, publics, agencies, bureaucracies, scientists and others. They will have the skills and knowledge that will allow them to choose the more appropriate and effective process structures and strategies to reach objectives.

### **Environmental and Community Land Planning (M.S., M.P.S., Ph.D.)**

Participating Faculty: BEIER, BRYANT, CARTER, DALEY, DIEMONT, DOBLE, DOELLE, M. HALL, HAWKS, MORAN, SELFA, TOLAND

Environmental and community land planning is concerned with orderly, efficient, equitable and aesthetic development of land with special concern for the state of the natural environment, the physical character of communities, and decision making at state, county and local levels of government. Planning balances competing demands on land and environment brought about by expanding urban and rural development, and enhancing viable natural and cultural resources is an important planning perspective. Another perspective involves the guiding of private and public development processes within a pluralistic political environment in order to promote sustainable communities while at the same time respecting fiscal, environmental and legal constraints.

The program is designed for students with social science, natural science, engineering or design backgrounds who are interested in an interdisciplinary and integrative program. Some students have majors in interdisciplinary programs in urban studies or environmental studies. Students develop an understanding and knowledge of development processes, natural systems and governmental planning and regulation. They develop a capacity to analyze environmental and community land planning problems and to form imaginative solutions. Skills obtained include preparation of land and environmental databases, plans, policies and implementation programs.

### **Environmental Systems and Risk Management (M.S., M.P.S., Ph.D.)**

Participating Faculty: BEIER, DALEY, DIEMONT, DOELLE, ENDRENY, C. HALL, M. HALL, KROLL, LIMBURG, LUZADIS, MAO, MORAN, MORSI-HUSSEIN, NAKATSUGAWA, NOMURA, NORDENSTAM, TAO, TEECE, VIDON, VOLK, YANAI

The environmental systems and risk management study area focuses on problems in environmental and natural resource policy in which scientific and technical issues are of central importance. The program is designed for graduate students with a science or engineering background. Current research includes urban ecology, spatial model construction, use of renewable materials in structures and processes, biomass energy production, ecosystems modeling, environmental risk assessment, use of technical information by regulatory agencies, land use forecasting for public policy decision making and sustainable resource and allocation. The environmental systems and risk management area of study provides a unique opportunity to study interdisciplinary problems. Specific coursework in environmental systems and risk management is supplemented by traditional disciplinary coursework in engineering or the natural sciences and policy analysis.

### **Environmental Policy and Democratic Processes (M.S., M.P.S.)**

Participating Faculty: LUZADIS, MANNO, MEISNER, MORAN, NORDENSTAM, SELFA, SMARDON, SONNENFELD

The environmental policy and democratic processes study area addresses problems of environmental decision making at a time of rapid institutional and social change. How our society can best meet the growing challenges of environmental stewardship through mandated and voluntary public participation in decision making is the central question. This concern is increasingly important to many segments of modern society, and we intend that students acquiring knowledge in this study area will be prepared to contribute positively to these processes in career pursuits.

The focus of this study area is on developing new understanding of public participation in environmental decision making, against the backdrop of environmental policy making and program implementation. Particular attention is given to (a) the variety of organizations involved in participation, which generally are the institutions and agencies of government, citizen-based non-governmental organizations and the business or industrial sector; (b) the availability and utility of environmental information for these groups; and (c) the participation and integration of all informed stakeholders into environmental decision making. This tripartite scheme of organizations, information and participation frames student programs of study and suggests important directions for student and faculty research efforts.

The study area advances understanding of these questions of participatory democracy for environmental decision making through research and instruction and is particularly suited to inquisitive students with degrees in environmental studies, political science, geography, engineering and other fields that provide interdisciplinary backgrounds in natural and social science.

### **Water and Wetland Resource Studies (M.S., M.P.S., Ph.D.)**

Participating Faculty: BOYER, DALEY, DOELLE, ENDRENY, KROLL, LEOPOLD, LIMBURG, MANNO, MITCHELL, MORAN, SELFA, SMARDON, STELLA, TAO, VIDON

The water and wetland resources area of study develops an understanding of technical, social and institutional aspects of water resources management, mitigation and restoration. Individual students may emphasize scientific or social subject areas but all students study in both areas. Scientific aspects include the basic physical, chemical and biological interactions occurring in water resources systems. The social aspects are concerned with planning, regulation, law and institutions and management of water and wetland resources.

Recommended coursework includes:

- physical sciences: civil engineering, geology, geomorphology, hydrology, meteorology, environmental engineering, soils, water chemistry, hydrogeology, hydrogeochemistry and geographic information systems;
- biological sciences: ecology, entomology, fisheries biology, forestry, microbiology, water quality and limnology; and
- social sciences: administration, economics, government, history, law, ethics, philosophy and policy.

**Environmental and Natural Resources Policy (Ph.D.)** [www.esf.edu/enrp](http://www.esf.edu/enrp)

Participating Faculty: BEIER, LUZADIS, MALMSHEIMER, MANNO, MORAN, NEWMAN, NORDENSTAM, SELFA, SMARDON, SONNENFELD, WAGNER

The environmental and natural resources policy Ph.D. program is a collaborative program offered by both the Graduate Program in Environmental Science and the Department of Forest and Natural Resources Management. This study area investigates how societies formulate and implement decisions regarding environmental and natural resources. Doctoral students integrate the biophysical sciences and policy-related social sciences to solve important problems in environmental and natural resources policy with applications throughout the world. The program offers an opportunity to work with outstanding faculty members on applied and theoretical studies.

Faculty members conduct studies at international, national, state and local levels on sustainability, implementation and administration of environmental, natural resources, and forest management programs and economic and institutional influences and impacts of government and non-government policies. The applications include environmental, natural resources and forest policy and administration; and environmental, natural resources, forest and ecological economics.

The environmental and natural resources policy (ENRP) doctoral program is a highly individualized program with coursework and research determined in consultation with the student, major professor and steering committee. Some coursework requirements may be met by transferring graduate credits as approved by the steering committee. Students may also fulfill coursework requirements by completing courses offered by the Maxwell School of Citizenship and Public Affairs at Syracuse University. Specific degree requirements are described in the Handbook for Environmental and Natural Resources Policy Ph.D., available in 320 Bray Hall, 107 Marshall Hall, and on the [ENRP Web site](#).

Students are expected to complete requirements resulting in a coherent body of theory, a depth of understanding in a specified area of biophysical science, appropriate research methods, and advanced policy analysis and understanding.

The following four core competencies must be satisfied prior to the doctoral candidacy examination. A minimum of 12 credits is required in each area.

Natural science: graduate courses (500 level or higher) in a definable area of biophysical science;

Policy-related social science: 600-level or higher courses including at least one government course and one economics course;

Research methods: 600-level or higher courses including a general research methods course (required), qualitative methods, quantitative statistical methods, GIS, or spatial statistics;

Advanced environmental and natural resources policy: 600-level or higher courses including policy analysis and program evaluation (required).

Graduates have careers as university professors and advanced policy or program analysts. They often become leaders in government, legislatures, corporations, not-for-profit organizations, advocacy groups and academic institutions, consulting firms and village associations throughout the world.

# Department of Chemistry

GREGORY L. BOYER, Chair  
118 Jahn Laboratory, 315-470-6855; FAX 315-470-6856  
[www.esf.edu/chemistry](http://www.esf.edu/chemistry)

The academic programs in chemistry emphasize fundamental chemical phenomena as well as links from chemistry to the biological and applied sciences. Programs include courses in traditional areas of chemistry, with advanced study in fields pertaining to environmental, life and materials sciences. Emphasis on the investigative function of chemical science is manifest in the wide array of ongoing research projects within the department. Chemistry classes and labs are held in Edwin C. Jahn Laboratory, a modern facility well-equipped with instruments necessary for teaching and research.

## Bachelor of Science in Chemistry

The Department of Chemistry offers three options leading to the bachelor of science degree: biochemistry and organic chemistry of natural products, environmental chemistry, and natural and synthetic polymer chemistry. Each option offers an advanced core of studies beyond the basic courses of the classical undergraduate chemistry curriculum. All options are excellent grounding for professional work at the B.S. level or for advanced graduate study. Recent graduates have careers in government or the chemical/pharmaceutical industries in roles as varied as research, quality control, and new process development. Other graduates have gone on to advanced graduate study (M.S., Ph.D.) in chemistry and related fields or have pursued careers in medicine or law.

### Biochemistry and Organic Chemistry of Natural Products

Participating Faculty: BOYER (Plant and Algal Biochemistry), GINER (Organic and Natural Products Chemistry), NOMURA (Biochemistry and Biotechnology), WEBSTER (Organic Chemistry, Chemical Ecology), WINTER (Polymer Biochemistry)

Biochemistry and organic chemistry of natural products stresses a chemical approach to problems in the life and health sciences. After students obtain a strong foundation in analytical, physical and organic chemistry, their studies are supplemented by advanced courses in natural products chemistry, natural biopolymers, spectroscopy, and biochemistry. Professional electives in botany, chemical ecology, genetics and molecular biology provide the background for interactions in the life and health sciences. Research areas include the elucidation of chemical signals by which organisms communicate with each other, the role of trace metals in the growth of microorganisms, and the origin and function of biologically active natural compounds.

### Environmental Chemistry

Participating Faculty: ABRAMS (Inorganic Chemistry, Chemistry Education Laboratory), BOYER (Environmental Biochemistry), DIBBLE (Environmental Chemistry), DONAGHY (Inorganic Chemistry), J.P.HASSETT (Environmental Chemistry), KIEBER (Environmental Chemistry, Oceanography), MAO (Atmospheric Chemistry), TEECE (Environmental Chemistry, Biogeochemistry)

Environmental chemistry stresses applications of fundamental chemical principles to describe and predict behavior of chemicals in the environment. After obtaining a strong foundation in analytical, physical and organic chemistry, students pursue advanced study in air and water chemistry. A wide variety of courses in biology, engineering, geology, and environmental policy are also available. Research encompasses field work, laboratory studies, and modeling, and focuses on the atmosphere as well as marine and freshwater systems. Studies are carried out on scales ranging from local to regional to global. Topics include behavior of nutrients in water, food webs, toxic algal blooms, photo-induced and radical chemistry, reactive and persistent organic pollutants, and global climate change.

### Natural and Synthetic Polymer Chemistry

Participating Faculty: CABASSO (Polymer Chemistry and Membrane Science, Applied Electrochemistry), CALUWE (Organic Chemistry, Synthetic Polymer Chemistry), A. CHATTERJEE (Polymer Physical Chemistry), DONAGHY (Inorganic Chemistry), GITSOV (Organic and Physical Polymer Chemistry), NOMURA (Biosynthesis and Biopolymer Chemistry), STIPANOVIC (Physical Chemistry of Biopolymers), WINTER (Physical and Biopolymer Chemistry)

Undergraduates in the natural and synthetic polymer option take advanced courses in mechanisms of polymerization and polymer synthesis, in the physical properties and characterization of polymers, and in the laboratory techniques of polymer synthesis and characterization. Special topics courses in contemporary polymer and material science are available as electives. In addition, courses in carbohydrate chemistry provide a solid background for chemists planning careers in paper, plastic, high-tech, energy, membranes, and related areas. Biochemistry is an appropriate elective for students interested in the growth of biotechnologies while environmental chemistry complements this program for students interested in working on problems of biodegradation. The program offers an excellent background both for direct entry into industrial chemistry and graduate study in areas such as chemistry, biotechnology or polymer science.

Students may enter the Bachelor of Science program as first-year students or as transfer students. Students who are preparing to transfer to ESF as juniors must have earned at least 60 credits of college coursework in courses comparable to the lower-division course requirements noted below.

## Undergraduate Program Requirements

### Lower Division Required Courses (47 credits):

Courses			Credits	
EWP	190	Writing and the Environment Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet the general education standards established by SUNY is listed <a href="#">in Academic Programs</a> .	G	3
EWP	290	Writing, Humanities and the Environment	G	3
EFB	101/	General Biology I and Laboratory		4

	102			
EFB	103/ 104	General Biology II and Laboratory		4
FCH	132	Orientation Seminar: Chemistry Required of all students regardless of entry level		1
FCH	150/ 151	General Chemistry I and Laboratory	G	4
FCH	152/ 153	General Chemistry II and Laboratory		4
FCH	221/ 222	Organic Chemistry I and Laboratory		4
FCH	223/ 224	Organic Chemistry II and Laboratory		4
APM	205	Calculus I	G	4
APM	206	Calculus II		4
PHY	211/ 221	General Physics I and Laboratory		4
PHY	212/ 222	General Physics II and Laboratory		4

#### Upper Division Electives (16 credits):

		Math Elective (Calculus III [APM307] or Statistics [APM391])		3
		Computing Elective (Typically, APM 255)		3
		General Education Course	G	3
		General Education Course	G	3
		General Education Course	G	3

#### Upper Division Required Courses (32 credits):

EWP	405	Writing for Science Professionals		3
ESF	200	Information Literacy		1
FCH	325	Organic Chemistry III		4
FCH	360	Physical Chemistry I		3
FCH	361	Physical Chemistry II		3
FCH	380	Analytical Chemistry I		3
FCH	381	Analytical Chemistry II		3
FCH	384	Spectrometric Identification of Organic Compounds		2
FCH	410	Inorganic Chemistry		3
FCH	495	Introduction to Professional Chemistry		1
FCH	497	Undergraduate Seminar		1
FCH	498	Introduction to Research Students may replace this requirement to allow time for special interest, by petition to the department.		5

#### Electives (minimum of 18 credits);

		Electives		9
		Professional Electives Students should complete a three-semester set of professional electives chosen from a list of courses available in the Department of Chemistry office. The courses provide a wide range of study including biology, chemistry, ecology, forestry, environmental law, mathematics, geology, physics, biophysics, and various engineering disciplines.		9

## Option Courses (9 credits)

### Biochemistry and Natural Products Option

FCH	530	Biochemistry I	3
FCH	531	Biochemistry Laboratory	3
FCH	532	Biochemistry II	3

### Environmental Chemistry Option

FCH	510	Environmental Chemistry I	3
FCH	511	Environmental Chemistry II	3
FCH	515	Methods of Environmental Chemical Analysis	3

### Natural and Synthetic Polymer Chemistry Option

FCH	550	Polymer Science: Synthesis and Mechanisms	3
FCH	551	Polymer Techniques	3
FCH	552	Polymer Science: Properties and Technology	3

Total minimum credits for the degree: 121 credits

## Graduate Programs

Graduate degrees require an appropriate program of courses at ESF and at Syracuse University. Master of Science and doctoral students must complete a minimum of 18 credit hours and 30 credit hours of graduate level coursework, respectively. In addition, doctoral students must pass two preliminary examinations and a doctoral candidacy examination.

Requirements for a Master of Science or Doctor of Philosophy degree also include FCH 997 and a research thesis or dissertation. For further details, contact the department. Current research projects encompass natural and synthetic polymer chemistry, biochemistry and microbiology; organic chemistry of natural products and chemical ecology; environmental chemistry of the air, water, and soils.

The four focal areas for study are Biochemistry, Environmental Chemistry, Natural Products/Organic Chemistry and Polymer Chemistry. ESF courses currently available in these subject areas are listed below. The Biochemistry, Environmental Chemistry and Polymer Chemistry areas each have a core sequence of three classes (FCH 530/531/532, 510/511/515 and 550/551/552; respectively). An M.S. or Ph.D. student interested in specializing in one of these areas must take the core sequence in that area. Students who have taken any of these courses (as undergraduates at ESF) may not repeat them for graduate credit.

### Biochemistry courses:

- FCH 530 Biochemistry I
- FCH 531 Biochemistry Laboratory
- FCH 532 Biochemistry II
- FCH 650 Plant Biochemistry

### Environmental Chemistry courses:

- FCH 510 Environmental Chemistry I
- FCH 511 Environmental Chemistry II
- FCH 515 Methods of Environmental Chemical Analysis
- FCH 560 Chromatography and Separations Techniques
- Other courses taught include Chemical Oceanography, Stable Isotopic Analysis, and Environmental Organic Chemistry

### Natural Products/Organic Chemistry courses:

- FCH 524 Topics in Natural Products Chemistry
- FCH 540 Carbohydrates I: Structure, Reactions and Analysis
- FCH 571 Wood Chemistry I: General Wood Chemistry
- CHE 575 Organic Spectroscopy

### Polymer Chemistry courses:

- FCH 550 Polymer Science: Synthesis and Mechanisms
- FCH 551 Polymer Techniques
- FCH 552 Polymer Science: Properties and Technology

- FCH 650 Statistical Physics and Chemistry of Macromolecules
- Other courses taught include Membrane Science and Technology and Biomass Chemistry

The Master of Professional Studies (M.P.S.) degree requires a total of 33 credits (minimum) in the following configuration:

Area	Credit hours
Chemistry, including at least 9 credits distributed among 3 of the areas of Biochemistry, Environmental Chemistry, Natural Products Chemistry or Polymer Chemistry.	15
Other sciences, engineering and mathematics	6
Seminars	3
Integrative experience (internship or independent study)	3
Elective coursework, seminars, internships or research experience	6
Total (minimum)	33

**15 credits of advanced chemistry courses**, including three credits of coursework in three of the focal areas of study. Additional graduate chemistry courses are available at ESF and Syracuse University.

**6 credits of graduate coursework in Science, Mathematics or Engineering.** These may include graduate courses offered at ESF or Syracuse University in physical or biological sciences, mathematics (including statistical analysis), or any area of engineering. Courses must be approved by the student's steering committee.

### 3 credits of seminar

FCH 997 Seminar (all students)

FCH 797 Graduate Seminar

Either of above, one-credit courses may be repeated, or students may choose seminars offered in other departments with approval of the advisor.

**3 credits for an integrative experience** in FCH 796 Special Topics in Chemistry or FCH 798 Research in Chemistry.

### 6 credits of additional graduate coursework:

The remaining six credits may be drawn from additional graduate level coursework, seminars, internships and research experience as approved by the student's steering committee.

The detailed list of course requirements above is for the M.P.S. degree; contact the Chemistry Department for detailed requirements for the M.S. and Ph.D. programs.

## Biochemistry (M.P.S., M.S., Ph.D.)

Graduate studies in biochemistry reflect the College's interests in microbial, insect, bio-based fuel, and plant biochemistry. After completing a one-year sequence in general biochemistry, students select advanced courses from a range of offerings in chemistry, organismal biology and molecular biology. Advanced courses in biochemistry are available both at ESF and Syracuse University.

A wide variety of research topics are available ranging from plant physiology to biotechnology. Selective research topics include microbial and algal production of biologically active natural products and their importance in cell biology (BOYER, GINER); chemical communication and recognition between organisms (WEBSTER); marine algal toxins (BOYER); trace metal/nitrogen physiology of symbiotic plants and algae (BOYER); the structure/function of natural biopolymers (NOMURA, WINTER); metabolic and protein engineering (NOMURA); and global gene expression studies of biopolymer-producing bacteria (NOMURA). Also, the use of microorganisms for the production of specialty chemicals including polysaccharide interconversions, and the application of bacterial and fungal enzymes and peptides in the bioremediation of environmental problems are explored.

## Environmental Chemistry (M.P.S., M.S., Ph.D.)

Research for graduate students in environmental chemistry is central to their program and includes both experimental and theoretical considerations. Research in environmental chemistry includes field work, laboratory work, and modeling, and span scales from local to global. Research topics include global climate change, coral reef ecosystems, biogeochemistry, atmospheric chemistry, regional and global air quality, transient and persistent organic pollutants.

Frequently, the problems to be addressed are transdisciplinary in nature. Thus, a student's coursework is carefully selected from areas of chemistry, biology, geology, engineering, mathematics and computer science in order to support the student's particular research needs. Special topics in analytical, environmental chemistry, or for methods development are often arranged.

Environmental chemistry faculty members currently have active research interests in both aquatic and atmospheric systems. These include the thermodynamics and kinetics of binding hydrophobic organic compounds by dissolved humic substances in water, the development of techniques for measuring the extent to this binding in both laboratory and field environments, and the characterization of poorly understood humic substances by techniques such as NMR (J.P. HASSETT); the study of chlorinated hydrocarbons in the Niagara River-Lake Ontario-St. Lawrence River system and their interaction with sediments, dissolved substances and organisms (J.P. HASSETT); the exchange of chlorinated hydrocarbons and other trace organics between aqueous and atmospheric phases in the environment (DIBBLE, J.P. HASSETT, KIEBER, MAO); understanding the role of organic matter in a variety of atmospheric, aquatic and sedimentary processes (DIBBLE, J.P. HASSETT, KIEBER, MAO, TEECE); the development of probe systems to study free radical processes and photochemical transformations of dissolved organic matter in natural waters (KIEBER); understanding the dynamics of the oceanic carbon and sulfur cycles and the importance of sunlight-driven photochemical transformations of organic matter in natural waters (KIEBER); the study of the presence and fate of pharmaceuticals in local streams

and the synthesis of novel inorganic materials for use as solid state indicators in aqueous environments (DONAGHY); the kinetics of elementary reactions that control the degradation of volatile organic compounds and the resulting yields of ozone, aerosols, and air toxics (DIBBLE); the application of laser spectroscopy and high-level quantum chemical calculations to investigating radical intermediates in atmospheric and combustion chemistry (DIBBLE); chemical studies of coral reefs (TEECE); application of stable isotope techniques to trophic relationships in reef-building corals (TEECE); the synthesis of oxynitride photovoltaic materials for water splitting (ABRAMS); and bio-based fuels and protein engineering (NOMURA).

### **Organic Chemistry of Natural Products (M.P.S., M.S., Ph.D.)**

Graduate students in organic chemistry of natural products take a one-year course sequence in mechanistic organic chemistry and another in synthetic organic chemistry. Additionally, one-semester courses are required in advanced physical chemistry and the organic chemistry of natural products. Courses in biochemistry, inorganic chemistry, statistics and specialized courses in chemistry or biology may be arranged and selected by the student in consultation with faculty.

Research in the field of organic chemistry of natural products takes three paths. These paths are the isolation and characterization of new natural substances; the synthesis of new or improved syntheses of better-known natural substances; and the study of the relation of molecular structure to biological response. Chemical research in each of these areas is coupled with biological testing. Research involving isolation and synthetic chemistry requires the student to develop expertise in separation techniques, such as the several methods of chromatography, and spectrometric identification of molecules. Successful investigation in structure/activity relationships requires the student to become familiar with statistical methods of analysis. Current topics of interest to the natural products faculty are the following: structure and function of natural metal chelators (BOYER); marine and freshwater algal toxins (BOYER); synthesis and biosynthesis of biologically active natural products (GINER); analysis and structure determination of steroidal compounds (GINER); isolation and identification of insect and mammalian pheromones and other semiochemicals such as alleomones and kairomones (WEBSTER); and synthesis of new natural products (semiochemicals) with particular emphasis on stereochemistry (WEBSTER).

### **Polymer Chemistry (M.P.S., M.S., Ph.D.)**

Graduate students in polymer chemistry select their courses from a range of offerings in chemistry, chemical engineering, mathematics, physics, and other appropriate areas. These courses will include a one-year sequence in either physical or organic chemistry of polymers and such additional courses as the student and advisor consider necessary. Special topics in a broad spectrum of polymer fields are offered or can be arranged in consultation with the faculty.

Research is an essential component of any graduate degree program in polymer chemistry. Current topics of research interest within the polymer faculty include the following: preparation, modification and technology of polymeric membranes (CABASSO); preparation, properties and applications of radiopaque polymers (CABASSO); inorganic polymers (CABASSO); applied electrochemistry, fuel cells, electrodes and electrosynthesis (CABASSO); novel methods of cellulose and cellulosic modification (CALUWE); clustering and percolation in polymer mixtures (A. CHATTERJEE); flow-induced effects on polymer miscibility (A. CHATTERJEE); synthesis of boron hydride containing polymers and the chemical functionalization of nanomaterials for polymer incorporation for hydrogen storage (DONAGHY); synthesis and characterization of polymers with novel architectures that incorporate dendritic, hyper-branched, star-like or cyclic fragments; amphiphilic copolymers; self-assembly and supramolecular chemistry (GITSOV); biomass conversion to biodegradable polyesters (NOMURA); biopolymer polymer rheology and stimuli responsive fluids (STIPANOVIC); controlled release applications of environmentally benign polymer gels (STIPANOVIC); diffraction methods, NMR, and dynamic molecular modeling approaches to polymer structure determination and prediction (WINTER); biomass conversion to industrial polysaccharides (WINTER).

### **Chemical Ecology (M.S., M.P.S., Ph.D.)**

Participating Faculty: BOYER (Environmental Biochemistry), GINER (Natural Insecticides), NAKAS (Microbial Ecology), NAKATSUGAWA (Xenobiotic Plant-Animal Interactions), TEALE (Insect Pheromones), TEECE (Chemical-Thermal Relationships), WEBSTER (Pheromone Chemistry)

The area of study in chemical ecology is offered through collaboration between the Department of Environmental and Forest Biology and the Department of Chemistry. Interested students should apply to the department of major interest, which will have prime responsibility for setting requirements. Faculty from both areas contribute to the development of a plan of study enabling a student to acquire sophisticated skills in either chemistry or biology and an ample understanding of the other field to grapple with problems requiring an understanding of both.

As a relatively new interdisciplinary endeavor, scientists in this field attempt to understand organismal interactions, both intra- and interspecific, mediated by chemical substances such as hormones, pheromones, kairomones and phytoalexins. These interactions occur at all taxonomic levels: between uni- and multicellular organisms, microbes and plants, plants and plants, plants and animals, microbes and animals and various species of animals. Study of such interactions has accelerated in recent years through joint efforts of biologists and chemists in basic and applied research in the laboratory and field.

### **Research Facilities**

Graduate research laboratories are located in Edwin C. Jahn Laboratory, a state-of-the-art, 70,000-square-foot research facility. These labs are well-equipped for chemical, polymer, and biochemical research. Available instrumentation includes: ICP-OES, ICP-MS, FTIR, GC/MS, high resolution MS, stable isotope mass spectrometer, MALDI/MS, UV/VIS, fluorescence, LC/MS, liquid and solid-state multinuclear NMR (300 and 600 MHz), and a complete thermal analysis suite (TGA, DSC, DMA). Ultra-structure study facilities include X-ray diffraction equipment, an atomic force microscope, and electron microscopes. Chromatographic equipment includes instrumentation for analytical and preparative liquid and gas chromatography. Jahn Laboratory is equipped for the use of radioisotopes in research including a separate radioisotope laboratory. Liquid and solid scintillation counters, and a multichannel analyzer are available. Other facilities include cw and nanosecond pulsed lasers, Linux computers for computational chemistry and atmospheric modeling, membrane and vapor phase osmometry, solution light-scattering photometers, dynamic oscillatory viscometer, tensile/compression test unit, and network access to the Internet. Field equipment includes a 17-foot boat with low emissions engine, water and sediment samplers, in-situ sensors for major chemical and physical parameters, fixed wavelength radiometers and spectroradiometers, and an atmospheric monitoring station on the roof of Jahn Lab.

# Department of Environmental and Forest Biology

DONALD J. LEOPOLD, Chair  
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[www.esf.edu/efb/](http://www.esf.edu/efb/)

Programs in environmental and forest biology provide students with a firm foundation in basic biology, ecosystem dynamics and environmental science. The programs encompass a variety of interconnected disciplines concerned with living systems, and treat not only the form, function and evolution of organisms, but their life requirements, tolerances, and interactions that are central to the stewardship of renewable natural resources and the maintenance of environmental quality.

Modern society places critical importance on natural resources and the quality of our environment has greatly broadened the services that a well-trained biologist can render. The faculty are committed to meet a dynamically changing array of opportunities through coursework enriched by an active program of research and professional experiences. The undergraduate programs, offered as seven distinct majors, prepare students for employment or graduate study in a broad range of disciplines. Graduate students may develop a course of study under the guidance of a major professor and graduate committee within any of several areas of study.

The academic programs stimulate interest in the recognition and understanding of plants, animals, fungi, bacteria and protists and deal with dynamic changes in biological systems in the context of ecology, conservation, physiology, genetics and evolution.

## Undergraduate Programs

The Department of Environmental and Forest Biology (EFB) offers seven undergraduate majors. Environmental biology is the broadest major and the degree program to which most students apply. The other six majors are specialized and are recommended only for students with strongly focused educational goals. They are: aquatic and fisheries science, biotechnology, conservation biology, forest health, natural history and interpretation, and wildlife science. For the first year or two the requirements of these programs are similar to those of environmental biology, and internal transfer among them is simple. Full program descriptions follow the discussions of general opportunities provided below.

### *Pre-health Professions*

Degrees in either environmental biology or biotechnology will prepare students for admission to a variety of professional schools in health-related areas, including human and veterinary medicine. A rigorous foundation in the basic biological sciences, calculus, physics and organic chemistry is provided by the core requirements of these majors. Potential electives include certain benchmark courses that admissions committees of professional schools frequently look for, such as comparative vertebrate anatomy and animal physiology. Pre-veterinary students will find strong supporting courses and faculty interest in vertebrate biology, and pre-medical students can pursue such relevant elective subjects as microbiology and environmental toxicology. In addition, ESF students take advantage of Syracuse University's broad array of relevant courses and the advising, counseling and resources of the Health Professions Advisory Program. Students can earn credit for a variety of internships, such as paid or volunteer work in clinics and other professional settings.

### **Internships**

A variety of internships are available, either in the summer or academic year. These are arranged in cooperation with the student's advisor and may carry course credits under EFB 420 Internship in Environmental and Forest Biology. Agencies actively involved with the internship program include the U.S. Fish and Wildlife Service, New York State Department of Environmental Conservation, Upstate Freshwater Institute, The Nature Conservancy, the National Park Service and the U.S. Geological Survey. Internships also are commonly associated with a local zoo. Field-based internships can, with approval, count toward the three-credit field experience elective required by most EFB degree programs.

### *Field Experience*

Field experience is a vital component of the programs in environmental and forest biology. Each student, except those in biotechnology, is required to attend a three-credit hour integrated course in field biology (EFB 202) at the Cranberry Lake Biological Station in the Adirondack Mountains, normally taken between the freshman and sophomore years. An additional three credits in a field experience elective are required, and this elective can be obtained at Cranberry Lake or through another approved field experience, either that same summer or subsequently. Students are encouraged to participate in as many field and internship experiences as possible during their college career. Additional field station courses beyond the six-credit requirement will be counted as elective credits. The College runs field programs in areas that recently have included Africa, Australia, Costa Rica, Ireland, Russia, and the Caribbean (Dominica). Additional opportunities exist in the School for Field Studies courses, which are offered around the world, as well as in many excellent programs throughout the United States. It is the student's responsibility to obtain current information on the various field stations and to work with an advisor to select courses that meet EFB program requirements and educational needs.

### **Cranberry Lake Biological Station (CLBS)**

[www.esf.edu/clbs](http://www.esf.edu/clbs)

The Cranberry Lake Biological Station is located along the southeastern shoreline of Cranberry Lake, the third largest body of water in the Adirondacks. Its environs are ideally suited for a biology summer program. The surrounding topography is rolling hill and lake country dotted with numerous small ponds, bogs and stream drainages. Because 80 percent of the shoreline is in state ownership, the lake remains pristine, unspoiled by recreational developments and pollution problems. Much of the original forest cover in the region was harvested a century ago; today a rich variety of community types occupies those sites as the vegetation reverts to mature forests. The remaining old-growth forests nearby also provide students with many examples of climax ecosystems, each type reflecting the particular environmental conditions controlling forest development. A wealth of wildlife parallels the variety of cover types. The area provides easy access to a wide range of additional ecosystems, ranging from bog to alpine vegetation.

Facilities include a wireless campus, four classroom-laboratories; a computer cluster; field and laboratory equipment; a dozen power boats; dining facilities for 120; faculty quarters and cabins; an administration building; 12 cabins housing six to eight students each; a recreation hall; and several smaller, supporting buildings.



The program extends from early June through mid-August, divided into two sessions. Courses are designed to emphasize and effectively utilize the unique nature of this Adirondack setting, and typically involve daily field trips into the surrounding forest, wetland, and aquatic ecosystems.

Information about the summer program, including courses and fees, may be obtained from the Director, Cranberry Lake Biological Station, State University of New York College of Environmental Science and Forestry, Syracuse, N.Y. 13210, or on the Internet at [www.esf.edu/clbs](http://www.esf.edu/clbs).

## Bachelor of Science in Aquatic and Fisheries Science

Aquatic and fisheries science is the study of aquatic ecosystems to increase scientific understanding and to apply basic ecological principles to their management, thereby sustaining them for multiple uses. Aquatic ecosystems include wetlands, streams, lakes, estuaries and oceans. Aquatic science professionals study and manage valued natural systems for seafoods, drinking water, recreation, transportation and aesthetics. Aquatic systems and their organisms are sufficiently distinct from terrestrial systems that numerous professional organizations and scientific journals have been founded specifically to foster communication among aquatic science professionals.

At ESF, Wilford E. Dence conducted pioneering studies on aquatic systems in New York in the early 1900s. The present aquatic program at ESF builds on that early tradition with a wide array of aquatic courses. Our program has national and international recognition and includes a balance of applied and basic aquatic science. Students in our program thus have the opportunity to interact with faculty and graduate students involved with diverse studies on aquatic systems.

Undergraduate students considering a career in aquatic and fisheries science need a solid foundation of basic sciences (math, chemistry, physics, statistics) combined with a broad training in organismal biology, ecology and evolution. Upper-division courses focus more specifically on aquatic systems and fishes, including field experience, methods of assessment and principles for management. Students should broaden themselves with studies on the natural history and diversity of various animal and plant groups. Other recommended subjects include communications, ecosystem science, social and economic principles, ecological modeling, and hydrology. ESF's many field stations provide important opportunities for field-oriented studies, both for taking formal courses and for directed independent research. Practical experiences such as a senior synthesis or internship also provide an important complement to formal courses.

Career opportunities for students with a B.S. in aquatic and fisheries science are in the areas of fisheries science, wetland science, limnology, marine biology and oceanography. Jobs are with federal and state agencies, research institutions, private consulting firms and non-governmental organizations, both local and international. The better students will have opportunities to continue with graduate studies, which will broaden career options and lead to positions with greater responsibility and higher salary. To pursue a career in research and teaching in a university, a Ph.D. is generally required.

## Undergraduate Program Requirements

### Required Courses (78 credits)

AP M	105	Survey of Calculus and Its Applications I Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed in <a href="http://www.esf.edu/catalog/GenEd.pdf">Undergraduate Education</a> and on the Internet at <a href="http://www.esf.edu/catalog/GenEd.pdf">www.esf.edu/catalog/GenEd.pdf</a>	G	4
AP M	391	Introduction to Probability and Statistics		3
EWP	190	Writing and the Environment (or English with a focus on writing)	G	3
EWP	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	101/ 102	General Biology I & Laboratory	G	4
EFB	103/ 104	General Biology II & Laboratory		4
EFB	120	The Global Environment & the Evolution of Human Society		3
EFB	132	Orientation Seminar: Environmental Biology Transfer students do not take EFB 132 and have one extra credit of open electives.		1
EFB	210	Diversity of Life I		3
EFB	211	Diversity of Life II		3
EFB	307/ 308	Principles of Genetics and Laboratory		4
EFB	311	Principles of Evolution		3
EFB	320	General Ecology		4
EFB	325	Cell Physiology		3
EFB	424	Limnology		3
EFB	486	Ichthyology		3

EFB	492	Senior Synthesis in Aquatic and Fisheries Science		1
FOR	207	Introduction to Economics	G	3
FCH	150/ 151	General Chemistry I and Laboratory		4
FCH	152/ 153	General Chemistry II and Laboratory		4
FCH	210	Elements of Organic Chemistry FCH 221 and 222, taken together, will satisfy the requirement for organic chemistry, but should be substituted only if FCH 223/224 is also planned as elective.		4
PHY	101	Major Concepts of Physics I Physics I also can be satisfied by PHY 211 and PHY 221, taken together. Physics II also can be satisfied by PHY 212 and PHY 222, taken together.		4
AP M	106	Survey of Calculus and Its Applications II <b>OR</b>		4
	102	Major Concepts of Physics II <b>OR</b>		4
PHY	223/ 224	Organic Chemistry II with laboratory		4

**The summer following the first or second year, students must take:**

EFB	202	Ecological Monitoring and Biodiversity Assessment (transfer students take this at their earliest opportunity)		3
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### Electives (48 credits)

General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations			G	6
Directed Electives				27
Open Electives				15

Total minimum credits for the degree 126 credits

### Directed Electives

At least three upper-division credits must be earned in each of the following subject areas. Lists of acceptable elective courses are available in the student handbook and from the curriculum coordinator.

1. Field Experience Elective
2. Animal Structure and Function
3. Organismal Diversity (three credits from each of two categories)
4. Plants and Microbes
5. Invertebrate and Vertebrate Animals
6. Physical/Chemical Environment
7. Environmental Systems Science
8. Management
9. Analytical Tools
10. Communications

## Bachelor of Science in Biotechnology

[www.esf.edu/biotech](http://www.esf.edu/biotech)

Biotechnology is the application of biological organisms, cells, or molecules to create products or services for the betterment of humans. The bachelor of science degree in biotechnology prepares students to tackle environmental, natural resource, agricultural and medical problems through training in molecular biology, cell biology, biochemistry, genetic engineering and related biological disciplines. As biotechnology is increasingly used to address such issues, it offers diverse career opportunities. The curriculum emphasizes the basic sciences with a strong foundation in biology, chemistry, calculus, and physics that prepares students for upper-level biology and chemistry courses, but encourages elective breadth in the social sciences, humanities, and environmental studies. The degree program provides sufficient breadth for a student to enter a clinical medical career, or other health profession. Students who complete this major will be qualified to enter the growing biotechnology-related job market or continue their studies in graduate or professional school.

### Internships, Independent Research, and Senior Project Synthesis

The biotechnology major features a strong practical experience component. Each student is required to fulfill an internship, which could be in a local, national, or international company, medical unit, or government research laboratory. The objective of this internship is to give students

experience working outside a purely academic setting. In addition, each student is required to perform one independent research project in a local, national, or international academic laboratory. The objective of the research requirement is to teach the student to develop and meet a research goal using the scientific method. During the senior year, each student is required to complete a senior project synthesis in which the results from either the internship or independent research—or both—will be organized and presented as a seminar or poster.

## Undergraduate Program Requirements

### Required Courses (83 credits)

APM	105	Survey of Calculus and Its Applications I Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed in <a href="#">Undergraduate Education</a> and on the Internet at <a href="http://www.esf.edu/catalog/GenEd.pdf">www.esf.edu/catalog/GenEd.pdf</a>	G	4
APM	106	Survey of Calculus and Its Applications II		4
BTC	132	Orientation Seminar: Biotechnology		1
BTC	401	Molecular Biology Techniques		4
BTC	497	Research Problem Design and Professional Development		1
BTC	498	Research Problems in Biotechnology		3
BTC	499	Senior Project Synthesis		1
EWP	190	Writing and the Environment (or English with a focus on writing)	G	3
EWP	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	101/2	General Biology I & Lab	G	4
EFB	103/4	General Biology II & Lab		4
EFB	210	Diversity of Life I		3
EFB	211	Diversity of Life II		
EFB	303	Introductory Environmental Microbiology		4
EFB	307/ 308	Principles of Genetics and Laboratory		4
EFB	320	General Ecology		4
EFB	325	Cell Physiology		3
FCH	150/ 151	General Chemistry I and Laboratory		4
FCH	152/ 153	General Chemistry II and Laboratory		4
FCH	221/ 222	Organic Chemistry I and Laboratory		4
FCH	223/ 224	Organic Chemistry II and Laboratory		4
FCH	530	Biochemistry I		3
FCH	532	Biochemistry II		3
PHY	101	Major Concepts of Physics I Physics I also can be satisfied by PHY 211 and PHY 221, taken together. Physics II also can be satisfied by PHY 212 and PHY 222, taken together.		4
PHY	102	Major Concepts of Physics II Physics I also can be satisfied by PHY 211 and PHY 221, taken together. Physics II also can be satisfied by PHY 212 and PHY 222, taken together.		4

The summer following the third year, students must take:

BTC	420	Internship in Biotechnology		3
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### Electives (40 credits)

General Education Course in three of the following categories: American History, The Arts, Western Civilization, Other World Civilizations			G	9
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Directed Electives		9
Open Electives		22

Total minimum credits for the degree 120 credits

### Directed and Open Electives

Nine credits of coursework related to biotechnology must be selected from a list of approved subjects, obtainable in the student handbook or from the curriculum coordinator. Twenty credits of open electives can be selected without subject constraints, with the help of a faculty advisor.

### Bachelor of Science in Conservation Biology

Conservation biology is the application of science to conserve the earth's imperiled species and ecosystems. The field is a relatively young one that is growing rapidly in response to the biodiversity crisis, perhaps the most critical environmental issue of our time. Conservation biologists view all of nature's diversity as important and having inherent value. This diversity spans the biological hierarchy and includes variation at the level of genes, populations, communities, ecosystems, and biomes.

A focus on biological diversity and an intrinsic valuation of nature is what distinguishes conservation biology from wildlife management (with its somewhat more utilitarian perspective and a focus on populations of birds and large mammals) and from general environmental biology (with a broad focus on environmental issues). Conservation biologists seek ways to integrate biological perspectives with social, economic, legislative and political ones to achieve conservation goals.

The courses associated with this major reflect the interdisciplinary and holistic nature of conservation biology. After obtaining a foundation in basic science communication, and general education subjects, students learn the evolutionary and ecological forces that have generated the patterns of biodiversity around us, through courses in organismal biology, evolutionary and systematic biology, population biology, ecology and ecosystem science.

An introductory course in conservation biology and one in problem solving in conservation biology familiarize students with the dimensions of the current biodiversity crisis and the management tools available to mitigate for it. These, in combination with a selection of advanced courses in conservation biology, a senior synthesis and an internship or research experience in conservation biology, cover the breadth of biological, social, political, and economic aspects of the biodiversity crisis.

The program prepares students for employment in a variety of government agencies at the municipal level (for example, as land use planners), state level (such as with the New York Department of Environmental Conservation or State Heritage Programs), federal level (such as with the U.S. Fish and Wildlife Service, U.S. Geological Survey, U.S. Forest Service, or National Park Service), and occasionally at the international level (such as with the United Nations Environment Programme). Many private conservation agencies such as The Nature Conservancy preferentially hire broadly trained conservation biologists. Ecological consulting firms are an increasingly important source of employment for conservation biologists. Training in conservation biology also provides a strong basis for postgraduate education and rewarding careers in research, teaching and environmental education.

### Undergraduate Program Requirements

#### Required Courses (68 credits)

APM	105	Survey of Calculus and Its Applications I Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed in <a href="#">Undergraduate Education</a> and on the Internet at <a href="http://www.esf.edu/catalog/GenEd.pdf">www.esf.edu/catalog/GenEd.pdf</a>	G	4
APM	391	Introduction to Probability and Statistics		3
EWP	190	Writing and the Environment (or English with a focus on writing)	G	3
EWP	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	101/ 102	General Biology I & Laboratory	G	4
EFB	103/ 104	General Biology II & Laboratory		4
EFB	120	The Global Environment & the Evolution of Human Society	G	3
EFB	132	Orientation Seminar: Environmental Biology Transfer students do not take EFB 132 and have one extra credit of open electives.		1
EFB	200	Physics of Life Physics also can be satisfied by PHY101 or by PHY 211 and PHY 221, taken together.		3
EFB	210	Diversity of Life I		3
EFB	211	Diversity of Life II		3
EFB	307/ 308	Principles of Genetics and Laboratory		4

EFB	311	Principles of Evolution		3
EFB	320	General Ecology		4
EFB	413	Introduction to Conservation Biology		3
EFB	414	Senior Synthesis in Conservation Biology		3
EFB	419	Problem Solving in Conservation Biology		3
EFB	420	Internship in Environmental and Forest Biology		3
EFB	498	Research Problems in Environmental and Forest Biology		
FCH	150/ 151	General Chemistry I and Laboratory		4
FCH	152/ 153	General Chemistry II and Laboratory		4

**The summer following the first or second year, students must take:**

EFB	202	Ecological Monitoring and Biodiversity Assessment (transfer students take this at their earliest opportunity)		3
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### Electives (58 credits)

General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations	G	6
Directed Electives		30
Open Electives		22

Total minimum credits for the degree 126 credits

### Directed Electives

Thirty credit hours of upper-division elective courses must be distributed among the following subject areas, as indicated. Lists of acceptable courses can be obtained from the student handbook or from the curriculum coordinator.

- Field Experience Elective (3 credits)
- Organismal Diversity (12 credits, at least three courses from any one of the following four categories)
  - Diversity of Microorganisms
  - Diversity of Plants
  - Diversity of Invertebrate Animals
  - Diversity of Vertebrate Animals
- Applied Conservation Biology (6 credits)
- Human Dimensions (3 credits)
- Communications and Interpretation (3 credits)
- Technical Skills (3 credits)

## Bachelor of Science in Environmental Biology

The curriculum for the bachelor of science degree in environmental biology is built around a core of required courses that provides a general education, a background in the principles of biological and physical science, and an orientation to natural resources and other environmental concerns. From this common foundation, the large number of elective credits allows each student to develop a unique plan of study, with the help of an assigned advisor who is expert in the student's general area of interest. In keeping with the hands-on, field orientation of our curriculum, students also must complete six credit hours of field experience.

With appropriate electives, students who complete the degree program will meet requirements for a wide range of federal, state, municipal and private-sector positions that call for training in biological sciences. (Students interested in federal and state positions should review civil service publications and become familiar with specific course requirements early enough to make timely elective choices.) General subject requirements for graduate study in virtually any area of biology also will be met.

Environmental biology is the broadest of the seven biology majors at ESF, covering topics from molecules to ecosystems to regional landscapes, but nearly all the courses in the specialized areas are also available as electives. Sufficient elective space exists to allow completion of a minor during the four-year program. In choosing electives, some students sample from the widest spectrum of classes in environmental biology; this is common for those wishing to enter graduate school for further, career-oriented education. Other students focus their electives to some extent, depending on their interests and their educational and career goals.

Through a joint degree program with Syracuse University, students pursuing the B.S. in environmental biology can couple a strong program in basic biological sciences with necessary education courses required to qualify for certification as biology teachers in grades 7-12 under New York regulations. See [Coordinated Programs with Syracuse University](#).

## Undergraduate Program Requirements

### Required Courses (67 credits)

Courses			Credits	
APM	105	Survey of Calculus and Its Applications I Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed in <a href="#">Undergraduate Education</a> and on the Internet at <a href="http://www.esf.edu/catalog/GenEd.pdf">www.esf.edu/catalog/GenEd.pdf</a>	G	4
APM	391	Introduction to Probability and Statistics		3
EWP	190	Writing and the Environment (or English with a focus on writing)	G	3
EWP	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	101/ 102	General Biology I & Laboratory	G	4
EFB	103/ 104	General Biology II & Laboratory		4
EFB	120	The Global Environment & the Evolution of Human Society	G	3
EFB	132	Orientation Seminar: Environmental Biology Transfer students do not take EFB 132 and have one extra credit of open electives.		1
EFB	200	Physics of Life Physics also can be satisfied by PHY 101 or by PHY 211 and PHY 221, taken together; if elected, Physics II can be satisfied by either PHY 102 or PHY 212/222.		3
EFB	210	Diversity of Life I		3
EFB	211	Diversity of Life II		3
EFB	307/ 308	Principles of Genetics and Laboratory		4
EFB	311	Principles of Evolution		3
EFB	320	General Ecology		4
EFB	325	Cell Physiology		3
FCH	150/ 151	General Chemistry I and Laboratory		4
FCH	152/ 153	General Chemistry II and Laboratory		4
FCH	210	Elements of Organic Chemistry FCH 221 and 222, taken together, will satisfy the requirement for organic chemistry, but should be substituted only if FCH 223/224 is also planned as elective.		4
APM	106	Survey of Calculus and Its Applications II		4
PHY	102	Major Concepts of Physics II		4
FCH	223/ 224	Organic Chemistry II with laboratory		4

**The summer following the first or second year, students must take:**

EFB	202	Ecological Monitoring and Biodiversity Assessment (transfer students take this at their earliest opportunity)		3
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### Electives (59 credits)

General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations			G	6
Directed Electives				25
Open Electives				28

Total minimum credits for the degree 126 credits

## Directed Electives

At least 25 upper-division credits must be earned in biological coursework. Among these, the following subject distribution requirements must be met. Lists of acceptable elective courses are available in the student handbook and from the curriculum coordinator.

- Field Experience Elective (3 credits)
- Organismal Structure and Function (3 credits)
- Organismal Diversity (6 credits, 3 from two of the following four categories)
  - Diversity of Microorganisms
  - Diversity of Plants
  - Diversity of Invertebrate Animals
  - Diversity of Vertebrate Animals

## Bachelor of Science in Forest Health

Forest health is a multidisciplinary and collaborative field of study that involves the understanding, monitoring, and protection of the world's forest resources. A solid foundation in forest health requires expertise in many disciplines including, but not limited to, plant pathology, entomology, ecology, dendrology, mycology, silviculture, and forest management. At ESF, we have provided academic training in these areas for decades, but only recently have they been merged into an academic major.

The forest health major prepares biology-oriented students for employment in positions that deal with maintaining the health of forest resources. The major is distinct from those in the Department of Forest and Natural Resources Management and its forest ecosystem science major, which provides skills and preparation in forest management. Employers today have expressed a need for a deeper understanding of the science behind the trees. Positions requiring a forest health background are found in federal and state agencies, nonprofit organizations, and the private sector. With good performance, the forest health major prepares students for graduate study in preparation for higher-level positions, such as forest pathologist, entomologist, or mycologist.

The curriculum provides a solid foundation in mathematics and the physical sciences (chemistry, physics) followed by courses focusing on forest trees and their requirements, the basic ecological principles that shape forest ecosystems, and the management of these ecosystems. Other required courses introduce students to the identification and impact of biological agents of disease and physical damage, and to the methods by which these are monitored. The flexibility of the major will permit students to pursue more intensive training in integral forest health specialties, such as forest pathology and forest entomology, or to obtain even broader knowledge in related fields such as forestry, microbiology, mycology, conservation biology, and ecology. Field experience is an important element of the program and is integral to several required courses and many of the directed electives. Two of the requirements are field courses at the Cranberry Lake Biological Station.

## Undergraduate Program Requirements

### Required Courses (85 credits)

APM	391	Introduction to Probability and Statistics Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed in <a href="#">Undergraduate Education</a> and on the Internet at <a href="http://www.esf.edu/catalog/GenEd.pdf">www.esf.edu/catalog/GenEd.pdf</a>	G	3
EWP	190	Writing and the Environment (or English with a focus on writing)	G	3
EWP	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	101/ 2	General Biology I & Lab	G	4
EFB	103/ 4	General Biology II & Lab		4
EFB	120	The Global Environment & the Evolution of Human Society	G	3
EFB	132	Orientation Seminar: Environmental Biology Transfer students do not take EFB 132 and have one extra credit of open electives.		1
EFB	200	Physics of Life Physics also can be satisfied by PHY 101 or by PHY 211 and PHY 221, taken together		3
EFB	210	Diversity of Life I		3
EFB	211	Diversity of Life II		3
EFB	303	Introduction to Environmental Microbiology		4
EFB	307/ 308	Principles of Genetics and Laboratory		4
EFB	311	Principles of Evolution		3

EFB	320	General Ecology		4
EFB	336	Dendrology		3
EFB	340	Forest and Shade Tree Pathology		3
EFB	351	Principles of Forest Entomology		3
EFB	352	OR Elements of Entomology		
EFB	420	Internship in Environmental and Forest Biology		3
EFB	498	OR Research Problems in Environmental and Forest Biology		
EFB	439	Forest Health Monitoring		3
EFB	494	Senior Synthesis in Forest Health		1
FCH	150/ 151	General Chemistry I and Laboratory		4
FCH	152/ 153	General Chemistry II and Laboratory		4
FCH	210	Elements of Organic Chemistry FCH 221 and 222, taken together, will satisfy the requirement for organic chemistry, but should be substituted only if FCH 223/224 is also planned as elective.		4
FOR	321	Forest Ecology and Silviculture		3
FOR	345	Introduction to Soils		3

**The summer following the first or second year, students must take:**

EFB	202	Ecological Monitoring and Biodiversity Assessment (transfer students take this at their earliest opportunity)		3
EFB	345	Forest Health (CLBS)		3

### Electives (41 credits)

General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations	G	6
Directed Electives		15
Open Electives		20

Total minimum credits for the degree 126 credits

### Directed Electives

Fifteen credit hours of electives related to forest health are required distributed among five (of seven) topic areas: forest protection and conservation biology; forestry/wood products; technology; ecology and environmental science; biodiversity; mathematics and physical sciences; and anatomy and physiology. A list of approved courses can be found in the student handbook or obtained from the curriculum coordinator.

### Bachelor of Science in Natural History and Interpretation

Natural history is the description of nature and differs from ecology in placing less emphasis on quantification and more on careful observation. The overarching goal is to elucidate patterns and relationships in the natural world and assimilate this information into human affairs. It uses traditional and modern tools, often with an aesthetic component, to differentiate the natural world, and focuses on identification, life history, distribution, abundance and interrelationships among and between individuals, populations and species. The field has a long and distinguished history including figures such as Darwin, Wallace and E. O. Wilson who are recognized for their seminal contributions to biology and ecology. Following a meteoric rise in popularity during the 19th century, natural history declined as new experimental and quantitative approaches came to dominate biology. In recent years, however, both the recognition of the role of biology in a holistic view of the planet, and the increasing emphasis on the value of education as the key to a sustainable future, have brought about a resurgence of interest in natural history and, crucially, its interpretation. Interpretation is defined as a communications process that reveals meanings and relationships about natural, cultural, historical and recreational resources. While interpretation may be viewed as a process to communicate any subject matter, historically it has always been linked with natural history. The methods of interpretation were forged by naturalists.

Interpretation and environmental education work hand in hand to help make connections between the world of science and the general public. Through the art of interpretation, students will learn how to help people make connections with the natural world and science.

The courses associated with the undergraduate major in natural history and interpretation reflect the interdisciplinary and holistic nature of this subject area. Students become well grounded in the natural sciences and in the skills specific to communication and informal education. This major seeks to integrate training in organismal biology, including a required field component, with in-depth training in the literature and context of natural history and a suite of environmental interpretation offerings. Students gain work experiences through an internship, where the recently acquired knowledge and skills in this arena can be applied.



The program prepares students for employment in nature centers, science museums, federal and state agencies, zoos, urban parks, arboreta, environmental education centers and aquaria, as well as in the ecotourism industry and travel agencies that sponsor natural history opportunities, such as birding and whale watching. Training in natural history and interpretation also provides a strong basis for a rewarding career in teaching and can act as a springboard for entry into graduate programs.

## Undergraduate Program Requirements

### Required Courses (74 credits)

APM	105	Survey of Calculus and Its Applications I Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed in <a href="#">Undergraduate Education</a> and on the Internet at <a href="http://www.esf.edu/catalog/GenEd.pdf">www.esf.edu/catalog/GenEd.pdf</a>	G	4
APM	391	Introduction to Probability and Statistics		3
EWP	190	Writing and the Environment (or English with a focus on writing)	G	3
EWP	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	101/ 102	General Biology I and Laboratory	G	4
EFB	103/ 104	General Biology II and Laboratory		4
EFB	120	The Global Environment & the Evolution of Human Society	G	3
EFB	132	Orientation Seminar: Environmental Biology Transfer students do not take EFB 132 and have one extra credit of open electives.		1
EFB	200	Physics of Life		3
EFB	210	Diversity of Life I		3
EFB	211	Diversity of Life II		3
EFB	215	Interpreting Science Through Art	G	3
EFB	307/ 308	Principles of Genetics and Laboratory		4
EFB	311	Principles of Evolution		3
EFB	320	General Ecology		4
EFB	404	Natural History Museums and Modern Science		3
EFB	405	Literature of Natural History		2
EFB	406	Great Naturalist Seminar		1
EFB	416	Introduction to Environmental Interpretation		3
EFB	420	Internship in Environmental and Forest Biology		3
FOR	372	Fundamentals of Outdoor Recreation		3
FCH	150/ 151	General Chemistry I and Laboratory		4
FCH	152/ 153	General Chemistry II and Laboratory		4
PHY	101	Major Concepts of Physics I Physics also can be satisfied by PHY 101 or by PHY 211 and PHY 221, taken together.		4

**The summer following the first or second year, students must take:**

EFB	202	Ecological Monitoring and Biodiversity Assessment (transfer students take this at their earliest opportunity)		3
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### Electives (52 credits)

General Education Course in one of the following categories: American History, The Arts, Western Civilization, Other World Civilizations			G	3
Directed Electives				24
Open Electives				25

Total minimum credits for the degree 126

### Directed Electives

Twenty-four credit hours in upper-division coursework must be distributed among the following subject areas, as indicated. Depending on category, acceptable courses are listed below or can be found in lists in the student handbook or obtained from the curriculum coordinator.

- Conservation Biology (3 credits): EFB 490 Wildlife Ecology and Management or EFB 413 Introduction to Conservation Biology
- Advanced Communication (3 credits): EWP 405 Writing for Science Professionals or LSA 301 Digital Graphics and Documents (2 credits) with LSA 302 3D Modeling (1 credit)
- Advanced Interpretation (3 credits): EFB 417 Perspectives of Interpretive Design
- Organismal Diversity (12 credits): four courses, at least one from each group
  - Diversity of Microorganisms
  - Diversity of Plants
  - Diversity of Invertebrate Animals
  - Diversity of Vertebrate Animals
- Field Experience Electives (3 credits)

### Bachelor of Science in Wildlife Science

Wildlife science is the application of ecological knowledge in a manner that strikes a balance between the needs of wildlife populations and the needs of people. Research and teaching in wildlife science began at ESF in 1914, one of the first such programs in the United States and was quickly followed by establishment of the Roosevelt Wild Life Station in 1919. Today, our program is recognized nationally and internationally, and our graduates are employed worldwide. The focus is applied wildlife ecology, and students engage the environmental challenges associated with managing wildlife, ranging from endangered species to overabundant populations. The program recognizes and accommodates the fact that wildlife scientists increasingly must deal with all forms of wildlife, including plants and invertebrates, and the scope is becoming more international.

Students obtain background in the basic sciences (math, chemistry, physics), then learn the basic ecological principles and evolutionary forces that affect wildlife and their associated habitats. Coursework then addresses the assessment and management of wildlife resources as well as the biology and natural history of various taxonomic groups. Students are advised to enhance career opportunities via taxonomic proficiency with one or more plant or animal groups, special skills such as GIS, and practical working experience as an intern, volunteer or paid employee of a conservation agency.

The program prepares students for careers with state and federal agencies as well as an array of domestic and international non-governmental organizations. Diverse job functions include management of wildlife on state, federal or private lands; inventory and assessment of wildlife populations and associated habitats; and interaction with the public to convey the value and rationale of wildlife conservation programs and initiatives. Students who excel academically will also be prepared to continue toward a graduate degree, which can greatly expand employment opportunities and is often necessary for even entry-level, career-track positions.

Undergraduates in wildlife science take advantage of ESF's field stations, which are unmatched nationally and provide myriad opportunities. These properties include the 15,000-acre Adirondack Ecological Center and the Cranberry Lake Biological Station in the Adirondacks, as well as the Heiberg Forest south of Syracuse. Many of the courses taken by wildlife science undergraduates include field exercises at these facilities, and the properties are also used for undergraduate research and other projects in which undergraduate students can become involved.

### Undergraduate Program Requirements

#### Required Courses (67 credits)

APM	105	Survey of Calculus and Its Applications I Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed in <a href="#">Undergraduate Education</a> and on the Internet at <a href="http://www.esf.edu/catalog/GenEd.pdf">www.esf.edu/catalog/GenEd.pdf</a>	G	4
APM	391	Introduction to Probability and Statistics		3
EWP	190	Writing and the Environment (or English with a focus on writing)	G	3
EWP	290	Writing, Humanities and the Environment (or literature with a focus on writing)	G	3
EFB	101/ 102	General Biology I & Laboratory	G	4
EFB	103/ 104	General Biology II & Laboratory		4
EFB	120	The Global Environment & the Evolution of Human Society	G	3
EFB	132	Orientation Seminar: Environmental Biology Transfer students do not take EFB 132 and have one extra credit of open electives.		1

EFB	210	Diversity of Life I		3
EFB	211	Diversity of Life II		3
EFB	307/ 308	Principles of Genetics and Laboratory		4
EFB	311	Principles of Evolution		3
EFB	320	General Ecology		4
EFB	390	Wildlife Ecology and Management		4
EFB	491	Applied Wildlife Science		3
EFB	493	Wildlife Habitats and Populations		4
FCH	150/ 151	General Chemistry I and Laboratory		4
FCH	152/ 153	General Chemistry II and Laboratory		4
EFB	200	Physics of Life		3
		<b>OR</b>		<b>OR</b>
FCH	210	Elements of Organic Chemistry		4

**The summer following the first or second year, students must take:**

EFB	202	Ecological Monitoring and Biodiversity Assessment (transfer students take this at their earliest opportunity)		3
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### Electives (59 credits)

General Education Course in two of the following categories: American History, The Arts, Western Civilization, Other World Civilizations			G	6
Directed Electives				24
Open Electives				29

Total minimum credits for the degree 126 credits

### Directed Electives

Twenty-four credits must be obtained in the following subject areas, through specified courses that are designed for juniors or seniors (i.e., courses numbered 300 or higher). Lists of acceptable courses are available from the student handbook and the curriculum coordinator. The subject areas are:

- Field Experience (3 credits)
- Vertebrate Diversity (6 credits)
- Plant Diversity (3 credits)
- Invertebrate Diversity (3 credits)
- Policy (3 credits)
- Structure and Function (3 credits)
- Technical Skills (3 credits)

### Graduate Program

The graduate program in environmental and forest biology is organized in areas of study designed to provide a strong background within specific interest areas. Faculty with nationally and internationally recognized expertise define the scope of subject matter within each study area, recommend acceptance of students, and guide them through a course of study appropriate to student goals and aspirations. Most students develop a degree of depth and specialization in at least one large taxonomic group, such as plants, fungi, vertebrates, or insects.

**M.S.** — The master of science degree entails a research-based thesis (6-12 credits of thesis research) in addition to 18-24 credits of graduate coursework (including special research topics and at least three seminars) for a total of at least 30 graduate credits. Students earning a M.S. degree find a much wider range of job options that have greater responsibilities and pay compared to jobs that require only a B.S. degree. Many jobs at the M.S. level require an ability to perform research. Students interested in research-type positions in government, non-profit organizations, and academic and industry settings should pursue a M.S., rather than M.P.S. degree. Additionally, although not required by many graduate schools, a M.S. degree is often a key step toward earning a Ph.D. The M.S. student presents a thesis proposal to the major professor and committee who will guide completion of the research and writing of the thesis. A capstone seminar and defense of thesis are required.

**M.P.S.** — The master of professional studies degree requires graduate coursework credits and graduate seminars. Depending on the area of study, students may complete the M.P.S. degree with coursework and seminars, or a combination of coursework, seminars, and professional experience (internship). The M.P.S. degree is designed to accommodate a great breadth of student goals and needs, including students desiring

additional education following some experience in their field, and science teachers seeking the master's degree for permanent certification. As in all degree programs in EFB, the student will be guided through the M.P.S. by a steering committee.

Coursework Option for the following areas of study: chemical ecology, conservation biology, ecology, entomology, environmental interpretation, environmental physiology, fish and wildlife biology and management, forest pathology and mycology, or plant science and biotechnology: At least 30 of the 42 credits required must be taken in residence at ESF. Coursework in this option includes seminars (EFB 797), and a maximum of six credits earned in EFB 798, or 898. Neither a comprehensive examination nor a capstone seminar is required.

Coursework Option for the area of study in applied ecology: Coursework requirements include three credit hours each from five of the seven focus areas, two credit hours in graduate seminars (EFB 797) and additional 19 credit hours of graduate coursework for a total of 36 credit hours. Neither a comprehensive examination nor a capstone seminar is required.

Coursework Option for the area of study in biotechnology: Coursework requirements consist of 19 credit hours of core coursework including two credit hours of graduate seminars (EFB 797), nine credit hours of directed electives and eight credit hours of open electives for a total of 36 credit hours. Neither a comprehensive examination nor a capstone seminar is required.

Professional Experience Option for the following areas of study: chemical ecology, conservation biology, ecology, entomology, environmental interpretation, environmental physiology, fish and wildlife biology and management, forest pathology and mycology, or plant science and biotechnology: In addition to an internship earning 6-12 credits (EFB 898), this option requires at least 30 credits of graduate coursework, of which 24 must be taken in residence at ESF. At least 36 credits must be earned between internship and coursework. Coursework for this option includes seminars (EFB 797) and a maximum of three credits earned in EFB 798. A written report of the internship is required as well as an oral comprehensive exam and capstone seminar. For students completing the concurrent degree program (M.P.S./M.S.) leading to certification in biology (7-12), 12 credits of student teaching and coursework will be accepted as equivalent to a professional experience.

**Ph.D.** — The doctor of philosophy degree may be pursued directly from the bachelor's level, or following a master's degree program. Doctoral study culminates in a dissertation (or its equivalent as refereed publications) based on original research. In many cases this work serves as a foundation for future studies and publications throughout the student's career. Research activity is often funded through extramural grants to the student's major professor. Abundant opportunities exist to gain teaching experience during the doctoral program. A written and oral examination is required to proceed to doctoral candidacy, at least one year prior to the capstone seminar and defense of the dissertation. Of the 60 credits required, 30-48 are awarded for coursework (including special research topics and at least five seminars) and 12-30 credits for the dissertation.

## Facilities and Academic Setting

The center of activity for environmental and forest biology is Illick Hall, with laboratories, classrooms, growth chambers, and equipment in a modern building in which 8,000 square meters of working space is available for graduate study and research. Laboratories, many of them temperature controlled, are provided for study and research in plant development, physiology, tissue culture, molecular biology, biochemistry and toxicology, ecology and animal behavior. An herbarium, mycological collections, insect and other invertebrate collections, and the Roosevelt Wild Life Collection of vertebrates are maintained as resources for the academic program. Eight rooftop glasshouse units are important to the full array of interests in plant science and plant-animal interactions. An important catalyst for graduate studies is the Roosevelt Wild Life Station, which helps to focus teaching, research and outreach in field studies.

Students and faculty have access to a variety of sophisticated instrumentation; a computer center and many computer clusters; diverse analytical equipment and measuring devices, including automated DNA sequencer; gas-liquid chromatography; and comprehensive analytical expertise. The N.C. Brown Center for Ultrastructure Studies offers coursework and research in scanning and transmission electron microscopy.

Supportive to the program are the academic resources and courses at Syracuse University, SUNY's Upstate Medical University and the several campus facilities described elsewhere in this catalog. Our students also participate in courses and utilize faculty and facilities at Cornell University and several SUNY campuses in cooperative exchanges.

Excellent field sites and facilities are available for research in all aspects of the program. In addition to the College's several campuses and field stations that offer a broad diversity of forest types, sites and conditions, there are New York state Department of Environmental Conservation lands, the Montezuma National Wildlife Refuge, the Adirondack and Catskill Mountains and the transition zones near Lake Ontario, Oneida Lake and Cicero Swamp. These areas offer a variety of habitat diversity from aquatic, wetland and terrestrial zones. The ponds, streams and lakes in Central New York and the St. Lawrence River are regularly used by graduate students in aquatic ecology, fisheries biology and ecosystem science. Faculty and students have access to a broad array of boats, motors, nets and sophisticated field sampling instrumentation.

Additional academic facilities enhancing the graduate program include the Adirondack Ecological Center ([www.esf.edu/aec](http://www.esf.edu/aec)) and the Roosevelt Wild Life Station ([www.esf.edu/rwls/](http://www.esf.edu/rwls/)).

Further academic advantages stem from the urban setting of the Syracuse campus. Nearby Onondaga Lake serves as a focus for many research and teaching activities. The greater Syracuse area provides a convenient laboratory for studies basic to urban ecology: urban wildlife, the conservation of natural areas, greenspace maintenance, the ecological restoration of waste beds and other badly degraded lands and waters, and the detoxification of pollutants. Disposal of industrial and human wastes requires deeper understanding of the role of plants, animals and microorganisms in the biodegradation of organic matter. The conversion of organic materials into energy (biofuels), into additives for plant growth, or into protein feeds for domestic animals are stimulating topics.

## Funding Opportunities

In addition to graduate assistantships, various awards are available to graduate students in environmental and forest biology. These include the Alexander Wetlands Award, the Betty Moore Chamberlaine Award, Henrietta and John Simeone Fellowship in Forest Entomology, the Robert L. Burgess Graduate Scholarship in Ecology, the Josiah L. Lowe – Hugh Wilcox Graduate Fellowship, the Leroy C. Stegeman Award, and the Robert Zabel Award. These awards are decided upon by a department committee selection process.

## Areas of Study

Eleven areas of graduate study are available: applied ecology, conservation biology, ecology, entomology, environmental interpretation, environmental physiology, fish and wildlife biology and management, forest pathology and mycology, plant biotechnology, and plant science

and biotechnology. One area, chemical ecology, is shared with the Department of Chemistry. Additional information on each of these areas of study is available by telephone, email or written request to any of the professors listed. Programs that bridge two or more areas may be developed by the student and steering committee.

### **Applied Ecology (M.P.S)**

Participating Faculty: BALDASSARRE (Wetlands, Waterfowl), COHEN (Wildlife Ecology and Management), DOVCIAK (Forest Ecology, Ecosystem Management and Restoration), FARRELL (Riverine Fish Ecology, Freshwater Coastal Wetlands, Great Lakes), FIERKE (Forest Insects, Tree Defenses), FRAIR (Vertebrate and Landscape Ecology), GIBBS (Vertebrate Conservation Biology), C. HALL (Systems Ecology), HORTON (Ecology, Fungal Communities, Mycorrhizal Relationships), KIMMERER (Bryocology, Restoration Ecology), LEOPOLD (Forest and Wetland Ecology, Restoration Ecology), LIMBURG (Fish Ecology), LOMOLINO (Mammalian Diversity, Biogeography), MCGEE (Plant Ecology), MCGRATH (Aquatic Ecology), MCNULTY (Forest Ecology), MITCHELL (Biogeochemistry), NAKAS (Microbiology), NEWMAN (Phytoremediation), NORTON (Invertebrates), PARRY (Forest Insects, Biological Control), RINGLER (Aquatic Ecology, Fish Behavior), RYAN (Disease and Landscape Ecology, Climate Change), SCHULZ (Limnology), SHIELDS (Vertebrate Behavior), STEWART (Aquatic Ecology), TURNER (Physiological Ecology), WEIR (mycology), WHIPPS (Infectious Diseases of Fish)

This area of study in the M.P.S. degree is designed for students who desire to solidify their background in applied ecology and professionals who would return for "retooling"; suitable for careers in environmental oversight, policy, planning, law, and education. This program begins with a three-day orientation in August at one or more of the ESF field facilities. Coursework requirements include three credit hours each from five of the seven focus areas: *GIS tools, Statistical Tools, Specialty Tools, Ecosystem Ecology, Organismal Ecology, Human Dimensions in Ecology, and Communications in Ecology*; two credit hours in graduate seminars (EFB 797) and additional 19 credit hours of graduate coursework for a total of 36 credit hours. A complete list of courses in each focus area is available from the graduate program director.

### **Conservation Biology (M.S., M.P.S., Ph.D.)**

Participating Faculty: BALDASSARRE (Wetlands, Birds, Waterfowl), COHEN (Threatened and Endangered Species), DOVCIAK (Plant Ecology), FARRELL (Riverine Fish Ecology, Freshwater Coastal Wetlands, Great Lakes), FIERKE (Forest Insects), FRAIR (Vertebrate and Landscape Ecology), GIBBS (Vertebrate Conservation Biology), C. HALL (Systems Ecology, GIS), HORTON (Ecology, Fungal Communities, Mycorrhizal Relationships), KIMMERER (Plant Restoration Ecology, Bryology), LEOPOLD (Wetlands, Restoration Ecology, Rare Species Conservation), LIMBURG (Riverine Fish and Estuarine Ecology), LOMOLINO (Mammalian Diversity, Biogeography), MCGRATH (Aquatic Ecology and Restoration), MCNULTY (Forest Ecology), NORTON (Ecology and Evolution, Invertebrates, Arachnids), PARRY (Insects, Biological Control, Invasive Species), POWELL (Genetic Engineering in Plant Conservation), RINGLER (Aquatic and Fisheries Restoration, Fish Ecology and Behavior), RYAN (Wildlife Conservation), SCHULZ (Aquatic Ecology, Plankton), SHIELDS (Conservation Theory, Genetics, Behavior in Birds and Mammals, Forensic DNA Analysis), STEWART (Tropical Fish Ecology and Systematics, Lake Systems Ecology), TEALE (Insect Behavior, Pheromones), TURNER (Physiological Ecology), UNDERWOOD (Wildlife Ecology), WEIR (Conservation Mycology), WHIPPS (Fish Conservation and Molecular Systematics)

This area entails study and maintenance of biological diversity at the level of genes, populations, communities, ecosystems and biomes; intellectual underpinnings include evolutionary theory, systematic biology, population biology and ecosystem science. Conservation biology seeks ways to integrate biological principles with social, economic and political perspectives to achieve conservation goals.

The field is a response of the scientific community to the biodiversity crisis. Conservation biologists view nature's diversity as important and having inherent value. Training in this field includes experience with the fundamental disciplines and theory of conservation biology, as well as specialization in conservation issues. Students are encouraged to explore the human dimensions of biological conservation through coursework in other departments of the College, and to acquire firsthand experience in the application of biological knowledge to problems by working for a conservation agency. Students find employment in a variety of government and private conservation agencies and in academic institutions. Many also work as administrators, policymakers, teachers and communicators. Current research areas in conservation biology include global climate change, endangered species biology, conservation genetics theory and practice, behavioral ecology, habitat fragmentation, restoration ecology, exotic species biology and control, forest and wetland ecosystem management, tropical ecology, ecological monitoring, conservation education and harvest management.

### **Ecology (M.S., M.P.S., Ph.D.)**

Participating Faculty: BALDASSARRE (Wetlands, Waterfowl), COHEN (Wildlife Ecology), DOVCIAK (Forest Ecology, Ecosystem Management and Restoration), FARRELL (Riverine Fish Ecology, Freshwater Coastal Wetlands, Great Lakes), FIERKE (Forest Insects, Tree Defenses), FRAIR (Vertebrate and Landscape Ecology), GIBBS (Vertebrate Conservation Biology), C. HALL (Systems Ecology), HORTON (Ecology, Fungal Communities, Mycorrhizal Relationships), KIMMERER (Bryocology, Restoration Ecology), LEOPOLD (Forest and Wetland Ecology, Restoration Ecology), LIMBURG (Fish Ecology), LOMOLINO (Mammalian Diversity, Biogeography), MCGEE (Plant Ecology), MCGRATH (Aquatic Ecology), MCNULTY (Forest Ecology), MITCHELL (Biogeochemistry), NAKAS (Microbiology), NORTON (Invertebrates), PARRY (Forest Insects, Biological Control), RINGLER (Aquatic Ecology, Fish Behavior), RYAN (Landscape Ecology), SCHULZ (Limnology), SHIELDS (Vertebrate Behavior), STEWART (Aquatic Ecology), TURNER (Physiological Ecology), WEIR (Mycology)

This integrative study area allows students to investigate the relationships of organisms to their environment and those factors that affect their distribution and abundance. Both the practical and theoretical applications of ecology are emphasized through courses and research. There are four major areas in ecology: organismal ecology, population-evolutionary ecology, community ecology and systems ecology. In consultation with the student's steering committee, courses are chosen from these areas, as well as other disciplines. Specific research may encompass any of the four major areas of ecology and entail the study of the distribution and abundance of organisms, community structure including trophic relationships, diversity, succession and ecosystem properties, such as patterns of energy transfer and biogeochemical cycling.

### **Entomology (M.S., M.P.S., Ph.D.)**

Participating Faculty: CASTELLO (Virology, Insect Vectors), FIERKE (Forest Insects, Tree Defenses), NAKATSUGAWA (Toxicology), NORTON (Soil Arthropods, Systematics), PARRY (Forest Insects, Biological Control), RINGLER (Aquatic Entomology), TEALE (Insect Pheromones), TURNER (Physiology)

Graduate study opportunities prepare students in the basic aspects of insect life and the role of insects in relation to humans and their environment. The wide range of effects stemming from insect activity, from the beneficial to the deleterious, allows for a variety of research subjects in which insects play a major role. Thesis topics may concern insects that affect forests, shade trees and wood products, those relating to the health and well-being of humans, those playing key roles as parasites and predators of pest species, and those serving as food for many birds and vertebrate animals. Current research areas include population dynamics of forest defoliators, pheromone communications in beetles and moths, evolution of chemical communication, effects of forest practices on stream benthic insects, natural control of insects in forest systems and biochemistry of insect detoxification mechanisms.

### **Environmental Interpretation (M.S., M.P.S., Ph.D.)**

Participating Faculty: COHEN (Wildlife Ecology), FIERKE (Forest Entomology), FOLTA (Natural History Interpretation, Informal Biology Education, Environmental Education), GIBBS (Conservation Biology), HORTON (Mycology, Plant Ecology), LEOPOLD (Freshwater Wetlands, Forest Ecology, Rare Plants), MCGEE (Forest Ecology), TEALE (Insect Ecology, Pest Management), WEIR (Fungi and Humans)

Environmental interpretation sharpens the cutting edge of communication among scientists and various public sectors. Graduate study enables students to explore interpretation/conservation education processes through application to specific projects in the natural sciences and science education. Students pursue career pathways in natural resource agencies, in nature centers, museums, aquaria, botanical gardens and especially in the science classroom. The environmental interpretation program incorporates a 15,000-acre reserve in the heart of the Adirondack Park and an associated Adirondack Interpretative Center with trail system. Internships and partnerships with a variety of conservation-based programs are vital to the program. Students develop their course of study from a large palette of graduate courses in Environmental and Forest Biology.

### **Environmental Physiology (M.S., M.P.S., Ph.D.)**

Participating Faculty: CASTELLO (Plant Virology), FERNANDO (Plant Developmental Biology), MITCHELL (Environmental Energetics), NAKAS (Microbial Physiology), NAKATSUGAWA (Insect and Vertebrate Toxicology), NEWMAN (Plant Physiology), RYAN (Disease Ecology), TURNER (Animal Physiology), WHIPPS (Fish Pathology)

Environmental physiology provides students with advanced training in the nature and control of biological processes. Current interests include: mechanisms of drought tolerance in plants; plant and microbial enzymology; virology; toxicity and disposition of insecticides and environmental toxicants in vertebrates; plant defenses against phytophagous invertebrates; thermal exchange in bird eggs; plant reproductive biology; and genetic improvement of willow and poplar.

### **Fish and Wildlife Biology and Management (M.S., M.P.S., Ph.D.)**

Participating Faculty: BALDASSARRE (Waterfowl), COHEN (Wildlife Ecology and Management), FARRELL (Riverine Fish Ecology, Freshwater Coastal Wetlands, Great Lakes), FRAIR (Vertebrate and Landscape Ecology), GIBBS (Vertebrate Conservation Biology), LIMBURG (Fish and Riverine Ecology), LOMOLINO (Mammalian Diversity, Biogeography), MCGRATH (Aquatic and Fish Ecology), MCNULTY (Forest Ecology), RINGLER (Fisheries, Aquatic Ecology), RYAN (Wildlife Conservation, Disease Ecology), SHIELDS (Vertebrate Behavior), SCHULZ (Plankton Ecology, Limnology), STEWART (Fisheries, Aquatic Ecology), TURNER (Vertebrate Physiology), UNDERWOOD (Wildlife Population Dynamics), WHIPPS (Fish Pathology)

Study in this area provides students with advanced preparation in biological concepts of fish and wildlife populations as they relate to resource management. Increasing concern for these wild animal resources has been matched by strong student interest in educational programs that prepare them for careers in the fish and wildlife professions. Graduate education is rapidly becoming a universal prerequisite to employment as a professional fisheries or wildlife biologist. A major strength is the diversity of cooperators including the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Geological Survey and the New York State Department of Environmental Conservation.

Areas of research include population habitat relationships, predator ecology, fish behavior, wildlife in Adirondack ecosystems, urban wildlife relationships, endangered species studies, feeding ecology of fishes, stream ecology, Great Lakes fisheries, ecology of larval fishes and estuarine properties of Great Lakes wetlands.

### **Forest Pathology and Mycology (M.S., M.P.S., Ph.D.)**

Participating Faculty: CASTELLO (Forest Pathology), FERNANDO (Plant Developmental Ecology), HORTON (Mycorrhizal Fungi), NAKAS (Microbiology), POWELL (Plant Pathology and Molecular Biology), WEIR (Fungal Biodiversity)

Forest pathology and mycology trains students to understand tree diseases and fungi from the perspective of basic biology and ecology as well as that of societal needs. This requires global understanding of the positive and negative ecological roles of diseases in the forest environment. It requires a broad knowledge of fungi, viruses, bacteria and abiotic environmental factors affecting forest systems. It also requires sophisticated application of molecular biology, physiology and genetics to host pathogen systems. Areas of interest include environmental, fungal and viral tree diseases; mycorrhizae; wood decay; monitoring and impact assessment of disease in forest and urban tree systems; epidemiology of tree diseases and the genetics of resistance to tree diseases and pathogen variability; molecular biology and physiology of fungus infection and invasion; and taxonomy and ecology of fungi.

### **Plant Biotechnology (M.P.S.)**

Participating Faculty: CASTELLO (Virology), FERNANDO (Plant Developmental Biology), HORTON (Ecology, Fungal Communities, Mycorrhizal Relationships), NAKAS (Microbiology), NEWMAN (Phytoremediation, Molecular and Cellular Biology), POWELL (Plant Pathology and Molecular Biology), WHIPPS (Fish Pathology)

This area of study in the M.P.S. degree is designed for students who need to broaden their knowledge base and technical skills in biotechnology, for professionals returning for "retooling," and for the recent graduate in a variety of disciplines in biology and chemistry. Requirements consist of 19 credit hours of core coursework including two credit hours of graduate seminars (EFB 797), nine credit hours of directed electives and eight credit hours of open electives for a total of 36 credit hours.

*Required Core Courses (19 credit hours):*

EFB 530 Plant Physiology (3)  
EFB 531 Plant Physiology Lab (2)  
EFB 601 Molecular Biology Techniques (3)  
EFB 625 Plant Biotechnology (3)  
EFB 626/FOR 626 Plant Tissue Culture Methods (3)  
EFB 627 Plant Developmental Biology (3)  
EFB 797 Seminar in Environmental and Forest Biology (2)

A complete list of directed elective courses is available from the graduate program director.

### **Plant Science and Biotechnology (M.S., M.P.S., Ph.D.)**

Participating Faculty: CASTELLO (Virology), DOVCIK (Plant Diversity), FERNANDO (Plant Developmental Biology), C. HALL (Systems Ecology), HORTON (Ecology, Fungal Communities, Mycorrhizal Relationships), KIMMERER (Bryocology, Restoration Ecology), LEOPOLD (Dendrology, Forest and Wetland Ecology), MCGEE (Plant Ecology), NAKAS (Microbiology), NEWMAN (Molecular and Cellular Biology), POWELL (Plant Pathology and Molecular Biology), WHIPPS (Molecular Systematics)

Plants, as the base for ecological food chains, serve as the structural and functional foundation of natural and managed systems. The study of plant science and biotechnology provides opportunity in a broad range of specialties fundamental to the understanding of plants and their interaction with other organisms and for specializing in plant biotechnology. Emphasis is on forests and related plant systems. Current research interests include: dynamics of plant communities as affected by humans and the environment; mechanisms of plant succession; epidemiology of forest and urban tree diseases; taxonomy, physiology, growth and ultrastructure of fungi; heritability of wood properties and disease resistance of trees; biochemistry and physiology of plant stress response; photosynthesis; mycorrhizae; plant reproductive biology; genetic engineering; transformation; molecular evolution; phylogenetics; taxonomy; plant-pathogen interactions, tissue culture and study of ancient DNA.

### **Chemical Ecology (M.S., M.P.S., Ph.D.)**

Participating Faculty: BOYER (CHEM; Environmental Biochemistry), GINER (CHEM; Natural Insecticides), NAKAS (Microbial Ecology), NAKATSUGAWA (Xenobiotic Plant-Animal Interactions), NEWMAN (Phytoremediation, Molecular and Cellular Biology), TEALE (Insect Pheromones), TEECE (CHEM; Chemical-Thermal Relationships), WEBSTER (CHEM; Pheromone Chemistry)

The area of study in chemical ecology is offered through collaboration between the Department of Environmental and Forest Biology and the Department of Chemistry (CHEM). Interested students should apply to the department of major interest, which will have prime responsibility for setting requirements. Faculty from both areas contribute to the development of a plan of study enabling a student to acquire sophisticated skills in either chemistry or biology and an ample understanding of the other field to grapple with problems requiring an understanding of both.

As a relatively new interdisciplinary endeavor, workers in this field attempt to understand organismal interactions, both intra- and interspecific, mediated by chemical substances such as hormones, pheromones, kairomones and phytoalexins. These interactions occur at all taxonomic levels: between uni- and multicellular organisms, microbes and plants, plants and plants, plants and animals, microbes and animals and various species of animals. Study of such interactions has accelerated in recent years through joint efforts of biologists and chemists in basic and applied research in the laboratory and field.

# Department of Environmental Resources Engineering

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## Participating Faculty

DALEY (Water Resources, Solid and Hazardous Waste Management, Ecological Engineering, Environmental Restoration), DIEMONT (Ecological Engineering), ENDRENY, Chair (Water Resources Engineering, Ecological Engineering), IM (Geospatial Information Systems, Image Processing, Remote Sensing) KROLL, (Stochastic and Deterministic Hydrology, Environmental Modeling, Water Resource Systems Engineering, Ecological Engineering), MOUNTRAKIS (Brownfield Studies, Geospatial Information Systems, Image Processing, Mapping Sciences, Remote Sensing, Water Resources), QUACKENBUSH (Geospatial Information Systems, Image Processing, Remote Sensing, Spatial Measurements), SHAW (Hydroclimatology, Water Resources Engineering), TAO (Ecological Engineering)

The Environmental Resources Engineering department engages in teaching, research, and service to advance engineering practices to meet the needs of the world. With an innovative undergraduate curriculum and a wide variety of graduate courses, we provide outstanding opportunities for students to create and explore a host of educational opportunities. The department offers an accredited undergraduate program in forest engineering that originated at ESF in 1971. Our ABET-accredited B.S. in Forest Engineering program will continue to be offered through a transition period through 2015. The Environmental Resources Engineering faculty have particular strengths in water resource engineering, ecological engineering, and geospatial engineering, though our flexible undergraduate curriculum allows students to also focus on traditional civil engineering practices. Required coursework in the humanities and social sciences ensures a well-balanced educational experience for graduates entering professional practice in engineering or those moving directly on to graduate school. With more than 1,200 graduates now in engineering practice, this unique program offers a breadth of engineering science and design coursework unparalleled in the United States.

The Department of Environmental Resources Engineering participates in graduate education leading to the master of professional studies, master of science, and doctor of philosophy degrees in environmental resource engineering.

## Bachelor of Science in Environmental Resources Engineering

The objectives of the program are to prepare baccalaureate students who can successfully:

- Engage in professional engineering practice specializing in natural and designed environments
- Pursue graduate studies in environmental resources engineering, including ecological, geospatial and water resources engineering, and
- Expand and adapt their knowledge and skills to address the technological, environmental and social challenges of a changing world

A broad base of study in the fundamentals of engineering enables graduates to enter professional practices that focus on civil works as well as use and protection of soil, water, air and other renewable and non-renewable resources to ensure sustainable development.

Emphasis in this unique program is placed on applications in resource inventory, prediction, and evaluation; site analysis and development; environmental monitoring and impact assessment; environmental systems design, evaluation and management; pollution abatement and residuals management; and environmental site remediation.

The special importance of continual measurement and evaluation of the broad-scale parameters that affect the resource base provides unique opportunities for study to students aiming toward professional careers involving the conceptualization, design and maintenance of geographically referenced resource information systems.

Graduates of the program enjoy many benefits derived from their capstone-curriculum course in engineering planning and design. This project-oriented course serves to help the student integrate four years of education to solve complex design problems commonly encountered in professional practice.

Students with an interest in graduate study can plan their undergraduate studies along an individualized track to prepare themselves for ESF's master of science program in environmental and resource engineering. Students who qualify will be admitted to a quality graduate program with minimal interruption in their studies. In addition, qualified graduates in search of additional education find ready acceptance to top engineering graduate schools throughout the country.

**The forest engineering program is accredited by the Engineering Accreditation Commission/Accreditation Board for Engineering and Technology (EAC/ABET).**

Students having advanced placement credits are encouraged to work closely with their adviser in order to best prepare for various upper-division elective sequences in technology, science, design and/or management.

The undergraduate curriculum in forest engineering consists of two broad categories of courses. The general education component provides students with knowledge and skills that are useful and important for all educated persons. The second category, professional courses, provides students with direct preparation for a career in engineering and applied sciences.

Students may be admitted directly as first-year freshman students at ESF or through a variety of transfer options. To enter the curriculum at the sophomore or junior level, a transferring student must have acceptable college credit in the designated coursework areas or suitable coursework substitutions. Regardless of which way students enter ESF, they must complete both the general and professional education requirements.



Note: The requirements listed below also apply to currently matriculated students in the Forest Engineering program.

## Undergraduate Program Requirements

### Lower Division Required Courses (58 credits)

Courses			Credits	
APM	205	Calculus I	G, M	4
APM	206	Calculus II	M	4
APM	485	Differential Equations for Engineers and Scientists	M	3
EWP	190	Writing and the Environment	G, NS	3
EWP	290	Writing, Humanities and the Environment	G	3
EFB	101/ 102	General Biology I & Laboratory	G, NS	4
ERE	223	Statics and Dynamics	PE, E	4
ERE	362	Mechanics of Materials	PE, E	3
FCH	150/ 151	General Chemistry I and Laboratory	NS	4
FCH	152/ 153	General Chemistry II and Laboratory	NS	4
ERE	132	Orientation Seminar: Environmental Resources Engineering <i>Required for students who enter as freshmen or transfers.</i>	PE	1
ERE	133	Introduction to Engineering Design	PE, E	3
ERE	275	Ecological Engineering I	E	3
FOR	321	Forest Ecology and Silviculture	NS	3
MAT	296	Calculus III	M	4
PHY	211/ 221	General Physics I and Laboratory	NS	4
PHY	212/ 222	General Physics II and Laboratory	NS	4

### Lower Division Electives (9 credits)

General Education Course			G	3
General Education Course			G	3
General Education Course			G	3

### Upper Division Required Courses (40 credits)

APM	395	Probability and Statistics for Engineers	M	3
CIE	337	Introduction to Geotechnical Engineering	ED	4
ERE	351	Basic Engineering Thermodynamics	E	3
ERE	371	Surveying for Engineers	E	4
ERE	440	Water Pollution Engineering	ED	3
ERE	335	Numerical and Computing Methods	M	3
ERE	340	Engineering Hydrology and Hydraulics	ED	4
ERE	365	Principles of Remote Sensing for Engineers	E	4
ERE	430	Engineering Decision Analysis	E	3
ERE	468	Solid Waste Management	ED	3
ERE	489	Forest Engineering Planning and Design	ED	3

ERE	496	Fluid Mechanics	E	4
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### Upper Division Electives (18 credits)

Directed Engineering Design Elective An upper-division engineering course that is adviser-approved and provides the equivalent of at least one credit hour of depth in the design and synthesis component of the program. Approved directed engineering elective courses are: ERE 475 Ecological Engineering for Waste Management, ERE 551 GIS for Engineers, ERE 412 River Form and Process, and ERE 448 Open Channel Hydraulics	E D	3
Engineering Design Elective Approved engineering design elective courses are: CIE 331 Analysis of Structures and Materials, CIE 332 Design of Concrete Structures, CIE 338 Foundation Engineering, CIE 443 Transportation Engineering, CIE 473 Transport Processes in Environmental Engineering, ERE 441 Air Pollution Engineering, ERE 445 Hydrologic Modeling, ERE 496 Environmental Systems Engineering, ERE 496 Ecosystem Restoration Design, ERE 511 Ecological Engineering in the Tropics, ERE 596 Stormwater Management, ERE 596 Remote Sensing of the Environment, ERE 596 Digital Image Analysis, ERE 596 Spatial Analysis, or Special Topics (by petition)	E D	6
Free Elective		3
General Education Course	G	3
General Education Course	G	3

Total minimum credits for the degree 125 credits

### Graduate Programs

Graduate studies and research are primarily concerned with environmental and resource-related problems. Students with a bachelor of science degree in engineering or in environmental sciences, physics, or mathematics have the opportunity to design an individual program of graduate study.

#### Facilities

The teaching and research facilities in Baker Laboratory were renovated in 2008 and support graduate study and research with modern laboratories and instrumentation. We have dedicated laboratories for ecological engineering, geospatial engineering, and water resources engineering research and instruction, supported by campus staff; wood and machine shops, and analytical and technical services. Research and analysis is facilitated by a powerful range of computing platforms and software. Off-campus facilities include the extensive ESF properties, and numerous field sites supported by an array of field equipment for environmental resource engineering measurements.

The ERE program in environmental and resources engineering offers options in:

#### Ecological Engineering (M.S., Ph.D.)

Participating Faculty: DALEY, DIEMONT, ENDRENY, KROLL, SHAW, TAO

Ecological Engineering is the design of ecosystems for the mutual benefit of humans and the environment. Ideal design considers humans to be part of nature rather than apart from nature. At SUNY-ESF we believe that ecological engineering education and research should meet local to global needs. We teach and research sustainable solutions and approach ecological engineering broadly, working in many areas of the world and in most major areas of ecological engineering. Graduates from the ecological engineering option commonly find employment or continue their advanced graduate education in any of the following areas of practice:

- Ecosystem restoration, including watershed, river, forest and wetland restoration
- Design of sustainable systems for wastewater treatment and stormwater management
- Environmental remediation
- Urban ecosystem design and development
- Industrial ecology, life cycle analysis and sustainability analysis

Ecological Engineering emphasizes engineering design of ecosystems consistent with ecological principles of natural, self-organizing, self-maintaining systems. This interdisciplinary field incorporates knowledge in engineering, ecology and social sciences to produce energy- and information-efficient solutions to environmental problems. Public policy, ethics and values are considered in the decision-making process. Students select between alternative solutions to ecological resource problems, in recognition of environmental, economic, legal, social and managerial constraints.

Program prerequisite or co-requisite courses include at least one semester of study in thermodynamics, fluid mechanics, or statics; probability and statistics; ecology; and hydrology. These are in addition to general course expectations for the Division of Engineering.

Program mastery courses include at least one course (3+ credit hours per course) in each of the 4 areas of competence listed below (illustrative courses are listed in parenthesis).

- Ecosystem Restoration (e.g., Ecosystem Restoration Design, Sustainability Analysis, River Form and Process, Ecological Engineering in the Tropics)
- Pollutant Treatment (e.g., Methods in Ecological Treatment, Ecological Engineering for Waste Management, Stormwater Management)
- Modeling (e.g., Hydrologic Modeling, Systems Engineering, Engineering Hydrology & Hydraulics)

- Ecosystem Sciences (e.g., Microbial Ecology, Ecosystems, Systems Ecology, Tropical Ecology, Ecological Biogeochemistry, Plant Ecology and Global Change, Aquatic Ecosystem Restoration, Limnology, Environmental Chemistry)

At least 12 credit hours of graduate coursework must be completed in engineering courses. Research credits complete the degree requirements.

### **Environmental Management (M.P.S.)**

Participating Faculty: DALEY, ENDRENY, IM, KROLL, QUACKENBUSH, SHAW

- Brownfield development
- Hazardous waste management
- Solid waste management
- Energy resources management
- Water resource management

Environmental Management combines environmental engineering with business management and environmental law or policy to provide breadth and perspective for the student aspiring to managerial responsibility in public or private employment. Student coursework is designed to enhance technical and problem-solving skills.

Program prerequisite or co-requisite courses include at least six 3-credit undergraduate courses from at least three of the following fields: chemistry, physics, geographic measurements, calculus, statistics, engineering mechanics, ecology, computer science, and economics.

Program mastery courses include at least 12 credit hours of graduate coursework completed in engineering courses; 3–6 credit hours in natural sciences; and 3-6 hours in resource management. A comprehensive project or practicum completes the M.P.S. degree requirements. Study programs are flexible and are tailored to the interests and strengths of individuals.

### **Geospatial Information Science and Engineering (M.S., Ph.D.)**

Participating Faculty: IM, MOUNTRAKIS, QUACKENBUSH

- Remote sensing and digital image/video analysis
- Spatial and spatiotemporal databases
- Artificial intelligence/machine learning in spatial analysis and modeling
- Environmental resources monitoring, modeling and assessment

Geospatial Information Science and Engineering is designed for specialized research in spatial information acquisition, analysis, modeling and applications. This includes theoretical and applied study in sensing systems and the location, measurement, analysis and description of ground features and earth resources. It also includes use of geographic information systems (GIS) to incorporate spatial data into a wide range of environmental and engineering problems.

Program prerequisite or co-requisite courses include at least one year of physics and calculus, one course in statistics, and one engineering science course in surveying, numerical methods, or computer science. These are in addition to general course expectations for the Division of Engineering.

Program mastery courses include at least one course (3+ credit hours) in each of the four Geospatial Information Science and Engineering areas (illustrative courses are listed in parenthesis):

- Remote sensing (e.g., Principles of Remote Sensing, Remote Sensing of the Environment)
- Geographic information systems (e.g., Introduction to Spatial Information, GIS for Engineers, GIS-Based Modeling, Introduction to Global Positioning Systems,
- Spatial analysis and programming (e.g., Spatial Analysis, Digital Image Analysis, Numerical and Computing Methods, Systems Engineering, Design and Analysis of Algorithm, Introduction to Artificial Neural Networks, Introduction to Database Management Systems, Data Mining, Artificial Intelligence)
- Statistics (e.g., Statistical Analysis, Multivariate Statistical Methods, Nonparametric Statistics, Analysis of Variance, Regression Analysis, Map Accuracy Assessment, Sampling Methods)

Ph.D. students will take an additional course in at least two of these areas (6+ credit hours total). These areas of competence form the basis for your graduate coursework and are supplemented by studies in systems analysis, environmental sciences and management, and geography. Departmental and other seminars are also required. Of the total graduate coursework, at least 12 credit hours must be completed in engineering courses. Research credits complete the degree requirements.

### **Mapping Sciences (M.P.S.)**

Participating Faculty: IM, MOUNTRAKIS, QUACKENBUSH

- Geographic information systems (GIS)
- Global positioning systems (GPS)
- Analytical and digital photogrammetry

- Remote sensing and image processing

Mapping Sciences covers the development and practice of mapping technologies for environmental and engineering applications. Technologies used include GIS and GPS, as well as remote sensing and image processing tools.

Program prerequisite or co-requisite courses include at least one year of both physics and calculus, one course in statistics, and one course in either surveying or computer science. Students admitted without necessary background would be required to take additional prerequisite courses.

Program mastery courses are taken so students upon completion demonstrate competency in spatial data acquisition and fundamental spatial analysis concepts. This is typically achieved through completion of fundamental courses in remote sensing, geographic information systems, spatial analysis, and statistics. Students may specialize by taking advanced courses in the mapping sciences, statistics, computing, environmental sciences and management, or other fields.

A comprehensive project or practicum completes the M.P.S. degree requirements. Study programs are flexible and are tailored to the interests and strengths of individuals.

### **Water Resources Engineering (M.S., Ph.D.)**

Participating Faculty: DALEY, ENDRENY, KROLL, SHAW

- Watershed hydrology monitoring, modeling, management
- Hydrologic and hydraulic experimentation and analysis
- Water resource systems engineering
- Stochastic and deterministic modeling
- Pollutant fate and transport
- River and watershed restoration

Water Resources Engineering deals with analysis and design of water resource systems through field, laboratory, and computer methods. Emphasis is placed on coordinating engineering to reduce impacts on human and natural systems. Students select among alternative solutions to water resource problems, in recognition of environmental, economic, legal, social and managerial constraints. Laboratory equipment includes soil columns, a river table and two tilting and sediment circulating flumes, all supported by monitoring sensors. Analytical techniques using statistics, numerical analyses, and computer applications are emphasized. Modeling efforts include computational fluid dynamics, GIS, and remote sensing applications, distributed and real-time models, and model calibration and validation.

Program prerequisite or co-requisite courses include probability and statistics, fluid mechanics, and engineering hydrology. These are in addition to general course expectations for the Division of Engineering.

Program mastery courses include at least one course (3+ credit hours) in each of the four areas of competence listed below (illustrative courses are listed in parenthesis). These areas of competence form the basis for your graduate coursework. Departmental and other seminars are also required.

- Environmental Hydraulics (e.g., Engineering Hydrology and Hydraulics, Open Channel Hydraulics, Transport Processes, Environmental Sediment Transport)
- Water Resources Modeling (e.g., Hydrologic Modeling, Systems Engineering, Groundwater Modeling)
- Hydrologic Zones and Fluxes (e.g., River Form and Process, HydroMeteorology, Vadose Zone Physics, Limnology, Hydrogeology)
- Water Quality (e.g., Water Pollution Engineering, Ecological Biogeochemistry, Environmental Chemistry; Environmental Aqueous Geochemistry,)

At least 12 credit hours of graduate coursework must be completed in engineering courses. Research credits complete the degree requirements.

# Department of Environmental Studies

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## Department Faculty

Environmental Studies Program: FELDPAUSCH-PARKER (Environmental Communication, Climate Change), M. HALL (Ecosystem Modeling, Urban Ecology), HIRSCH (Environmental Conservation Trade-offs, Decision-making Processes), LUZADIS (Ecological Economics and Policy, Coupled Human and Natural Systems); MANNO (Sustainable Development, Ecological Economics, Great Lakes Policy), MEISNER (Environmental Communication, Environmental Thought and Ethics), MORAN (Environmental Policy and Politics, Water Issues), NORDENSTAM (Environmental Risk, Environmental Policy, Survey Design), SELFA (Environmental, Agricultural and Development Sociology, Qualitative Methods), SMARDON (Landscape and Sustainability Planning, Environmental Management, Wetland Assessment), SONNENFELD (Environmental Sociology, Sustainable Development, Asian Environmental Policy); Writing Program: DeBAISE (Environmental Writing), JAGER (Environmental and Science Writing), WHITMORE (Environmental Communication, Environmental Writing)

## Participating Faculty

BEIER (Forest Ecology, Climate Change), C. HALL (Systems Ecology), GIBBS (Conservation Biology), LIMBURG (Aquatic Ecology), NAKATSUGAWA (Toxicology, Health Impacts of Chemicals), SHIELDS (Animal Behavior, Evolution and Genetics)

## Adjunct Faculty

ABRAHAM (Public Health), BLISS (Water Resources), BRECHIN (Environmental Sociology), CALLAHAN (Enterprise Sustainability), CASTRO (Development Anthropology), DRIESEN (Environmental Law), DURKIN (Environmental Risk Assessment), EFFLER (Water Quality Modeling), EMERY (Research Geography), FAUST (Human Ecology, Ethnoecology), FERRANTE (Watershed Ecology and Management), JEZER (Environmental Politics), KROEGER (Natural Resource Economics), NOWAK (Urban Ecosystems), SAGE (Community Building), WARNEKE (Administration and Planning)

## Bachelor of Science in Environmental Studies

To address environmental issues, we must first understand the problems that underlie them. Because those issues and problems exist at the interface of complex human and natural systems, understanding them requires the right synthesis of scientific, social, and cultural knowledge. Addressing those problems also requires scientific, social and cultural skills. The Environmental Studies program at SUNY-ESF offers students just those sorts of learning and skill-development opportunities in the context of a well-rounded, yet substantial, education.

The program has been carefully designed to provide students with as comprehensive an understanding of environmental affairs as is possible in an undergraduate education. That means learning about the scientific diagnosis of environmental issues and having enough scientific knowledge to work with scientists. It also means learning about the social, cultural and technological causes of those issues. Finally, it means understanding the diversity of approaches needed to treat the problems. In the pursuit of these objectives, we bring together philosophical, theoretical and practical perspectives on a wide range of environmental concerns. In this way, our program prepares students with the knowledge, skills and experience to work for a more ecologically sustainable and socially just world.

Because the environmental studies program is broadly multidisciplinary as well as interdisciplinary, it provides students with a broad-based liberal education and asks them to be proficient across a breadth of scholarly and practical areas. Graduates of the environmental studies program have gone on to graduate school in many disciplines as well as to law and medical school. They have also proceeded to work in nongovernmental organizations (NGOs), education, government, and the private sector, pursuing careers in such areas as policy, advocacy, conservation, consulting, administration, law, and education to name just a few.

## Guiding Principles

There are six principles that guide the design and implementation of the environmental studies program:

- *Holistic interdisciplinary education:* We seek to offer our students an education that demonstrates the interconnectedness and integration of the many disciplines and fields that intersect with environmental concerns.
- *Critical skills:* We encourage our students to be active learners and prepare them with invaluable lifelong skills, including research, analysis, writing, and critical thinking.
- *Diversity and complexity:* We encourage our students to recognize and value the diversity and complexity of ecological and social systems, and of the perspectives that inform society's understanding of environmental affairs.
- *Ecological literacy:* We seek to develop students' awareness, knowledge, and appreciation of the intrinsic values of ecological processes and communities.
- *Justice and equity:* We encourage students to value social and ecological justice and equity in all contexts.
- *Thoughtful professionalism:* We seek to prepare our students to be reflective and sensitive, yet also effective and professional, in whatever endeavors they choose to pursue.

## Program Description

In the first two years of the program, students develop a foundation in the humanities, social sciences, and natural sciences as they relate to environmental affairs. During that time, students also fulfill SUNY general education requirements and take some open elective courses.

In the final two years of the program, students must select one of three specializations, or "option areas":

- *Environmental Communication, Culture and Writing*: This option focuses on the ways that communication influences environmental affairs, including rhetoric and discourse; news media; public participation; advocacy campaigns; collaboration; conflict resolution; risk communication; and representations of nature in literature and popular culture. It is through written, oral, and visual communication that humans determine their relationship with the rest of the planet and with each other concerning it, and this option provides a broad-based foundation in environmental communication theory and application. In addition to gaining a critical perspective, students obtain a range of skills within the option, including oral presentation, nature and science writing, environmental journalism, multimedia, and collaboration. Students may also choose to emphasize environmental education, environmental ethics and values, or other cultural perspectives.
- *Environmental Policy, Planning and Law*: This option is concerned with how environmental policies, plans, and laws from the local to the global are created, implemented and contested. It emphasizes legislative, regulatory, and collaborative approaches to addressing environmental issues.
- *Biological Science Applications*: This option is designed for students interested in the interface between biology and socio-economic issues. It provides an emphasis on biology with an eye to the interaction with societal issues ranging from education to habitat management.

In each of these options, students have the flexibility to pursue more specific interests. Also, several undergraduate minors, including a minor in urban environmental science, are available.

In addition to traditional courses available through the core environmental studies curriculum and in the options, our program features the following:

- Community engagement through service learning
- Internships that provide valuable hands-on experience; and
- Opportunities to study abroad for a semester.

The scope and complexity of coursework within the environmental studies program demands both discipline and commitment from students seeking this degree. But the value of a broad education is widely acknowledged by educators and professionals. We hope that in offering this program we can prepare students not only to work in the diverse field of environmental protection, but also in any area that might interest them after graduation.

The undergraduate curriculum in environmental studies consists of two broad categories of courses. The first category, general education, provides students with knowledge and skills that are useful and important for all educated persons regardless of their profession. General education courses also help prepare students for advanced courses leading to a specific profession. The second category, professional courses, provides students with direct preparation for specialization in environmental studies and career opportunities.

Students may enter the Bachelor of Science program as first-year students or as transfer students. Students who are preparing to transfer to ESF as juniors must have earned at least 60 credits of college coursework, in courses comparable to the lower-division course requirements as noted below.

The following table outlines the specific course requirements for the degree in environmental studies. Please refer to the student handbook, available online at [www.esf.edu/es](http://www.esf.edu/es), for details on how individual courses meet program requirements and for lists of courses that fulfill specific requirements.

## Undergraduate Program Requirements

### Lower Division Environmental Studies Core Courses (61-62 credits)

EST	132	Introduction to Environmental Studies Required for all environmental studies majors.		3
APM	104	College Algebra and Precalculus (3)	G	3-4
APM	105	Survey of Calculus and Its Applications (4) Students who pursue the biological science applications option need to complete APM 105 Survey of Calculus and Its Applications. Meets the requirements for general education skills and knowledge area. A complete listing of courses that meet general education standards established by SUNY is listed in <a href="#">Undergraduate Education</a> .		
APM	255	Computing Applications		3
EWP	190	Writing and the Environment	G	3
EWP	290	Writing, Humanities and the Environment	G	3
EFB	120	The Global Environment & the Evolution of Human Environment		3
EFB	101/ 102	General Biology I and Laboratory	G	4
EFB	103/ 104	General Biology II and Laboratory		3-4
EST	231	Environmental Geology Students who pursue the biological science applications option need to complete EFB 103 and EFB 104 General Biology II and General Biology II Laboratory		

ESF	200	Information Literacy		1
EST	200	Cultural Ecology	G	3
EST	221	Introduction to American Government		3
EST	245	Nature and Popular Culture		3
FCH	150/ 151	General Chemistry I and Laboratory		4
FOR	207	Introduction to Economics	G	3
		General Education Course: Western Civilization	G	3
		General Education Course: The Arts	G	3
		Electives Students who pursue the biological science applications option need to complete FCH 152 and FCH 153 General Chemistry II and General Chemistry Laboratory II as one of these electives.		9

### Upper Division Environmental Studies Core Courses (34-35 credits)

APM	391	Introduction to Probability and Statistics		3
EWP	410	Writing for Environmental Professionals		3
EFB	320	General Ecology		4
EST	321	Government and the Environment		3
EST	361	History of the American Environmental Movement	G	3
EST		Social Science EST 353 Environmental Psychology, EST 366 Attributes, Values and the Environment, EST 388 Psychological Principles of Risk Communication, EST 390 Social Processes and the Environment, or EST 426 Community Planning and Sustainability.		3
EST	494	Senior Seminar in Environmental Studies		1
		Upper Division Computing <b>OR</b> Natural Science Course List of recommended courses is available in the student handbook.		3
		Electives		9
		Senior Synthesis		3

### Environmental Communication and Culture Option Requirements (27 credits)

CMN	393	Environmental Discourse & Communication		3
EWP	300	Survey of Environmental Writing		3
EWP	420	Advanced Public Presentation Skills		3
Two of the following four courses:				
EWP	495	Environmental Journalism		3
EWP	490	Literature of Nature		3
CMN	493	Environmental Communication Workshop		3
CRS	338	Communication in Organizations		3
		Environmental Communication, Culture and Writing Option Courses List of recommended courses is available in the student handbook.		12

### Environmental Policy, Planning and Law Option Requirements (27 credits)

EST	550	Environmental Impact Analysis <b>AND law course AND a planning course</b> <i>Specific courses listed in Environmental Studies Handbook.</i>		9
		Policy/Planning Methods Courses List of recommended courses is available in the student handbook.		6
		Environmental Policy/Planning/Law Option Courses		12

	List of recommended courses is available in the student handbook.	
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### Biological Science Applications Option Requirements (27 credits)

Please note the specific lower division required courses for students in the biological science applications option

Microbes Course	3
Plants Course	3
Animals Course	3
Geographic Information Systems course	3
Policy or Law Course	3
Biology Focus Area Courses	12
A list of recommended courses is available in the student handbook.	

Total minimum credits for the degree 121-124 credits

Note: Total credits must include a minimum of 51 credit hours at the 300 level or above.

### Undergraduate Minors

ESF offers a campuswide minor in urban environmental science that allows students to gain the ability to identify and analyze the biophysical and social aspects of urban environmental issues from a systems science perspective; develop awareness of how diverse social, cultural and urbanization forces influence human perception of, and relation to the environment; and develop the ability to synthesize efficient, equitable and sustainable management, policy and design strategies to improve and sustain the quality of life in the urban community. A complete description of minors available to ESF students is found [in Undergraduate Minors](#).

Campuswide minor in **Environmental Writing and Rhetoric**: Writing, reading and presentation skills are essential to students' success in college and beyond. The EWR minor encourages students to develop fluency and expertise in each of these skills and other 21st century literacies. Students in the minor will engage in a rhetorical approach to writing, reading and communicating, preparing them to be active participants in academic, professional, civic and cultural life.

Students who meet eligibility requirements may take one of three **minors in business: marketing, entrepreneurship, or general management studies**; or the **minor in computer and information technology**. The minors are composed of courses taught at ESF and at Syracuse University. To be eligible for admission to one of the minors offered in conjunction with Syracuse University's School of Management, students must have a cumulative grade point average of 2.750 or better after one semester at ESF. To be eligible for admission to the minor in computer and information technology, students must have a cumulative grade point average of 2.800 or better after one semester at ESF.

### Graduate Degrees in Environmental Studies

The Environmental Studies graduate program at SUNY-ESF is dedicated to preparing students to actively support local to global communities working to achieve sustainability. The program integrates social, cultural, and environmental knowledge and skills to address the challenges of the 21st century. Students in this program want to make a difference. Our program offers students a focused, yet flexible, interdisciplinary understanding of environmental issues, the problems that underlie them, and the paths that lead to sustainable communities. The program facilitates student engagement with the study of fundamental cultural, social, political, technical, and economic forces that drive environmental degradation as well as the emerging approaches that can foster sustainability. Two graduate degrees in environmental studies are offered: the Master of Professional Studies and the Masters of Science. Environmental Studies faculty members also advise Ph.D. students in the interdisciplinary Ph.D. program in the Graduate Program in Environmental Science.

### Coursework

Students in our master's degree programs draw on the frameworks of social science, humanities, and natural science to enhance their critical, analytical, and communication skills. Coursework combines theoretical, practical, and applied approaches to engage areas such as *environmental policy, environmental communication, sustainable communities, human behavior, collaborative governance, public participation, and environmental impact analysis*.

Core Environmental Studies graduate courses present its many disciplines and methodologies, and demonstrate its applicability to problem analysis, action, and the quest for sustainability. In addition to completing the core requirements, students may pursue a general program of study or emphasize a particular theme. A general program of study builds on the core and typically broadens it in multiple directions, providing a thorough preparation for diverse professional careers. A thematic focus builds additional competencies related to specialized academic and career goals. Suggested themes and lists of recommended courses are available in the Environmental Studies graduate program handbooks. Examples include *conflict resolution, sustainable development, risk management, media and environmental journalism, watershed policy, and ecosystem-based management*.

For M.S. students, a thematic choice is the preferred — though not required — alternative, since it should strengthen substantive content knowledge in an area relevant to the thesis. Final capstone presentations are required for both M.S. and M.P.S. students.

### Plan of Study

Faculty work with individual students to develop a tailored plan of study to meet their specific goals. The plan of study is an opportunity for students to work out their learning, research and career objectives in narrative form and outline a sequence of courses and other learning



experiences to help meet those objectives. The plan of study is also used by their major professor in order to provide effective advising on program, research, and internship choices. Guidelines for preparing the plan of study are available in the Environmental Studies graduate program handbooks.

## Degree Options

The Environmental Studies graduate program offers two degree options: the Master of Science (M.S.) or Master of Professional Studies (M.P.S.). The requirements of each are outlined below. The M.P.S. and M.S. degrees may be completed in 1-1/2 to 2 years of full-time study, respectively.

### Master of Science (M.S.)

The Environmental Studies M.S. degree program is a 37-credit-hour experience focused on advanced academic scholarship and research related to environmental affairs and sustainability. This degree requires the completion of a Master's thesis. Details on thesis proposals and expectations are available in the Environmental Studies M.S. graduate program handbook. All students must present a Capstone Seminar during their final semester. If necessary, the distribution of required credits may be adjusted to take into account a student's prior academic work and background.

#### Core (12 credits)

Courses		Credits
All students take:		
EST 600	Foundations of Environmental Studies	3
EST 626	Concepts and Principles of Sustainable Development	3
All students also take at least two of the following:		
EST 608	Environmental Advocacy Campaigns and Conflict Resolution	3
EST 612	Environmental Policy and Governance	3
EST 640	Environmental Thought and Ethics	3
EST 650	Environmental Perception and Human Behavior	3

#### Research Methods (7 credits)

Courses		Credits
All students take:		
EST 797	Environmental Studies Seminar Students are required to take the specific section of this seminar that deals with research proposal preparation.	1
All students also take two research methods courses, typically from the following list and typically to support their thesis research needs:		
APM 510	Statistical Analysis	3
APM 625	Introduction to Sampling Techniques	3
APM 630	Regression Analysis	3
APM 635	Multivariate Statistical Methods	3
CRS 602	Empirical Research in Social Communication	3
CRS 604	Qualitative Communication Research Methods	3
EST 604	Social Survey Research Methods for Qualitative Methods	3
EST 605	Environmental Issues	3
EST 702	Environmental and Natural Resource Program Evaluation	3
LSA 640	Research Methodology	3
PPA 721	Introduction to Statistics	3
PPA 722	Quantitative Aids for Policy Analysis	3
PSC 602	Public Policy Analysis	3
PSC 693	Introduction to Quantitative Political Analysis	3
PSC 694	Qualitative Political Analysis	3
SOC 614	Introduction to Qualitative Research	3

### **Generalized/Thematic Area (12 credits)**

All students take four courses, typically in a thematic area, in consultation with their major professor. The thematic area should be used to substantively prepare the student for thesis work. EST 898 and EST 899 may not be included as thematic area courses.

### **Thesis Research (6 credits)**

All students with an approved thesis proposal take at least six credits of:  
EST 899 Master's Thesis Research

### **Master of Professional Studies (M.P.S.)**

The Environmental Studies M.P.S. degree program is a 39-credit-hour experience focused on advanced academic scholarship and its application to environmental affairs and sustainability. This degree requires the completion of a synthesis experience which frequently, though not always, involves a professional internship. Details on internships and other synthesis options are available in the Environmental Studies M.P.S. graduate program handbook. All students must present a Capstone Seminar during their final semester. If necessary, the distribution of required credits may be adjusted to take into account a student's prior academic work and background.

### **Core (18 credits)**

All students take:

EST 600 Foundations of Environmental Studies 3  
EST 608 Environmental Advocacy Campaigns and Conflict Resolution 3  
EST 612 Environmental Policy and Governance 3  
EST 626 Concepts and Principles of Sustainable Development 3  
EST 640 Environmental Thought and Ethics 3  
EST 650 Environmental Perception and Human Behavior 3

### **Natural Sciences (3 credits)**

All students take one natural science course. Typically this would be one of the following courses, though alternatives may be considered in consultation with the major professor.

EFB 516 Ecosystems 3  
EFB 518 Systems Ecology 4  
EFB 523 Tropical Ecology 3  
EFB 600 Toxic Health Hazards 4  
EFB 611 Topics in Environmental Toxicology 3  
EFB 623 Marine Ecology 5

### **Research / Technical Methods (6 credits)**

All students take two research or technical methods courses, typically from the following list and typically to support their learning objectives:

APM 635 Multivariate Statistical Methods 3  
ENS 519 Spatial Ecology 3  
ERE 550 Introduction to Geographic Information Systems 3  
EST 550 Environmental Impact Analysis 3  
EST 604 Social Survey Research Methods for Environmental Issues 3  
EST 605 Qualitative Methods 3  
EST 702 Environmental and Natural Resource Program Evaluation 3  
FOR 556 Introduction to Raster GIS Analysis 3  
FOR 557 Practical Vector GIS 3  
FOR 558 Advanced Topics in GIS 3  
LSA 500 Computer Graphics I 3  
LSA 501 Computer Graphics II 3  
LSA 552 Graphic Communication 3  
LSA 640 Research Methodology 3

### **Generalized / Thematic Area (6 credits)**

All students take two courses in consultation with their major professor. The thematic area should be used to substantively prepare the student for capstone synthesis work. EST 898 and EST 899 may not be included as thematic area courses.

### **Synthesis (6 credits)**

All students take the equivalent of two courses of either:

EST 798 Problems in Environmental Studies  
EST 898 Professional Experience

## **Certificate of Graduate Study in Environmental Decision Making**

### **Purpose**

The certificate of graduate study in environmental decision making is designed for graduate students enrolled in law, management, public administration, or information studies programs at Syracuse University. It provides an exposure to specialized environmental study that is relevant to students' primary professional interests in the fields identified. Because students in each of these programs will engage important environmental policy, program implementation and decision-making processes in their professional efforts, the distinctive environmental orientation of this certificate program will help students to better understand some of the complexities of environmental decision making from their unique professional perspectives.

The focus of certificate study is on environmental decision making, which can be defined as the process by which stakeholders in environmental outcomes engage in communications to seek solutions to environmental problems. Familiarly, decision making can refer to environmental policy making by governmental institutions, but a meaningful understanding of the topic in today's world will also include processes such as information acquisition and dissemination and such notions as negotiation, mediation, information policy and public participation as part of the decision-making lexicon. The decision-making focus furthermore expands the scope of stakeholders to include not only the institutions and agencies of government, but also the large variety of citizen-based nongovernmental organizations and the business and industrial private sector.

### **Student Eligibility**

Graduate students currently matriculated and in good academic standing in their law, management, public administration, or information studies degree programs at Syracuse University are eligible to apply for entrance into the certificate program. Applications from any other sources cannot be accepted at this time.

### **Administrative Procedures**

Application and admissions procedures, compliance with college requirements for successful graduate study and the awarding of certificates are all administered by the SUNY-ESF dean of Instruction and Graduate Studies. If enrollment limitations are established, acceptances will be made on a rolling basis, according to the date of receipt of applications.

Student applications are made by completing the application form found in the advising guide. This provides contact information for applicants and verifies their matriculated status at Syracuse University. Upon completion of program credit-hour requirements, students file a certificate request form, which identifies completed coursework and initiates actions to produce official transcripts, leading to the award of the certificate.

Forms are available in the College's Office of Instruction and Graduate Studies, 227 Bray Hall, and in the Environmental Studies Graduate Office, 107 Marshall Hall. To assist certificate students in making suitable course selections and to answer related program questions, students should contact the department chair, 106 Marshall Hall.

### **Academic Advisement**

Prospective students are encouraged to speak with their Syracuse University academic advisors about the advisability of and timing for entering this certificate program. Students might also wish to contact the following persons, who are knowledgeable of certificate goals and requirements:

- Law: TBA
- Management: Patrick DiRubbo, Academic Services
- Public Administration: Christine Omolino, associate director
- Information Studies: TBA

# Department of Forest and Natural Resources Management

DAVID H. NEWMAN, Chair  
320 Bray Hall, 315-470-6534; FAX 315-470-6535  
[www.esf.edu/fnrm](http://www.esf.edu/fnrm)

The Department of Forest and Natural Resources Management (FNRM) offers programs leading to bachelor's, master's and doctoral degrees at the main college campus in Syracuse, N.Y., and three programs leading to the associate in applied science (A.A.S.) degree at The Ranger School in Wanakena, N.Y. See The [Ranger School](#) section for information about the associate of applied science degrees in forest technology, land surveying technology, and environmental and natural resources conservation.

## Faculty

ABDEL-AZIZ (Applied Mathematics), BEIER (Forest Ecology, Regional Analysis), BEVILACQUA (Forest Measurements, Statistics), BRIGGS (Forest Soils, Silviculture), CONAHAN (Applied Mathematics), GERMAIN (Sustainable Forestry Systems, Forest Operations), KUEHN (Recreation Resources Management and Tourism), LAVIE (Applied Mathematics), MALMSHEIMER (Forest and Natural Resources Law and Policy), MAYNARD (Tree Improvement, Plant Tissue Culture and Transformation), MORRISON (Resource Sociology and Urban Forestry), NEWMAN, Chair (Forest Resource Economics and Policy), C. NOWAK (Vegetation Management, Sustainable Forest Management, Silviculture), NYLAND (Silviculture and Forest Management), STEHMAN (Statistics, Environmental Sampling), STELLA (Watershed Management), VIDON (Hydrology, Biogeochemistry), VOLK (Woody Biomass Energy), VONHOF (Natural Resources History), WAGNER (Forest Resource Economics, Business), YANAI (Forest Soils, Ecosystem Nutrient Cycling, Simulation Modeling), ZHANG (Biometrics, Quantitative Silviculture)

## Adjunct Faculty:

BENZEL, BICK, BURNS, CASTRO, COLLINS, CULKOWSKI, R. DAVIS, HEISLER, KELLEHER, LAUTZ, D. NOWAK, PAVESE, PEREZ, ROBISON, SCHUSTER, SMITH, STOUT, D. WHITE, WOOD, WIELOPOSKI

## Mission and Vision

ESF's forest and natural resources management programs are science-based and values-driven. The integration of values and scientific facts characterize professions that are successful in democracies. ESF-trained foresters and natural resource managers are able to integrate these two threads in America's complex society.

The mission of ESF forest and natural resources management programs is to produce knowledge and transmit it to our customers; encourage continual learning about forest and related renewable resources and their role in making people's lives better; and develop leaders who will manage renewable resources on a sustainable basis.

The Department's vision of professional forest and natural resource managers is that they are problem solvers who master disciplinary knowledge and skills, then integrate them to protect and manage forest and natural resources; and leaders who help people solve the more complex problems with the world's forest and natural resources.

ESF forest and natural resources management's educational goals are to:

- Understand forests and related natural resources — how they function and their dynamics;
- Be skilled in managing forests and other natural resources and predicting the consequences;
- Monitor citizen and owner values of forests and other natural resources and be respectful of them; and
- Integrate values with scientific facts and know the limits of our knowledge.

## Undergraduate Programs

The forest and natural resources management programs prepare students for work with public and private sector organizations and consultancies and for further professional or scientific study at the graduate level. Students develop professional skills, which employers look for in new employees:

- Management skills including leadership, communication abilities, and teamwork;
- Scientific knowledge and technical skills in measurements and analysis for management;
- The ability to analyze and solve resource management problems using both social and biophysical sciences; and
- A clear understanding of ethics and stewardship.

These skills are best developed by a broad base in the social sciences and humanities, communication, the natural sciences, and quantitative and qualitative methods. The majority of coursework taken during the first two years (lower division) is in these basics.

Students are required to complete general education requirements and a professional core. Forest resources management students may concentrate some of their technical electives. Natural resources management majors have a ready opportunity to earn a minor in an area of disciplinary interest.

## Bachelor of Science in Forest Resources Management

Professional forestry education has been featured at ESF since the College's founding in 1911. Today's forest resources management program is based on a clear vision that combines professional competency with a strong foundation in the biophysical sciences, humanities, and social sciences to meet society's needs for forest managers.

Many ESF students enjoy trees and forests and want to work in forested settings. They appreciate nature and want to master the knowledge and skills needed to conserve and manage forests and the environment. With 25,000 acres of College forest lands as teaching and research laboratories, ESF provides many opportunities to meet student needs for experiential learning. The forest technology program at ESF's Wanakena campus prepares students for careers in field forestry and is a route to the forest resources management program that emphasizes field practice. Internships with forest-based organizations in the private, public and nonprofit sectors amplify these hands-on experiences. Practical experience is combined with learning concepts and problem solving and critical thinking skills in the classroom and laboratory on ESF's Syracuse campus. The educational outcomes of the forest resources management degree program are among the best anywhere in North America.

Forest resources management is an integration of forest ecology and biology, forest measurements, forest policy and administration, and courses to predict and evaluate the effects of manipulation. Timber, water, soils, recreation, wildlife, and a broad array of environmental values and services, such as biodiversity and healthy forest systems, are important results of effective management. This major prepares students to be well-rounded generalists who can practice forestry and succeed as professionals in a variety of allied natural resource management fields.

The educational program in forest resources management, leading to the professional bachelor of science degree in forest management, is accredited by the Society of American Foresters (SAF). SAF is recognized by the Commission on Recognition of Postsecondary Accreditation as the specialized accrediting body for forestry in the United States.

Forest management offers a wide variety of employment opportunities. Our graduates are working throughout the United States as professional foresters and natural resource managers in public agencies, private industry, and for nonprofit organizations. Their duties range from timber management to recreation planning to environmental education, to name a few.

The undergraduate curriculum in forest resources management consists of two broad categories of courses. The first category, general education, provides students with knowledge and skills that are useful and important for all educated persons regardless of their profession as well as preparation for advanced courses leading to a specific profession. The second category, professional courses, provides students with direct preparation for a career. The first two years of college usually focus on general education and the second two on the professional studies.

### Summer Program

The Summer Program is required for ALL students in forest resources management. Students who completed an A.A.S. degree from the ESF Ranger School meet this requirement through transfer credits. The program is a four-week session that begins at the end of May and lasts through late June. It is taught at ESF's Wanakena Campus in the Adirondacks. The program consists of one course: FOR 304 Adirondack Field Studies. Students must complete the summer program before the junior year.

### Program Admission

Students may follow one of three paths to enter and complete the forest resources management program:

The freshman path is for students who enter ESF as freshmen and complete all degree requirements at ESF with the Summer Program after the second year.

The combined A.A.S./B.S. path is for students who wish to have more field measurement and field problem-solving skills and leadership development in context of forestry problems. The first year can be at ESF or another college and the second year is spent at The Ranger School, Wanakena campus. Students then complete their B.S. degree requirements at ESF. This path can be completed in a total of four years with careful planning.

The transfer path is for students who complete all or part of their lower division coursework at another two- or four-year campus, attend the Summer Program the summer before entering ESF and complete the upper-division requirements at ESF. Students preparing to transfer to ESF with full junior status must have earned at least 60 credits of college coursework.

## Undergraduate Program Requirements

### Lower Division Required Courses (47 credits)

Courses					Credits
APM	104	College Algebra and Precalculus Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY <a href="#">in Undergraduate Education</a> .	G	3	
APM	391	Introduction to Probability and Statistics		3	
EWP	190	Writing and the Environment	G	3	
EWP	290	Writing, Humanities and the Environment	G	3	
EWP	220	Public Presentation Skills for Environmental Professionals		3	
EFB	101/ 102	General Biology I and Laboratory	G	4	
EFB	336	Dendrology	PE	3	
ESF	200	Information Literacy		1	
FCH	150/ 151	General Chemistry I and Laboratory		4	
FOR	132	Orientation Seminar: Forest and Natural Resources Management	PE	1	

		Required for all students (freshmen and transfers). Professional education course		
FOR	203	Western Civilization and the Environment	G	3
FOR	204	Natural Resources in American History	G	3
FOR	207	Introduction to Economics	G	3
FOR	232	Natural Resources Ecology	PE	3
FOR	332	Forest Ecology	PE	3
PHY	101/ 102	General Physics I and Laboratory (or EFB 200 3 hrs)		4

### Electives (6 credits)

General Education Course: Other World Civilization			G	3
General Education Course: The Arts			G	3

### Required Summer Courses (4 credits)

The summer following the second year, students must take:

FOR	304	Adirondack Field Studies	PE	4
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### Upper Division Required Courses (38 credits)

ESF	300	Introduction to Geospatial Information Technologies		3
ESF	332	Seminar for New Transfer Students Required for students who enter as transfer students		0
FOR	360	Principles of Management		3
FOR	322	Forest Mensuration	PE	3
FOR	323	Forest Biometrics		3
FOR	333	Natural Resources Managerial Economics	PE	3
FOR	334	Silviculture	PE	4
FOR	345	Introduction to Soils	PE	3
FOR	370	Forest Management Decision Making & Planning	PE	3
FOR	372	Fundamentals of Outdoor Recreation	PE	3
FOR	373	Forest Operations	PE	3
FOR	402	Professional Forestry Mentoring Program	PE	1
FOR	465	Natural Resources Policy	PE	3
FOR	490	Integrated Resources Management	PE	3

### Electives (33 credits)

Technical Electives Technical electives must include at least one course in vegetation manipulation, water resources, forest health, wildlife management, and wood technology/science. Students should consult with their advisor and the Forest and Natural Resources Management Handbook for recommended courses			PE	15
Electives			PE	18

Total minimum credits for the degree 128 credits

## Bachelor of Science in Natural Resources Management

The natural resources management program is based on a vision that combines professional competency in management skills with a strong foundation in the social and biophysical sciences. Students interested in this program typically are drawn to natural settings and environments, enjoy nature and want to develop the professional knowledge and skills needed to conserve, steward and manage natural resources and the environment. ESF provides a wide variety of opportunities to meet student needs utilizing 25,000 acres of forest lands as teaching laboratories and College faculty in many natural resource management disciplines. Experiential field learning is combined with learning concepts and skills in the classroom and laboratory on ESF's Syracuse campus.

The natural resources management program allows students to develop professional skills that employers tell us are the most important traits they look for in new employees. These traits are developed through a broad base of classes in the natural sciences, social sciences and humanities, communication, and quantitative and qualitative problem-solving skills. The majority of work scheduled during the first two years (lower division) is in these areas. This major prepares students to be well-rounded natural resources managers, provides them a ready opportunity to minor in specific areas of disciplinary interest, and prepares them with a foundation for future graduate degree work.

Natural resources management offers a wide variety of employment opportunities. Graduates work throughout the United States in public agencies, private industry, and for nonprofit organizations. Their duties range from policy analysis for federal agencies to resource managers for nonprofit organizations; from recreation planning for state park agencies to recreation management in federal wilderness areas; and from watershed hydrologists to land managers maintaining surface water quality.

### Summer Program

The Summer Program is required for ALL students in natural resources management. Students who completed an A.A.S. degree from the ESF Ranger School meet this requirement through transfer credits. The summer program is a four-week session that begins at the end of May and lasts through late June. It is taught at ESF's Wanakena Campus in the Adirondacks. The program consists of one course: FOR 304 Adirondack Field Studies. Students should complete the summer program before the junior year.

### Program Admission

Students may follow one of three paths to enter and complete the natural resources management program:

The freshman path is for students who enter ESF as freshmen and complete all degree requirements at ESF with the Summer Program after the second year.

The combined A.A.S./B.S. path is for students who wish to have more field measurement and field problem-solving skills and leadership development in context of environmental and natural resources conservation problems. The first year can be at ESF or another campus and the second year is spent at The Ranger School, Wanakena campus. Students then complete their B.S. degree requirements at ESF. This path can usually be completed in a total of four years.

The transfer path is for students who complete all or part of their lower-division coursework at another two- or four-year campus, attend the Summer Program the summer before entering ESF and complete the upper-division requirements at ESF. Students preparing to transfer to ESF with full junior status must have earned at least 60 credits of college coursework.

## Undergraduate Program Requirements

### Lower Division Required Courses (40 credits)

APM	104	College Algebra and Precalculus Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY <a href="#">in Undergraduate Education</a> .	G	3
APM	391	Introduction to Probability and Statistics		3
EWP	190	Writing and the Environment	G	3
EWP	220	Public Presentation Skills for Environmental Professionals		3
EFB	101/ 102	General Biology I and Laboratory	G	4
EFB	103/ 104	General Biology II and Laboratory		4
EFB	320	General Ecology		4
ESF	200	Information Literacy		1
FCH	150/ 151	General Chemistry I and Laboratory		4
FCH	152/ 153	General Chemistry II and General Chemistry Laboratory II		4
PHY	211/ 221	or General Physics I and General Physics Laboratory I		
FOR	132	Orientation Seminar: Forest and Natural Resources Management Required for all students (freshmen and transfers). Professional education course	PE	1
FOR	207	Introduction to Economics	G	3
FOR	360	Principles of Management		3

### Lower Division Elective Courses (18 credits)

General Education Course: American History			G	3
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General Education Course: The Arts	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3
General Education Course: Humanities	G	3
Sociology or Psychology course FOR 202 Introduction to Sociology (3), SOC 101 Introduction to Sociology (3), or PSY 205 Foundations of Human Behavior (3)		3

### Required Summer Courses (4 credits)

The summer following the first or second year, students must take:

FOR	304	Adirondack Field Studies	PE	4
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### Upper Division Required Courses (30 credits)

EWP	405	Writing for Science Professionals		3
ESF	300	Introduction to Geospatial Information Technologies		3
FOR	321	Forest Ecology and Silviculture		3
FOR	333	Natural Resources Managerial Economics	PE	3
FOR	340	Watershed Hydrology		3
FOR	345	Introduction to Soils	PE	3
FOR	372	Fundamentals of Outdoor Recreation		3
FOR	465	Natural Resources Policy	PE	3
FOR	488	Natural Resources Agencies and Administration		3
FOR	490	Integrated Resources Management	PE	3

### Upper Division Elective Courses (30 credits)

Accounting or Finance Course ACC 201 Introduction to Accounting for Non-Management Students (3) or FIN 301 Finance for Non-Management Students (3).	3
Human Dimensions Course EST 390 Social Processes and the Environment (3), FOR 312 Sociology of Natural Resources (3), or FOR 475 Human Behavior and Recreation Visitor Management (3)	3
Wildlife or Fisheries Course EFB 390 Wildlife Ecology and Management (4) EFB 487 Fisheries Science and Management (3) or EFB 493 Wildlife Habitats and Populations (4)	3
Electives	21

Total minimum credits for the degree 122 credits

## Bachelor of Science in Forest Ecosystem Science

The bachelor of science in forest ecosystem science degree program is based on a vision that combines professional competency in forest management skills with an enhanced understanding of ecological sciences. Students interested in this program typically are drawn to natural settings and environments, enjoy nature, and want to understand how forested ecosystems work. ESF provides a wide variety of opportunities to meet student needs utilizing 25,000 acres of forest lands as teaching laboratories. Internships with natural resource-based organizations in the business, public and nonprofit sectors provide additional hands-on experiences. Experiential field learning is combined with learning concepts and skills in the classroom and laboratory on ESF's Syracuse campus.

The program allows students to develop professional skills that employers look for in new employees. These skills are developed through a combination of core courses required in the undergraduate programs in forest resources management and in environmental biology. Forest ecosystem science offers a wide variety of employment opportunities. Graduates work throughout the United States in public agencies, private industry, and for nonprofit organizations. They also are well prepared to enter graduate programs in management of natural resources, ecological research, or other areas of applied forest biology.

The undergraduate curriculum in forest ecosystem science consists of two broad categories of courses. The first category, general education, provides students with knowledge and skills that are useful and important for all educated persons regardless of their profession as well as preparation for advanced courses leading to a specific profession. The second category, professional courses, provides students with direct preparation for a career. The first two years of college usually focus on general education and the second two on the professional studies.



## Summer Program

The Summer Program is required for ALL students in forest ecosystem science. Students who completed an A.A.S. degree from the ESF Ranger School meet this requirement through transfer credits. The program is a four-week session that begins at the end of May and lasts through late June. It is taught at ESF's Wanakena Campus in the Adirondacks. The program consists of one course: FOR 304 Adirondack Field Studies. Students must complete the summer program before the junior year.

## Program Admission

Students may follow one of three paths to enter and complete the forest ecosystem science program:

The freshman path is for students who enter ESF as freshmen and complete all degree requirements at ESF with the Summer Program after the second year.

The combined A.A.S./B.S. path is for students who wish to have more field measurement and field problem-solving skills and leadership development in context of natural resource problems. The first year can be at ESF or another campus and the second year is spent at The Ranger School on the Wanakena campus. Students then complete their B.S. degree requirements at ESF. This path can be completed in a total of four years with careful planning.

The transfer path is for students who complete all or part of their lower-division coursework at another two- or four-year campus, attend the Summer Program the summer before entering ESF, and complete the upper-division requirements at ESF. Students preparing to transfer to ESF with full junior status must have earned at least 60 credits of college coursework.

## Program Requirements

### Lower Division Required Courses (47 credits):

Courses			Credits	
APM	105	Calculus and Its Applications I Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY <a href="#">in Undergraduate Education</a> .	G	4
APM	391	Introduction to Probability and Statistics		3
EWP	190	Writing and the Environment	G	3
EWP	290	Writing, Humanities and the Environment	G	3
EFB	101/ 102	General Biology I and Laboratory	G	4
EFB	103/ 104	General Biology II and Laboratory		4
ESF	200	Information Literacy		1
FCH	150/ 151	General Chemistry I and Laboratory		4
FCH	152/ 153	General Chemistry II and Laboratory		4
FOR	132	Orientation Seminar: Forest and Natural Resources Management <i>Professional education course</i>	PE	1
FOR	207	Introduction to Economics	G	3
FOR	232	Natural Resources Ecology	PE	3
FOR	332	Forest Ecology	PE	3
FOR	360	Principles of Management	PE	3
PHY	211/ 221	General Physics I and Laboratory		4

### Lower Division Elective Courses (6 credits):

General Education Course: American History			G	3
General Education Course: Western Civilizations			G	3

### Upper Division Required Summer Courses (4 credits):

The summer following the second year, students must take:

FOR	304	Adirondack Field Studies	PE	4
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### Upper Division Required Courses (minimum 25 credits):

EFB	336	Dendrology	PE	3
ESF	300	Introduction to Geospatial Information Technologies	PE	3
FOR	322	Forest Mensuration	PE	3
FOR	323	Forest Biometrics	PE	3
FOR	334	Silviculture	PE	4
FOR	345	Introduction to Soils	PE	3
FOR	465	Natural Resources Policy	PE	3
FOR	490	Integrated Resource Management	PE	3

### Upper Division Elective Courses (42 credits):

Directed Electives: Biology	PE	9
Directed Electives: Ecology and Ecosystems	PE	9
Directed Electives: Management and Human Dimensions	PE	9
Students should consult with their advisors and read the Forest and Natural Resources Management Handbook for lists of courses that can be elected to meet degree requirements.		
Free Electives		15

Total minimum credits for the degree 124 credits

## Graduate Programs

The Department of Forest and Natural Resources Management (FNRM) offers the master of science (M.S.), the master of professional studies (M.P.S.), the master of forestry (M.F.), and doctor of philosophy (Ph.D.) degrees. The graduate program is organized in areas of study designed to provide students with a strong background within specific interest areas. Faculty with nationally and internationally recognized expertise define the area of study's subject matter and guide students through an individually-designed program of study appropriate to student goals and aspirations. The FNRM graduate program prepares students for careers in resource administration, management, scientific research, professional education, and a variety of other specialized positions related to the sustainable management of forest ecosystems. Students with a non-natural resources bachelor's or master's degree and a strong interest in forests are encouraged to apply.

**Master of Forestry (M.F.):** The M.F. degree is designed to provide students with non-forestry baccalaureates a professional education in forestry. As such, the degree is designed to be students' first professional degree in forestry. The degree is appropriate for students who want to successfully function as professional foresters on multidisciplinary forest management teams and respond to the challenges related to the sustainable management of local, regional, and global forest resources.

The degree requires 37 graduate credits of coursework. At least 24 of the coursework credits must be taken in residence at ESF. The degree meets the accreditation standards of the Society of American Foresters. The current Forest and Natural Resources Management Graduate Handbook ([www.esf.edu/fnrm/documents/GraduateHandbook.pdf](http://www.esf.edu/fnrm/documents/GraduateHandbook.pdf)) provides more detail on specific course requirements.

**Master of Professional Studies (M.P.S.):** The M.P.S. degree is a coursework-based degree that enables students to increase, define, and integrate their natural science and social science knowledge and expertise in forest and natural resources management. The degree is designed to be the first professional degree in forest and natural resources management. It is appropriate for students with a baccalaureate degree in a natural resources-related discipline interested in enhancing their knowledge of forest and natural resources management, and for students with other baccalaureate degrees seeking an expertise in forest and natural resources management.

The degree requires at least 30 graduate credits of coursework. At least 24 of the course credits must be taken in residence at ESF. Within these credits, students must complete a core of required courses and other requirements. The current Forest and Natural Resources Management Graduate Handbook ([www.esf.edu/fnrm/documents/GraduateHandbook.pdf](http://www.esf.edu/fnrm/documents/GraduateHandbook.pdf)) specifies these requirements.

**Master of Science (M.S.):** The M.S. degree enables students to investigate practical forest and natural resources research problems and apply their specialized knowledge to solve those problems. The degree provides students with coherent body of theory and a set of appropriate methods to test that theory by completing a thesis. The M.S. degree is appropriate for students entering professions that require a research-based degree (such as environmental agencies and organizations that focus on science) and for students planning on completing a Ph.D. degree.

The degree requires at least 30 graduate credits, of which 24 are for coursework and six for the thesis. One-half of the 24 hours of coursework must be at the 600-level or above. At least 18 of the coursework credits must be taken in residence at ESF. All students must take one FOR 797 topical seminar and one additional graduate seminar.

**Doctor of Philosophy (Ph.D.):** The Ph.D. degree is normally built upon a M.S. degree, but in some instances it can be undertaken after a non-research based graduate degree (such as a J.D., M.B.A, M.P.A, or M.P.S. degree). The degree provides students with an opportunity for in-depth study and to conduct a comprehensive scientifically based research program using advanced research tools. Ph.D. dissertations are expected to lead to a number of peer-reviewed articles in influential journals. The degree is appropriate for students interested in advanced positions as forest and natural resources educators, managers, and analysts.

The degree requires at least 60 graduate credit hours, of which 48 are for coursework and 12 for the dissertation. One-half of the 48 hours of coursework must be at the 600-level or above. At least 24 coursework credits must be taken in residence at ESF. All students must take one FOR 797 topical seminar and one additional graduate seminar.

### Research Facilities and Faculty

FNRM students work with faculty in a variety of sophisticated laboratories. Graduate students have access to diverse analytical equipment and measuring devices, and comprehensive, investigative computing capabilities. FNRM faculty and students conduct research throughout the world, particularly in the northeastern United States. ESF's 25,000 acres on regional New York state campuses and field stations offer a broad diversity of forest ecosystems for teaching and intensive research that evaluates terrestrial and aquatic environments. Faculty and students also pursue research on lands managed by the state Department of Environmental Conservation, USDA Forest Service, U.S. Fish and Wildlife Service, National Park Service, and Bureau of Land Management. Many students also conduct research and serve internships in Washington, D.C., New York City, Albany, and other international, national, regional, and state resource management headquarters.

FNRM graduate students work closely with faculty recognized by their students and peers as among the best in the world. FNRM faculty include SUNY Distinguished Teaching Professors and Distinguished Service Professors, as well as recipients of the SUNY Chancellor's Award for Excellence in Teaching, the SUNY Chancellor's Award for Professional Service, and the ESF President's Public Service Award. More than a third of FNRM professors have been awarded the ESF Distinguished Teacher Award by the ESF student body, many more than once. ESF professors also serve in leadership roles in professional societies.

### Funding Opportunities

More than 70 percent of full-time FNRM graduate students receive partial or full support through graduate research or teaching assistantships. Awards range from \$11,060 to \$27,000 per year. All fully supported students receive tuition scholarships and health insurance. In addition to assistantships, FNRM annually awards several fellowships, based on students' accomplishments and promise for future professional and personal development. We also offer some graduate student stipends to support semester-long and summer internship experiences.

### Collaborative Arrangements

FNRM encourages interdisciplinary graduate programs. This often involves selecting steering committee members from other ESF and Syracuse University departments, or more formally, by arranging for joint study with other college departments and with Syracuse University. Concurrent degree programs that provide the student with two masters' degrees, one from ESF and another from Syracuse University, are available with the following SU schools: Whitman School of Management, Maxwell School of Citizenship and Public Affairs, S.I. Newhouse School of Public Communications, and School of Education.

Concurrent degree programs usually add at least an additional year to a master's program of study. To be eligible, a student must have been matriculated full-time at the College for at least one semester, have a grade point average of at least 3.5, and be formally accepted into the concurrent degree program by the other school. Students who are interested in any of these programs must complete an application process through the ESF Office of Instruction and Graduate Studies within their first year of study.

### Areas of Study

The FNRM graduate degree program offers students opportunities to pursue individualized advanced study in seven areas of study or an interdisciplinary doctoral program. Each area of study description includes a sampling of faculty members' research interests and employment opportunities. With more than 75 graduate students currently in FNRM programs, these examples are only highlights from the wealth of opportunities available. Additional information about each of these areas of study is available by telephone, e-mail, or written request to any of the professors listed and at: [www.esf.edu/fnrm/graduate](http://www.esf.edu/fnrm/graduate).

#### Ecology and Ecosystems (M.P.S., M.S., Ph.D.)

The Ecology and Ecosystems area of study focuses on the structure, function, dynamics, and resilience of terrestrial ecosystems, at a range of scales, from tree genetics and plant physiology to landscape ecology, modeling and remote sensing. Because functioning and resilient ecosystems are central to human well-being, research opportunities in this area of study address a diversity of topics that help us better understand and enhance the sustainability of terrestrial ecosystems in a rapidly changing world.

Topic Area	Participating Faculty
Forest Ecology	Beier, Yanai, Briggs, Volk, Nyland, Stella, Nowak, Bevilacqua, Maynard, Johnston
Watershed Ecology	Stella, Briggs, Vidon, Yanai
Soils	Briggs, Nowak, Yanai, Johnston
Biogeochemistry	Yanai, Vidon, Nowak, Johnston
Landscape Ecology	Beier, Stella, Nowak, Bevilacqua
Forest Health	Nyland, Maynard, Beier, Nowak, Yanai, Germain, Johnston
Restoration Ecology	Nowak, Stella, Nyland, Maynard,
Tree-ring Science (Dendroecology and Dendroclimatology)	Stella, Beier, Bevilacqua
Ecological Modeling	Yanai, Stella, Beier, Vidon, Bevilacqua

#### Management (M.P.S., M.S., Ph.D.)

The Management area of study focuses on both the underlying theory and on-the-ground application of practices to achieve sustainable outcomes in natural resource systems. Because management practices and decisions arise from the combination of ecological knowledge,

economic considerations and landowner/manager objectives and/or policies, research opportunities in management are interdisciplinary by nature.

Topic Area	Participating Faculty
Silviculture	Nyland, Nowak, Germain, Bevilacqua, Volk, Maynard, Beier, Johnston
Integrated Vegetation Management	Nowak
Forest Management and Operations	Germain, Wagner, Nyland, Nowak
Forest Biotech and Tree Improvement	Maynard
Agroforestry/Short Rotation Woody Crops	Volk, Johnston
Forest Management for Renewable Energy	Volk, Beier, Germain, Malmshiemer
Recreation Management	Kuehn
Ecotourism & Nature Tourism	Kuehn
Watershed Management	Briggs, Vidon, Stella, Nowak, Germain, Yanai

**Economics, Governance and Human Dimensions (M.P.S., M.S., Ph.D.)**

The Economics, Governance and Human Dimensions area of study emphasizes the human dimensions of resource systems involved in the processes of decision-making and action related to how coupled human-natural systems may be managed for sustainable outcomes. This area of study also incorporates rigorous research into human behavior in recreational and natural settings, a topic that draws from multiple disciplinary perspectives in the social sciences.

Topic Area	Participating Faculty
Forest and environmental economics	Wagner, Newman
Ecological economics	Luzadis, Beier
Ecosystem services	Luzadis, Beier, Wagner, Malmshiemer, Newman, Briggs
Policy	Malmshiemer, Luzadis, Wagner, Germain, Beier, Newman
Law	Malmshiemer
Human Behavior in Recreational Settings	Kuehn, Luzadis

**Monitoring, Analysis and Modeling (M.P.S., M.S., Ph.D.)**

The Monitoring, Analysis and Modeling area of study focuses on the application of statistical and operations research methods and techniques used to sample, describe and predict how individual trees, forest stands and terrestrial ecosystems change over both temporal and spatial scales. Because trees and forests respond in varying ways to an array of human and natural disturbances, research opportunities in this area of study address a diversity of topics that help us to better understand and evaluate the dynamics of terrestrial ecosystems in a rapidly changing world.

Topic Area	Participating Faculty
Sampling/Inventory	Stehman, Bevilacqua
Biometrics	Zhang, Bevilacqua, Johnston
Growth and Yield Modeling	Bevilacqua, Zhang, Nyland
GIS/Spatial Analysis	Bevilacqua, Beier, Zhang
Quantitative Silviculture	Zhang, Bevilacqua, Nyland, Johnston
Operations Research	Wagner
Simulation	Wagner, Bevilacqua

# Department of Landscape Architecture

RICHARD S. HAWKS, Chair  
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[www.esf.edu/la](http://www.esf.edu/la)

## Participating Faculty

BRYANT (Regional Landscape Planning, Urban and Landscape Ecology, Greenway/Parks Planning, Geographic Information Systems), CARTER (Urban Design, City and Regional Planning, Development Process, Sustainable Communities, Planning and Design Theory), DOBLE (Community Planning and Design, Citizen Participation, Site Planning and Design, Graphics, Education), HAWKS, Chair (Community Planning and Design, Rural Town Design, University Campus Master Planning), HOFFMAN (Design with Emphasis on Grading and Stormwater Management, Visual Resources), MILLER (Graphic Communication, Urban Design, Plant Materials), POTTEIGER (Cultural Landscape History, History of Landscape Architecture, Design Theory and Methodology), REUTER (Ecology in Landscape Planning, Design and Management of Wetlands, Computer Applications in Environmental Planning and Design Simulation), SHANNON (Site Planning and Design, Urban Analysis and Design, Sustainable Design and Development, Rural Community Planning), TOLAND (Landscape and Urban Ecology, Site Design, Urban Infrastructure Planning, Land Planning, Urban Streetscape)

The manipulation of the physical environment has been a human activity since the earliest humans formed settlements. The design and planning of the environment became a professional activity in the mid-1800s when Fredrick Law Olmsted and Calvert Vaux created the plan for Central Park in New York City.

Since 1911 the landscape architecture program at ESF has been educating practitioners and teachers, designers and planners, advocates and policy makers who have contributed their careers to a viable, sustainable integration of natural and cultural communities.

The program has 11 full-time faculty supported by several adjunct professors, lecturers and visiting instructors. Faculty interests range from design and history to landscape narratives, from materials and construction to regional planning, from ecological planning to urban design, from theoretical landscapes to historic preservation.

The Department of Landscape Architecture offers three degree programs designed to educate students to contribute in varied ways to the wise use of land and landscape. Each provides a basis for students to establish career directions in the profession of landscape architecture. The bachelor and master of landscape architecture, and master of science degrees are offered. Qualified undergraduate students may apply for the combined B.L.A./M.S. fast-track option.

Graduates of programs in landscape architecture find careers in city planning, landscape design, and environmental planning and restoration. Recent graduates are historic landscape preservation architects, landscape architects, landscape contractors, site planners, and urban designers.

## Support Facilities

Department of Landscape Architecture members believe that computer and video technologies are very important to the future of the profession. They are committed to exploring the application of digital technologies to the practice of landscape architecture and encourage the use of these technologies by the students. Advanced students may choose to specialize in the application and integration of computer technologies.

Support facilities within landscape architecture include access to a wide variety of computing equipment and applications for graphics, image processing, AutoCAD, GIS, 3-D modeling, desktop publishing, presentations, and other Internet and professional applications. Advanced computing is supported through the Computer Aided Visualization Laboratory (CAV Lab).

The program also provides individual studio workspace for each student, and office space for special research and public service projects. In addition, the Department of Landscape Architecture maintains an extensive collection of more than 40 years of student projects completed abroad for the LA Off-Campus Program, as well as other archival materials dating from 1913.

## Bachelor of Landscape Architecture

The B.L.A. program is designed for those students desiring to enter the profession of landscape architecture either directly after completing the degree or after completing graduate school. This is a professional degree with an emphasis on the skills and knowledge required to qualify as a landscape architect.

### **The degree is accredited by the American Society of Landscape Architects (ASLA).**

The B.L.A. degree is granted at the end of five years of study and requires the successful completion of 150 credit hours. Students are accepted into the lower-division landscape architecture program as freshmen or as sophomore transfers and into the upper-division program as junior transfers.

The undergraduate curriculum consists of two broad categories of courses. The first category, general education, provides students with knowledge and skills that are useful and important for all educated persons, regardless of their profession, as well as preparation for advanced courses leading to a specific profession. The second category, professional courses, provides students with direct preparation for a career through practice and application of the basic principles and skills of landscape architecture design, land manipulation and engineering, applied ecology, and communications. Studio instruction holds a special place within the program because it mimics the professional environment where students will integrate these principles and skills in order to solve landscape architectural problems. The number of students in a typical studio section is 10 to 15 because this type of problem-based learning requires intensive interaction and mentoring relationships with studio faculty. The quality of a student's professional development is monitored in part by a requirement that a grade of C or higher be earned to progress to the next studio.

The major objective of the B.L.A. program is to develop basic proficiency in design, engineering, and communication skills necessary for formal admission into the profession of landscape architecture. When the prerequisite period of work experience has been completed, a person

holding a B.L.A. degree may apply to take the examination leading to a license to practice landscape architecture. At present, the State of New York requires those holding a five-year B.L.A. degree to complete a three-year period of internship in the field prior to applying for the licensing examination. Other states have varying requirements for obtaining licensure (Refer to <http://www.asla.org/ContentDetail.aspx?id=23148>).

As in any area of professional study, students seeking the B.L.A. degree are expected to demonstrate a high level of commitment and scholarship in their studies. This professional commitment is demonstrated by a desire to serve society in an objective, rational, and ethical manner.

Students receiving a B.L.A. degree have entered the profession as employees in public agencies, not-for-profits, or in private offices offering landscape architectural services. Also, B.L.A. graduates have entered graduate schools in landscape architecture, planning, urban design, regional design, and specialties including historic preservation, environmental policy, public administration, recreation, management, and research.

### Off-Campus Program

The off-campus program is the Department of Landscape Architecture's undergraduate centerpiece and one of the most unique educational programs within the State University of New York.

Since 1970, more than 1,600 students have studied in more than 52 different countries and throughout the United States.

The off-campus program is centered on the idea of an "experiential studio." It is quite different, however, from most studio- or laboratory-based programs that teach using example and participation. Prior to the off-campus semester, students identify a particular design-related study topic, then develop plans to leave the traditional university setting and travel to locations that are uniquely suited to the topic. Students see and experience exemplary works of landscape architecture in the best locations in the world. At the same time, students learn from experiencing unfamiliar places, cultures and languages, and gain an insight into the natural and cultural environment—a sense of place that is unattainable in the campus classroom. Finally, students learn lessons about themselves and American culture that are equally valuable as landscape architects and as citizens in a larger society.

Studies may take any of several forms—they may be relatively independent, focusing on a particular student's interests and aspirations (self-described study); they may be directed by a faculty member's interests or research (faculty-described study); or they may be more applied and directed by a local group or organization on site, similar to an internship arrangement (work study). Each off-campus group is coordinated and advised by a participating faculty member, and assisted by an on-site consultant (usually a local alumna or alumnus, landscape architect, or university professor). Each student spends a full, 15-week semester "off-campus" pursuing the study, earning 15 credit hours. Typically the off-campus study is undertaken during the fall semester of the fifth year.

Each student in the B.L.A. program is required to participate in an off-campus experience and students must achieve a cumulative GPA of 2.000 or greater prior to participation. The off-campus program requires students to pay for tuition, books and materials, room and board, and travel costs to the location of study.

### Program Expenses

In addition to the normal college expenses, students must plan for special expenses such as studio equipment and materials, field trips, and the off-campus semester.

- Studio equipment and materials. In a design curriculum, students normally spend more for expendable supplies than they would on books for a lecture course. The cost of equipment, printing, and materials for studio courses is typically between \$350 and \$500 each semester. While projects are normally returned, they may be retained temporarily for display or permanently kept as part of the archives.
- Field trips. Landscape architecture students may be required to participate in a field trip as part of their studio courses. These trips are used to acquaint students with the exemplary works of landscape architecture found in Boston, Montreal, New York, Ottawa, Philadelphia, Toronto, Washington, D.C., or other cities in the Northeast. The typical cost of transportation, meals and lodging for field trips range between \$350 and \$500.
- Off-campus semester. This is a self-designed and student-budgeted program. If a student plans well, there is no need for this semester to cost any more than one spent in Syracuse. Typical expenses for the off-campus semester during the previous academic year, including tuition and travel to and from the study site, were between \$9,000 and \$10,000. However, a few students had higher expenses because of the study location they chose and the extracurricular opportunities they enjoyed while abroad. Student financial aid is available to assist with a portion of the costs associated with the off-campus semester program.
- Computers. Proficiency with computers and associated design software is essential to the success of students in the landscape architecture curriculum. Students are required to purchase a laptop computer with appropriate software by the beginning of the spring semester of the sophomore year and are expected to carry them to studio. Equipment guidelines are available from the Department of Landscape Architecture. Anticipated costs for computing equipment (hardware and software) may be between \$2,000 and \$3,000 over the course of the student's tenure at ESF.

### Prerequisites for Transfer Entry

The breadth of learning in the B.L.A. program makes it imperative that entering students prepare themselves with a broad range of foundation coursework. The environmental issues that students will engage require a strong background in the natural and social sciences, as well as in the arts and humanities. In addition, competency in graphics, written and oral communication, mathematics, and computer applications is required. Due to the specialized nature of much of this coursework, it is highly recommended that students wishing to transfer into the B.L.A. program consider doing so **no later than the beginning of the sophomore year**. Students wishing to transfer with greater than beginning sophomore standing are required to submit a portfolio of visually expressive design or graphic work for review. If students have met the sophomore transfer requirements, have completed 62 or more credit hours of coursework at another college or university, and submit portfolio work suggesting they have sufficiently advanced skills in design and graphic communication, they may be granted junior status and can enter into the core B.L.A. studio sequence.

## Portfolios

Freshman applicants are not required, but are highly encouraged to submit a portfolio of their creative work for review; transfer applicants seeking greater than first semester sophomore standing are *required* to submit a portfolio as a part of their application for admission.

Faculty members embrace a broad conception of the term “creative work,” ranging from pencil sketching to poetry; however, for the purpose of indicating an aptitude for landscape architecture, portfolio work should focus on visually expressive examples, including both traditional and digital media. Submittals will be used to assess drawing and other graphic communication skills, as well as spatial awareness and the ability to visualize and convey design ideas. Portfolio items should be no larger than 11-by-17-inch, generally consisting of good-quality photographic or xerographic reproductions, or in Adobe PDF, PowerPoint, or JPEG digital format on standard CD-R, CD-RW, or DVD media. Color slides or prints of large or 3-D work, or digital HTML “Web page” portfolios are also acceptable. Applicants should not send original artwork or rolled materials. Portfolios can be returned if accompanied by a self-addressed, pre-posted return envelope.

## Undergraduate Program Requirements

### Lower Division Required Courses (44 credits)

EFB	101/ 102	General Biology I and Laboratory		4
ESF	200	Information Literacy		1
EWP	190	Writing and the Environment <i>Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet general education standards established by SUNY is listed <a href="#">in Undergraduate Education</a>.</i>	G	3
EWP	290	Writing, Humanities and the Environment	G	3
EWP	220	Public Presentation Skills		3
LSA	132	Orientation Seminar: Landscape Architecture		1
LSA	182	Drawing Studio	G	3
LSA	200	Basic Computing		1
LSA	206	Art, Culture, and Landscape II		3
LSA	220	Introduction to Landscape Architecture		3
LSA	226	Foundation Design Studio I		4
LSA	227	Foundation Design Studio II		4
LSA	301	Digital Graphics and Documents		2
LSA	302	3D Modeling		1
LSA	305	History of Landscape Architecture I		3
LSA	311	Natural Processes in Design and Planning		3
LSA	333	Woody Plants in the Built and Natural Environment		2

### Electives (18 credits)

General Education: American History			G	3
General Education: Social Sciences			G	3
General Education: Other World Civilizations			G	3
General Education: Mathematics			G	3
Biological Science Elective				3
Natural/Physical Science Elective				3
Elective				3

### Upper Division Required Courses (79 credits)

EWP	410	Writing for Environmental Professionals		3
LSA	303	Computer Aided Design		2
LSA	304	Integrated Digital Graphic Methods		3
LSA	306	History of Landscape Architecture II		3

LSA	312	Place/Culture/Design	3
LSA	321	Ecological Applications in Planning and Design	3
LSA	326	Landscape Architectural Design Studio I	5
LSA	327	Landscape Architectural Design Studio II	5
LSA	342	Landscape Architecture Construction Technology	4
LSA	343	Landscape Materials and Structures	3
LSA	422	Landscape Architectural Design Studio III	5
LSA	423	Landscape Architectural Studio IV	5
LSA	424	Preparation for Off-Campus Design Thesis Studio	1
LSA	425	Orientation for Off-Campus Design Thesis Studio	3
LSA	433	Planting Design and Practice	3
LSA	451	Comprehensive Land Planning	3
LSA	455	Professional Practice in Landscape Architecture	3
LSA	458	Off-Campus Studio: Faculty Advisor Visit, Weekly Reports and Field Studies	4
LSA	459	Off-Campus Design Thesis Studio: Design Journal and Project Notebook	4
LSA	460	Off-Campus Design Thesis Studio: Thesis Project	7
LSA	461	Off-Campus Final Presentation Seminar	1
LSA	470	Thematic Landscape Design Studio	6

### Electives (9 credits)

Electives	9
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Total minimum credits for the degree 150 credits

### B.L.A./M.S. Fast Track

This option is available to outstanding fourth-year bachelor of landscape architecture students and provides the opportunity to receive both the bachelor of landscape architecture and master of science degrees during a six-year period at the College. Students who apply must have a minimum 3.000 GPA and are accepted into the program during the fall semester of the fourth year of the bachelor of landscape architecture program. The transition between the bachelor of landscape architecture and master of science curriculum requirements begins in the fall of the fifth year. The B.L.A. degree is awarded on completion of all professional requirements and a minimum of 150 credit hours. The M.S. degree is awarded after the completion of 30 graduate credits and successful completion of a research thesis. Depending on the student's needs and research interests, there are two options available for pursuing an off-campus semester or a field research component. The first option (option A) allows students to pursue the off-campus semester with their undergraduate peers. The second option (option B) links the off-campus semester to graduate field research for their theses.

### Program Requirements

#### Fast-Track Option A – Summer start

##### Fourth Year, Summer option only

LSA	458	Off-Campus Studio: Faculty Advisor Visit, Weekly Reports and Field Studies	4
LSA	459	Off-Campus Design Thesis Studio: Design Journal and Project Notebook	4
LSA	460	Off-Campus Design Thesis Studio: Thesis Project	7

##### Fifth Year (25-28 credits)

LSA	455	Professional Practice in Landscape Architecture	3
LSA	461	Off Campus Final Presentation Seminar	1
LSA	470/ 670	Thematic Landscape Studio	6
LSA	596	Special Topics in Landscape Architecture or equivalent	3



LSA	640	Research Methodology	3
LSA	697	Topics and Issues of Landscape Architecture	Audit
LSA	799	Thesis Proposal Development	3
		Directed Electives	6-9

B.L.A. program completed with a minimum of 150 credits earned

**Sixth Year (12-24 credits)**

LSA	899	Master's Thesis Research	6-12
		Directed Electives	6-12

Students may register for LSA 899 Master's Thesis Research as necessary for completion up to the time limit of the M.S. program.

M.S. program completed with a minimum of 180 credits (minimum 30 graduate credits)

**Fast-Track Option B – Fall start**

**Fifth Year (24-27 credits)**

LSA	455	Professional Practice in Landscape Architecture	3
LSA	470/ 670	Thematic Landscape Design Studio	6
LSA	596	Special Topics in Landscape Architecture	3
LSA	625	Orientation for Off-Campus Experiential Studio	Audit
LSA	640	Research Methodology	3
LSA	697	Topics and Issues of Landscape Architecture	Audit
		Directed Electives	6-9

**Fifth Year, Summer (6-12 credits)**

LSA	760	Off-Campus Experiential Studio <i>(must be linked to thesis)</i>	12
		<b>OR</b>	
LSA	798	Research Problem <i>(must be linked to thesis)</i>	6

B.L.A. program completed with a minimum of 150 credits

**Sixth Year (18-24 credits)**

LSA	899	Master's Thesis Research Additional semesters of LSA 899 may be completed as necessary.	6-12
		Graduate-level Directed Electives	6-12

Students may register for LSA 899 Master's Thesis Research as necessary for completion up to the time limit of the M.S. program.

**M.S. program completed with a minimum of 180 credits (minimum 30 graduate credits)**

**Graduate Programs**

Graduate studies in landscape architecture attract a broad range of people. Those with undergraduate degrees in landscape architecture may seek specialization within the profession, advanced exploration or an academic career. Others, with degrees in related fields such as architecture, city and regional planning, and environmental design, enter the program to broaden or redirect their design and planning skills. Some students with degrees in fields less closely related (such as humanities or arts and sciences) seek new career options or to focus prior interests through a licensed design and planning profession.

Three degree tracks address the needs of the students with these differing educational backgrounds. The Master of Science (M.S.) in Landscape Architecture is a two-year academic degree program for applicants who have completed a first professional degree in landscape architecture or a professional degree in environmental design, planning, or preservation. The degree may be earned through two years of full-time study or up to seven consecutive semesters (3-1/2 years) of full-time or part-time study. A three-year program for applicants who have no design or planning background leads to the fully accredited professional degree of Master of Landscape Architecture (M.L.A.). This program is for students who intend to complete coursework full-time. Applicants with a related design or planning degree may enter the three-year program with advanced standing. Finally, a fast-track option enables qualified candidates within the College's B.L.A. program to proceed directly into the Master of Science program and work on both degrees. Refer to the previous section for information on the fast-track options.

The Master of Science program serves the advanced professional or the aspiring academic. It is highly flexible and can be customized to reflect the breadth and depth of a student's interests. The Master of Landscape Architecture program, for the student seeking a first-professional degree in landscape architecture, is a more tightly structured curriculum because it leads to the pre-requisite work experience that qualifies the graduate for the Landscape Architecture Registration Examination (L.A.R.E.).

Students seeking a multidisciplinary education may choose to pursue a concurrent degree within the College of Environmental Science and Forestry or at Syracuse University.

Doctoral level studies in landscape architecture may be tailored in connection with the interdisciplinary Ph.D. program in the Graduate Program in Environmental Science (GPES). Please see The [Division of Environmental Science](#) section of this catalog.

## M.L.A. Program Requirements

The M.L.A. program requires 66 credit hours. At least 42 of those credit hours must be at the graduate level.

LSA	500	Computer Graphics I	3
LSA	501	Digital Graphics and Documents	2
LSA	502	3D Modeling	1
LSA	503	CADD	2
LSA	504	Integrated Digital Methods	1
LSA	552	Graphic Communication	3
LSA	600	Design Studio I	4
LSA	601	Design Studio II	4
LSA	606	History of Landscape Architecture	3
LSA	611	Natural Processes in Planning and Design	3
LSA	615	Site Construction, Grading, Drainage, Road Layout	3
LSA	620	Design Studio III—Advanced Site Design	4
LSA	625	Orientation for Off-Campus Experiential Studio (optional unless student will enroll in LSA 760)	2
LSA	633	Plant Identification	2
LSA	633	Planting Design and Practice	3
LSA	640	Research Methodology	3
LSA	645	Construction Documentation Studio	3
LSA	650	Behavioral Factors of Community Design	3
LSA	651	Comprehensive Land Planning	3
LSA	655	Professional Practice in Landscape Architecture	3
LSA	670	Thematic Landscape Design Studio	6
LSA	697	Topics and Issues of Landscape Architecture	1
LSA	700	Advanced Design Studio	4
LSA	760	Off-Campus Experiential Studio	12
LSA	898	Professional Experience	1-12
LSA	799	Capstone or Thesis Proposal Development	3
LSA	800	Capstone Studio	6
Electives (as determined in consultation with major professor)			

## M.S. Program Requirements

The M.S. program requires between 30 and 42 credit hours (depending on background and experience), at least 30 of which must be at the graduate level.

Because the M.S. program serves the advanced professional, course requirements do not address foundation professional courses in landscape architecture. However, the student, in consultation with the major professor and steering committee, has great flexibility in developing a program of study suited to career goals in the chosen area of study.

### M.S. Required Courses and Thesis Credits (minimum of 13 credits)

LSA	640	Research Methodology	3
LSA	697	Topics and Issues in Landscape Architecture	1

LSA	799	Capstone or Thesis Proposal Development	3
LSA	899	Masters Thesis Research: minimum of 6 credits	6

### **M.S. Elective Courses (minimum of 17 credits) 17**

Total minimum credits for the degree 30 credits

#### **Areas of Study**

The landscape architecture graduate degree programs provide a well-balanced curriculum in landscape architectural design and planning, coupled with opportunities to pursue individualized advanced study in a broad range of topics. The diversity of faculty interests and expertise offer both M.L.A. and M.S. students opportunities for in-depth exploration in three areas of study: community design and planning, cultural landscape conservation, and landscape and urban ecology.

#### **Community Design and Planning (M.L.A., M.S.)**

The purpose of this area is to address design, planning and research with regard to human settlements including discrete traditional communities such as cities, towns, hamlets, and their hinterlands; regional and rural communities connected to agriculture, watersheds and forests; and specialized communities such as institutional and corporate campuses, co-housing and new towns.

The studios, seminars and lecture courses provide introductory and advanced exploration into the theories, principles and practices of design, planning, preservation, and revitalization, as well as the search for new paradigms. The courses are supported by a wide range of electives in departments at the College of Environmental Science and Forestry and Syracuse University. There are also a significant number of opportunities for public service and research in the communities of New York state and beyond.

This area of study is especially appropriate in an era that calls for the redefinition of the American city, the retrofitting of the post-WWII suburb, the conservation and rejuvenation of rural and regional landscapes, and the exploration of traditional and new design paradigms that create sustainable symbiosis of community, ecology and place. The courses explore how to design and plan the socially interactive, environmentally sound, aesthetically pleasing settlement patterns that engender a strong sense of place and of citizenship.

There are abundant opportunities for careers in urban design, rural preservation and development, city and regional planning and corporate facilities planning. This focus is for graduate students interested in design, planning and research at the community scale via public, private, academic or non-traditional practice.

#### **Cultural Landscape Studies and Conservation (M.L.A., M.S.)**

This area addresses a range of issues germane to the developmental and interpretive history of the cultural landscape. At its most fundamental level, the study area prepares students to address preservation planning and management for a range of cultural landscape types including historic sites and settlements, designed landscapes and vernacular landscapes. There is also a growing set of interdisciplinary methods relevant to cultural landscape studies such as critical history, landscape representation, media, visual perception and reception of landscapes, interpretation, narrative and participatory design. Graduate students may explore and/or integrate these methods with design and preservation practices.

Required courses and directed electives provide the student with introductory and advanced investigations into the history, theory, and practices of cultural landscape design and stewardship, in the context of broader cultural and environmental concerns. Core courses are supported by a wide range of elective offerings both in the College of Environmental Science and Forestry and at Syracuse University.

The study of cultural landscapes is of vital concern in this era of globalization and rapid urban and suburban transformations. Not only are cultural landscapes important places in which we stage our lives, but they are also part of a larger system of cultural and social heritage which affects our identities as individuals, communities and nations. Areas of expertise associated with the study of cultural landscapes include preserving relationships between natural and cultural resources; developing policies and techniques for preservation, rehabilitation, restoration and reconstruction of cultural landscapes; mediating alternative ideas of stewardship and balancing them within a collective sense of place; using cultural landscapes as the basis for contemporary design and development; and understanding the variety and history of human experience through patterns, forms and stories in the landscape.

There are a growing number of domestic and international career opportunities that address cultural landscapes in public, private and academic practices. Graduates might work in fields such as preservation planning, sustainable tourism, land use planning, urban design, interpretive design, or cultural history and theory.

#### **Landscape and Urban Ecology (M.L.A., M.S.)**

The purpose of this area of study is to address a range of theoretical and practical applications in landscape and urban ecosystems as they relate to the practice of landscape architecture and community design. In this contemporary interdisciplinary approach, students will learn about the structure, heterogeneity and ecological processes of a broad range of natural, modified and urban landscapes. People are recognized as an integral part of the landscape and are included as a major focus of research and practice.

Students have an opportunity to develop a theoretical and analytical framework for describing different landscapes and their ecological components from different levels: the individual organism perspective, a population and community point of view, and ultimately at the ecosystem level.

Landscape ecology includes an integration of landscape issues: disturbance, fragmentation, landscape manipulation, fundamental ecological processes, composition and structure, and environmental influences. Urban ecology includes integration of climatology, geomorphology and soils, hydrology, plant and animal communities, and ecological engineering and restoration. Both landscape and urban ecology are affected by human landscape perceptions, attitudes toward the environment or landscape types, patterns of settlement, and socio-economic issues and behavior. All these elements are used to develop an understanding of the ecological essence of landscapes in order to design ecologically sustainable settlements that promote human quality of life.

There are growing numbers of domestic and international opportunities that address landscape and urban ecology issues in academic, public, private and nontraditional practice. Graduates might be involved in research and consultancy in urban forestry, ecological design, and urban

planning. This study area is supported by a wide range of electives in other departments at the College of Environmental Science and Forestry and Syracuse University as well as an urban forestry research program of the U.S. Forest Service based at ESF.

### **Final Integrative Experience**

Both M.S. and M.L.A. students must complete an integrative experience. The M.S. student must complete a thesis (6 credits). The thesis may be research in which new, original knowledge is generated, it may be a study that focuses on the application of existing knowledge to a new situation, or it may combine both elements. The M.L.A. student must participate in the capstone studio and complete a 6-credit independent design project during the final semester of the program. Both M.S. and M.L.A. students must disseminate the results of their integrative studies through capstone seminars.

### **Prerequisites and Admission Requirements**

Students seeking admission to the M.L.A. program may apply to enter based on education and experience. Admission requires:

1. An undergraduate degree
2. Graduate Record Examination scores
3. A minimum 3.000 (4.000=A) cumulative grade point average is generally required for admission. However, other circumstances may be considered (e.g., work experience) for those below this standard.
4. Three letters of recommendation
5. A completed course is recommended in each of the following six areas:
  - botany, biology, or ecology
  - geology, geomorphology, or earth science
  - anthropology, psychology, or sociology
  - computer applications
  - drawing, drafting
  - art or architecture history
6. A portfolio of creative work, which may include samples of photography, writing, drawing, digital designs or other related artistic expressions. Portfolios can be returned if accompanied by a self-addressed, pre-posted return envelope.

Students seeking admission to the M.S. program or admission to the M.L.A. program with advanced standing must additionally provide:

1. Transcripts from an accredited or recognized design or planning degree with a minimum 3.000 (4.000=A) cumulative grade point average. However, other circumstances may be considered (e.g., work experience) for those whose credentials are below this standard.
2. A portfolio of design work (required for M.L.A. program applicants and strongly encouraged for M.S. applicants)

Applicants may be assessed as deficient in one or more areas deemed important to their admission to graduate study in the program. Courses taken to make up deficiencies (e.g., English for international students) may not count toward the credit hours required for the graduate degree.

Applications should be completed prior to February 1 for fall admission. Visits to the college are highly recommended.

### **Graduate Assistantships**

Students with associated professional degrees may be considered for a graduate assistantship (stipend and tuition scholarship) upon admission, depending upon qualifications and portfolio. Other students may apply for landscape architecture graduate assistantships after the first year of the first professional degree track. Assistantships may also be available with community service or research projects and are awarded by individual faculty to students with the necessary qualifications.

A limited number of teaching assistantships is awarded each year to highly qualified candidates seeking an academic career. Individuals with prior landscape architectural work experience who intend to pursue a career in teaching at the university level are encouraged to discuss their options with the graduate program coordinator in the Department of Landscape Architecture.

### **Research and Community Service**

Research and community service are important aspects of the graduate experience in landscape architecture. Students may participate in the funded studies directed by individual faculty or in unique studies of their own design. Furthermore, many community service projects are performed in the context of a design studio, thereby bringing real world problems into the studio as a learning experience. In this way, the ongoing efforts of students and faculty help to further develop the body of knowledge of the field, while providing a challenging academic environment for the students.

Some of the vehicles currently available for research and community service include Your Town—The Citizens Institute for Rural Design, an award-winning program that provides rural planning/design workshops and technical assistance to rural communities throughout the United States; the ESF Center for Community Design Research, a research and public service vehicle for in-depth exploration of community and place, and for imparting design literacy through community education; the Olmsted Center for Landscape Preservation, the technical center of the Northeast Region of the National Park Service, that provides assistance in cultural landscape research, planning, stewardship and education; and the SUNY Center for Brownfield Studies, an educational initiative focused on environmental management and the redevelopment of brownfield properties.

## Regional, National and Global Opportunities

Major areas of recent research activity include cultural landscape preservation, visual analysis, rural town planning, ecotourism, urban forestry and infrastructure, and wetland impact mitigation. Recent public service activities include neighborhood urban design, campus design, arboretum and botanical garden design and environmental management. Research and public service activities have been funded or sponsored by the National Park Service; the National Endowment for the Arts; the National Science Foundation; the Nature Conservancy; the U.S.D.A. Forest Service; the New York State Council on the Arts; the State University of New York Construction Fund; the New York State Office of Parks, Recreation and Historic Preservation; private corporations; and such communities as the cities of New York, Philadelphia, Syracuse and Utica. Students participate in these projects through funded assistantships, coursework, and independent studies.

Graduate students may take advantage of extensive opportunities to conduct research or do internships abroad. The Department of Landscape Architecture requires all B.L.A. candidates to spend a semester off campus and most of the faculty annually travels abroad to visit and work with those students. As a result, the faculty can also offer graduate students a rich network of contacts and sponsors for graduate exploration in Europe, Latin America, the Far East and elsewhere. These opportunities support the expanding role of landscape architecture in addressing such globally important issues as metropolitan development, environmental conservation and symbiosis among community, ecology and place. Graduate research projects abroad have taken place in Italy (urban design), Mexico (ecotourism), Czechoslovakia (urban plazas), Wales (cultural landscape preservation), Northern Ireland (cultural landscapes), Indonesia (sense of place), Canada (rehabilitation of urban parks), Costa Rica (sustainable futures), Brazil (community design); Chile (urban forestry as urban design) and Spain (historic Moorish landscapes, and sustainable cities).

Graduate students may also participate in an Ibero-American consortium on sustainable communities. The consortium includes the Department of Landscape Architecture at SUNY-ESF, the Department of Forest Sciences at the University of Chile, the Department of Forest Engineering and Nature Conservation at the Polytechnic University of Madrid, Center for Environmental Studies in Vitoria-Gasteiz, Spain, and the Department of Geography at the University of the Basque Country. The agenda for this consortium includes international conferences on sustainable community planning and design; design competitions; community design charettes; exchanges of students, faculty and staff; parallel and collaborative research and public service projects; and the founding of landscape architecture/planning programs at the University of Chile and the University of the Basque Country. Graduate students will find opportunities for independent research, classroom/studio studies abroad and for internships, conferences and design charettes. The activities of the consortium are particularly (but not exclusively) geared to the interests of students seeking preparation in landscape and urban ecology.

The sustainable futures studio is an off-campus program offered during the summer in cooperation with the Monteverde Institute in Monteverde, Costa Rica. Students who have completed at least their junior year with a cumulative GPA of 3.000 or better may apply to participate in the program as a means to satisfy the off-campus program requirement. Sustainable futures is a studio internship through which participating students undertake a range of service learning community design and planning projects for existing rural communities and non-governmental organizations (NGO) in the Monteverde region. The internship work focuses on sustainable design and development and includes a multidisciplinary design studio with architects, landscape architects and urban planners; lecture and seminar components in sustainable design, ecotourism, and local culture and ecology; and intensive Spanish language training. The studio is co-sponsored by SUNY-ESF, SUNY Buffalo, the University of Maryland, and the University of Illinois.

## College and Regional Context

Students in the graduate program in landscape architecture have an excellent opportunity to draw upon the extensive college expertise in ecology, natural sciences, resources management, engineering, forestry, and many other environmental disciplines. Add to this the resources available through Syracuse University, such as architecture, geography, and the Maxwell School, and the breadth of academic choices offered to a student at ESF becomes very significant.

The city of Syracuse has the largest concentration of professional landscape architectural offices in the Central New York region. This centralized location also provides easy access to major metropolitan centers such as Ottawa, Toronto, Montreal, New York, Boston, Philadelphia, and Buffalo, and to unique rural and natural landscapes, such as Lake Ontario, the Finger Lakes, the Catskills, and the Adirondacks. Basic geography, therefore, provides the student with a wide diversity of natural and cultural contexts in which to pursue academic and career goals.

# Department of Paper and Bioprocess Engineering

GARY M. SCOTT, Chair

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[www.esf.edu/pbe](http://www.esf.edu/pbe)

The academic programs in the Paper and Bioprocess Engineering Department (PBE) emphasize fundamental engineering science and engineering skills pertaining to chemical engineering with specialization in the pulp, paper, and allied industries and the bioprocess and chemical industries. Programs include courses in traditional areas of applied chemistry, industrial bioprocessing/biotechnology, chemical engineering, and pulp and paper technology.

The paper engineering and paper science programs provide a broad base of study in the field of pulp, paper, and biobased products to prepare graduates for professional positions in the pulp, paper, and allied industries. This biobased industry is the fifth largest in the nation and is very strong internationally. The College pioneered instruction for the pulp and paper industry in 1920 with the formation of the department originally called pulp and paper manufacture. The PBE department has maintained a leading position in this area of professional education with recent efforts leading to new biorefinery technologies.

The bioprocess engineering program is a chemical engineering-based program with an emphasis on system sustainability, providing a broad base of study in the field of biological transformation, chemical transformation, biotechnology, environmental engineering, separation, transport, and optimization. The program prepares graduates to advance their studies and for professional positions in the bioprocess, bioenergy, pharmaceutical, and chemical industries. The College pioneered instruction for bioprocess engineering education in 2006, one of the first of its kind in the United States.

These programs have longstanding reputations for preparing graduates for such rewarding positions as research chemists, biotechnology scientists, process engineers, technical service representatives, and managers. Graduates have advanced to positions of leadership in research, management, technical operations, and sales in the pulp and paper industry as well as allied industries of heavy equipment manufacture, process chemicals, and other biobased industries. Other graduates have gone on to successful careers in medical, chemical and other varied fields.

The programs provide education in the physical sciences and chemical engineering, with specific emphasis on those aspects that relate to the sustainable manufacture of pulp, paper, and other products from wood and other lignocellulosic materials. This includes the chemistry, anatomy and components of wood; the conversion of wood to pulp, paper, and other products; the chemistry and physics of paper and paper formation; and the industrial utilization of biological processes and sustainable raw materials. The engineering programs include the basics of chemical engineering with a foundation of unit operations and specialized courses, for example, in air and water pollution abatement from an industrial perspective. The paper engineering program extends this foundation to present a chemical engineering education tailored specifically to the pulp and paper industry. The bioprocess engineering program extends a chemical engineering education with a focus on biomass feedstocks and biological processes rather than a focus on petroleum. The industry is now using advanced chemistry and biotechnology to improve its utilization of renewable carbon and hydrogen in lignocellulosic materials. The paper science program takes a more science-based (e.g., chemistry or biology) approach to the study of pulp and paper systems. With the science program, students are able to more deeply explore a particular aspect of the industry. The paper engineering and paper science programs have identical first years, allowing students to switch between programs without loss of course credits. Similar lower-division schedules among all three programs allow students to switch programs with only minimal disruption.

**The paper engineering program is accredited by the Engineering Accreditation Commission/Accreditation Board for Engineering and Technology (EAC/ABET).**

## Faculty:

AMIDON (Biorefinery, Fiber Properties, Paper Properties, Management, Pulping, Bleaching, Deinking), BUJANOVIC (Chemistry of Lignocellulosics and Products, Lignin Structure and Reactivity, Pulping, Bleaching), S. CHATTERJEE (Transport Phenomena, Design, Simulation, Pollution Abatement), DOELLE (Papermaking, Paper Fillers, Recycling, Renewable Energy, Bioprocesses, CO<sub>2</sub> Reduction), FIESCHKO (Bioprocess Engineering, Fermentation Processes, Industrial Biotechnology), FRANCIS (Bioenergy, Chemical Engineering, Pulping), LAI (Chemistry of Wood, Pulping, and Bleaching, Lignin Reactivity and Utilization, Biomass Fractionation, Bioproduct Development), LIU (Upstream and Downstream Bioprocess Engineering, Fermentation, Kinetics, Separation, Pulping, Bleaching, Fiber Properties), RAMARAO (Chemical Engineering, Instrumentation, Flow Phenomena, Process Control), SCOTT, Chair (Biotechnology, Bioprocess Engineering, Paper Machine Operations, Recycling, Modeling)

## Facilities

The Department of Paper and Bioprocess Engineering is located in Walters Hall, which is devoted to education and research in pulp, paper, bioproduct, bioenergy, and allied fields. In addition to a large number of special purpose laboratories and highly sophisticated scientific equipment, there is a pilot plant equipped with machinery and instrumentation for studies of pulping, pulp cleaning and screening, recycling, refining, and papermaking. Equipment includes two complete paper machines, one 48-inch and one 12-inch; two pressurized refiners for mechanical pulping; and auxiliary equipment. An environmental engineering laboratory includes various methods of paper recycling and waste treatment. A state-of-the-art laboratory for testing paper and other materials is in service. A modern bioprocess engineering lab includes fermenters, spectrophotometer, shakers, anaerobic chamber, incubators, autoclaves, bio- and chemical reactors. Pilot facilities also include equipment for the biological treatment and the separation processes for production of specialized chemicals and polymers from wood, including a 400-liter fermenter, nanoseparation equipment, and incubators for the growth of ligninolytic organisms. This equipment, as well as the extensive chemical engineering laboratory, is employed for both education and research. Computer hardware and software are continually updated for teaching and research in process control and simulation.

## Bachelor of Science in Bioprocess Engineering

The bioprocess engineering program prepares students for careers as engineers in biological and chemical process-related fields, filling positions that are typically filled by chemical engineers following additional training. As we begin the 21st century, growth and development worldwide will need to be done in a sustainable manner that looks to the long-term survival of humanity and ecosystems as we know them today. The bioprocess engineering program educates engineers versed in the traditional chemical engineering fields with a focus on developing products and energy from sustainable sources in a sustainable manner, especially from wood and other lignocellulosic materials rather than non-renewable sources, such as fossil fuels.

Program educational objectives are broad statements that describe the career and professional accomplishments that the Bioprocess Engineering program is preparing the graduates to achieve. We expect graduates:

1. To achieve rewarding careers in bioprocess engineering and related fields after graduation.
2. To demonstrate advancement in their careers through increasing professional responsibility and continued life-long learning.

To achieve these objectives, students study a broad base of topics in the fundamentals of engineering focused on the chemical and biological processing of raw materials from sustainable sources. Emphasis in this program is on using renewable biomass resources to replace petroleum in energy and industrial product applications. Examples of such technology include the production of ethanol, acetic acid, butanol, lactic acid, polymers, and other chemicals that have traditionally been produced from fossil fuels such as oil, coal, and natural gas.

Students gain valuable experience through a capstone design experience in which they work on significant problems in the design and implementation of new technologies. In addition, a summer internship is required of all students during which they gain valuable skills and experience in terms of technical knowledge and professional development. Both of these experiences serve to integrate the knowledge gained in their coursework with real-world work experiences commonly seen in their first positions after graduation.

The curriculum consists of several categories of courses. The general education component, which is required of all ESF students, broadens the students' perspectives on global and societal issues, an important component of any education. Students also take a number of courses in math and the basic sciences—chemistry, physics, and biology—to provide the background for the courses that prepare students for engineering practice. The engineering courses cover a variety of topics that are traditional for a chemical engineering program, supplemented with courses specific to bioprocess engineering. The moderate requirement of 127 credit hours allows for students to explore areas of interest through additional courses of their own choosing (free electives).

Students may be admitted to the bioprocess engineering program as first-year students with appropriate science backgrounds from their high school or as transfer students at any level with accommodations for coursework requirements. Students who have the associate degree in engineering science, chemical technology, biological sciences, or general science and mathematics are encouraged to apply as transfer students.

## Undergraduate Program Requirements

### Lower Division Required Courses (58 credits)

APM	205	Calculus I	G,M	4
APM	206	Calculus II	G, NS	4
		Calculus III	M	4
APM	485	Differential Equations for Engineers and Scientists	M	3
BPE	132	Orientation Seminar: Bioprocess Engineering	ES	1
EWP	190	Writing and the Environment	G	3
EWP	290	Writing, Humanities, and the Environment	G	3
EFB	103/4	General Biology II: Cell Biology and Genetics	G,NS	4
FCH	150	General Chemistry I	G, NS	3
FCH	151	General Chemistry Laboratory I	NS	1
FCH	152	General Chemistry II	NS	3
FCH	153	General Chemistry Laboratory II	NS	1
FCH	221	Organic Chemistry I	NS	3
FCH	222	Organic Chemistry Laboratory I	NS	1
FCH	223	Organic Chemistry II	NS	3*
FCH	224	Organic Chemistry Laboratory II	NS	1*
FCH	360	Physical Chemistry I	NS	3
FOR	207	Introduction to Economics	G	3
GNE	160	Computing Methods for Engineers and Scientists	PE	3
PHY	211	General Physics I	G,NS	3
PHY	221	General Physics Laboratory I	NS	1

PSE	223	Introduction to Lignocellulosics	ES	4*
PSE	370	Principles of Mass and Energy Balances	ENG	3

\* Only 4 credits are required from FCH 223/224 and PSE 223.

### Electives (6 credits; students are required to take two among the following four)

General Education Course: American History	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilization	G	3
General Education Course: The Arts	G	3

### Upper Division Required Courses (48 credits)

APM	395	Probability and Statistics for Engineers	M	3
BPE	304 305 498	Summer Internship in Bioprocess Engineering <u>or</u> Co-op Experience in Bioprocess Engineering <u>or</u> Research Experience in Bioprocess Engineering	ES	2
BPE	310	Colloid and Interface Science	ENG	3
BPE	300	Introduction to Industrial Bioprocessing	ENG	3
BPE	335	Transport Phenomena	ENG	3
BPE	336	Transport Phenomena Laboratory	ENG	1
BPE	420	Bioseparations	ENG	3
BPE	421	Bioprocess Kinetics and Systems Engineering	ENG	3
BPE	435	Unit Process Operations	ENG	3
BPE	440	Bioprocess and Systems Laboratory	ENG	3
BPE	481	Bioprocess Engineering Design	ENG	3
EWP	405	Writing for Science Professionals	G	2
ESF	200	Information Literacy	G	1
GNE	330	Professional Skill Seminars	ENG	6/0.5
PSE	361	Engineering Thermodynamics	ENG	3
PSE	371	Fluid Mechanics	ENG	3
PSE	480	Engineering Design Economics	ENG	3
PSE	477	Process Control	ENG	3

### Directed Electives (12 credits)

Junior or higher Biology or Biochemistry Electives	0 – 12
Junior or higher Chemistry Electives	0 – 12
Junior or higher Engineering Electives	0 – 12
Any above	12

### Free Electives (3 credits)

Free Elective	3
TOTAL MINIMUM CREDITS FOR THE DEGREE	127

The list of directed elective courses is available in the student handbook and from the student's advisor. Students are encouraged to select elective courses to focus on one concentration area from among the following: biomolecular engineering, biochemical engineering, biopolymer engineering, bioenergy engineering, biomaterials, environmental engineering, industrial engineering or paper engineering.

### Internships, Co-ops, and Research Experiences

Bioprocess engineering students enjoy the advantage of hands-on learning in the bioprocess and allied industries through internships and co-ops. All students are required to complete a two-credit internship, co-op, or research program in the industry. Internships provide students



with valuable experience, financial benefits, and two credits toward graduation. Students must submit a report and give a presentation for completion of the internship.

Students who complete a co-op in addition to the 12-week internship find the experience highly valuable because they are often able to see engineering projects through to their completion. Generally, students who have had the co-op experience are more highly recruited for permanent employment after graduation.

The co-op position, when taken in conjunction with the summer internship, consists of a work period approximately seven months in duration, either beginning in May and ending in December, or beginning in January and ending in August. Usually it takes students who complete a co-op one extra year to complete the degree requirements. Co-op students are enrolled for two credits and are required to submit a project report to fulfill the requirements for the class.

The employment interview schedule generally begins in mid-October with scheduling preference given to Syracuse Pulp and Paper Foundation member companies. Some companies schedule interviews for co-ops and summer internships at the same time they hold interviews for permanent positions. Other companies choose to hold interviews for co-ops and interns in the spring semester.

## Bachelor of Science in Paper Engineering

The paper engineering program is a chemical engineering-based curriculum designed to provide greater depth in fiber and paper processing for students preparing for an engineering career in the pulp, paper, and allied industry. The pulp and paper industry is at the forefront of the renewable resources industry. It represents the first industry that uses biomass in large quantities to produce commodity and specialized products. Graduates are well prepared to move into assignments in the engineering field and advance quickly to positions of responsibility in the analysis and design of processes and equipment.

Program educational objectives are broad statements that describe the career and professional accomplishments that the Paper Engineering program is preparing the graduates to achieve. We expect graduates:

1. To achieve rewarding careers in paper engineering and related fields after graduation.
2. To demonstrate advancement in their careers through increasing professional responsibility and continued lifelong learning.

Courses present the principles of chemical engineering with the specific content and examples selected especially for the pulp and paper industry. Courses include study in the basic sciences — chemistry, mathematics, physics, computer science — as well as engineering topics such as statics and dynamics, mechanics, thermodynamics, transport phenomena, electricity, and design. The general education component, which is required of all ESF students, broadens the students' perspectives on global and societal issues, an important component of any education. The engineering courses cover a variety of topics that are traditional for a chemical engineering program, supplemented with courses specific to pulp and paper engineering. The moderate requirement of 130 credit hours allows room for students to supplement their education with courses of their own choice (free electives).

Students in the program gain valuable experience through a capstone design experience in which they work on significant problems in the design and implementation of new technologies, typically in conjunction with a local recycled-paper mill. In addition, a summer internship is required of all students in which they gain valuable skills and experience in terms of technical knowledge and professional development. Both of these experiences serve to integrate the knowledge gained in their coursework with real-world work experiences commonly seen in their first positions after graduation.

Students may enter the bachelor of science program as first-year students or as transfer students at any class level with accommodations for program requirements. Students who have the associate degree in engineering science, chemical technology, general engineering, chemistry, or general science and mathematics are encouraged to apply as transfer students.

**The paper engineering program is accredited by the Engineering Accreditation Commission/Accreditation Board for Engineering and Technology (EAC/ABET).**

## Undergraduate Program Requirements

### Lower Division Required Courses (55 credits)

APM	205	Calculus I	G,M	4
APM	206	Calculus II	G,NS	4
		Calculus III	M	4
APM	485	Differential Equations for Engineers and Scientists	M	3
EWP	190	Writing and the Environment	G	3
EWP	290	Writing, Humanities and the Environment	G	3
FCH	150	General Chemistry I	G, NS	3
FCH	151	General Chemistry Laboratory I	NS	1
FCH	152	General Chemistry II	G,NS	3
FCH	153	General Chemistry Laboratory II	NS	1
FCH	221	Organic Chemistry I	NS	3
FCH	222	Organic Chemistry I Laboratory	NS	1

FCH	223	Organic Chemistry II	NS	3*
FCH	224	Organic Chemistry II Laboratory	NS	1*
FOR	207	Introduction to Economics	G	3
GNE	160	Computing Methods for Engineers and Scientists	PE	3
PHY	211	General Physics I	G,NS	3
PHY	221	General Physics Laboratory I	NS	1
PHY	212	General Physics II	G,NS	3
PHY	222	General Physics Laboratory II	NS	1
PSE	132	Orientation Seminar: Paper Science and Engineering	ES	1
PSE	201	The Arts and history of papermaking	G	3
PSE	223	Introduction to Lignocellulosics	ES	4*

\* Only 4 credits are required from FCH 223/224 and PSE 223.

### Electives (3 credits, students are required to take one among the following three)

General Education Course: American History	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3

### Upper Division Required Courses (48 credits)

APM	395	Probability and Statistics for Engineers	M	3
BPE	335	Transport Phenomena	ENG	3
ESF	200	Information Literacy	PE	1
EWP	405	Writing for Science Professionals	PE	2
FCH	360	Physical Chemistry I	NS	3
GNE	330	Professional skill seminars	ENG	6x0.5
PSE	200	Introduction to Papermaking	ES	3
PSE	202	Pulp and Paper Laboratory Skills	ES	1
PSE	304	Mill Experience	ES	2
PSE	350	Fiber Processing	ES	3
PSE	465	Fiber and Paper Properties	ES	3
PSE	361	Engineering Thermodynamics	ENG	3
PSE	370	Principles of Mass and Energy Balances	ENG	3
PSE	371	Fluid Mechanics	ENG	3
PSE	468	Papermaking Processes	ES	6
PSE	480	Engineering Design Economics	ENG	3
PSE	481	Engineering Design	ENG	3

### Directed Electives (12 credits)

Select from the following:

Science Directed Electives	3
Engineering Directed Electives	18

### Free Electives (3 credits)

Free Elective	3
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TOTAL MINIMUM CREDITS FOR THE DEGREE	130
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The list of directed elective courses is available in the student handbook and from the student's advisor. Some courses are available in an exchange program with Germany.

## Bachelor of Science in Paper Science

The paper science program allows those students who are more science-focused to prepare for careers in the pulp, paper, and allied industries. Students graduating from this program are well-suited for employment in many different facets of the industry, the allied chemical industry, as well as in applications of chemistry and biology. This program prepares the student for careers in the technical, managerial, or technical representative areas that extend in many directions.

Program educational objectives are broad statements that describe the career and professional accomplishments that the Paper Science program is preparing the graduates to achieve. We expect graduates:

1. To achieve rewarding careers in paper science and related fields after graduation.
2. To demonstrate achievement in their careers through increasing professional responsibility and continued life-long learning.

The program consists mainly of chemistry, some engineering courses, and specialized courses relating to the manufacture and use of pulp and paper products. The student may choose to complete one of the options described below, with some options requiring the completion of a college minor. The option electives allow the student to specialize in a subject area of interest. Students may be admitted to the paper science program as first-year students with appropriate science backgrounds from their high school or as transfers at any level with accommodations for coursework requirements. Students who have the associate degree in engineering science, chemical technology, or science and mathematics are encouraged to apply as transfer students.

## Undergraduate Program Requirements

### Lower Division Required Courses (50 credits)

APM	205	Calculus I	G,M	4
APM	206	Calculus II	G,NS	4
EWP	190	Writing and the Environment	G	3
EWP	290	Writing, Humanities and the Environment	G	3
FCH	150/ 151	General Chemistry I and Laboratory <i>Natural science course</i>	G, NS	4
FCH	152/ 153	General Chemistry II and Laboratory	G,NS	4
FCH	221/ 222	Organic Chemistry I and Laboratory	NS	4
FCH	223/ 224	Organic Chemistry II and Laboratory	NS	4
FCH	380	Analytical Chemistry I	NS	3
FOR	207	Introduction to Economics	G	3
GNE	160	Computing Methods for Engineers and Scientists	PE	3
PHY	211/ 221	General Physics I and Laboratory	G,NS	4
PHY	212/ 222	General Physics II and Laboratory	NS	4
PSE	201	The Art and History of Papermaking <i>Meets the requirements for general education skills and knowledge area. A complete listing of ESF or Syracuse University courses that meet the general education standards established by SUNY is listed <a href="#">in Undergraduate Education</a>.</i>	G	3

### Electives (3 credits, students are required to take one among the following three)

General Education Course: American History	G	3
General Education Course: Western Civilization	G	3
General Education Course: Other World Civilizations	G	3

### Upper Division Required Courses (37 credits)

EWP	405	Writing for Science Professionals		3
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ESF	200	Information Literacy		1
FCH	360	Physical Chemistry I		3
FCH	361	Physical Chemistry II		3
PSE	132	Orientation Seminar: Paper Science and Engineering	ES	1
PSE	200	Introduction to Papermaking	ES	3
PSE	202	Pulp and Paper Laboratory Skills	ES	1
PSE	304	Mill Experience	ES	2
PSE	350	Pulping and Bleaching Processes	ES	3
PSE	351	Pulping and Bleaching Laboratory	ES	2
PSE	370	Principles of Mass and Energy Balances <i>Engineering course</i>	ENG	3
PSE	465	Paper Properties	ES	4
PSE	466	Paper Coating and Converting	ES	3
PSE	467	Papermaking Wet End Chemistry	ES	3
PSE	468	Papermaking Processes	ES	3

**Engineering Electives (9 credits selected from the following:)**

BPE	335	Transport Phenomena	ENG	3
ERE	440	Water Pollution Engineering	ENG	3
GNE	461	Air Pollution Engineering	ENG	3
PSE	361	Engineering Thermodynamics	ENG	3
PSE	371	Fluid Mechanics	ENG	3
PSE	436	Pulp and Paper Unit Operations	ENG	3
PSE	477	Process Control	ENG	3
PSE	480	Engineering Design Economics	ENG	3
PSE	481	Engineering Design	ENG	3

**Technical Elective Courses (14-18 credits)**

Students completing the paper science program must complete 15-18 credits of technical electives in order to satisfy the graduation requirements. Courses taken to satisfy the engineering electives above cannot also be used to satisfy the technical elective requirement. This technical elective requirement can be satisfied by completing one of the collegewide minors listed below:

- Bioprocess Science
- Computer and Information Technology
- Construction Management
- Entrepreneurship
- General Management Studies
- Marketing
- Sustainable Construction

Students not completing one of the listed minors must complete at least 15 credits of department-approved technical elective concentration coursework in the following areas:

- Biology
- Chemistry
- Pollution abatement
- Applied mathematics
- Computer modeling
- Mechanics

- Engineering design
- Materials science
- Forestry and forest management
- Biotechnology
- Wood science
- Other department-approved areas

### **Free Electives (6 credits)**

Total minimum credits for the degree 126 credits

### **Internships and Co-ops**

Paper engineering and paper science students enjoy the advantage of hands-on learning in the pulp, paper, and allied industries through paid internships and co-ops. All students are required to complete a two-credit, 12-week summer intern program in the industry (PSE 304). Internships provide students with valuable experience, financial benefits, and two credits toward graduation. Students must submit a mill report for completion of the internship.

Students who complete a co-op in addition to the 12-week internship find the experience highly valuable because they are often able to see engineering projects through to their completion. Generally, students who have had the co-op experience are recruited for permanent employment.

The co-op position is approximately seven months in duration, either beginning in May and ending in December, or beginning in January and ending in August. Usually it takes students who complete a co-op one extra year to complete degree requirements. Co-op students are enrolled for two credits and are required to submit a co-op project report in addition to the mill report required for the two-credit summer internship course.

The employment interview schedule generally begins in mid-October with scheduling preference given to Syracuse Pulp and Paper Foundation member companies. Some companies schedule interviews for co-ops and summer internships at the same time they hold interviews for permanent positions. Other companies choose to hold interviews for co-ops and interns in the spring semester.

### **Minors**

Students are eligible to take any of the minors that are offered at ESF. The minors most commonly completed are the general management studies minor, the bioprocess science minor, the paper science minor, and the computer and information technology minor, which are summarized below. See [Academic Programs](#) for complete description of the course requirements for these and other minors at ESF.

#### **Bioprocess Science Minor**

The bioprocess science minor is available to students in the paper science and paper engineering programs who maintain a minimum cumulative GPA of 2.800 and who desire to develop greater knowledge of bioprocess science and its related fields.

#### **Computer and Information Technology Minor**

The computer and information technology minor is available to all ESF undergraduates who want to develop greater skill in computer science and information technology applications. By understanding of the basic principles behind software development, students can more effectively use these tools in their chosen fields. The minor courses can be used to satisfy the technical electives in the paper science program.

#### **General Management Studies Minor**

The general management studies minor may be taken in conjunction with the bioprocess science, paper science, or paper engineering programs. In the paper science program, the minor courses can be used to satisfy the technical electives. Students should complete a course in microeconomics and a course in accounting prior to entering the junior year.

#### **Paper Science Minor**

The paper science minor is available to students in the bioprocess engineering program who maintain a minimum cumulative GPA of 2.800 and who desire to develop greater knowledge of paper science and its related fields.

### **Graduate Program in Paper and Bioprocess Engineering**

The department participates in graduate education leading to the master of professional studies (M.P.S.), master of science (M.S.), and doctor of philosophy (Ph.D.) degrees in Paper and Bioprocess Engineering. Three options are available within this program:

- Paper Science and Engineering (PSE)
- Bioprocess Engineering (BPE)
- Biomaterials Engineering (BME)

The program in Paper and Bioprocess Engineering allows students to investigate a diverse range of topics in the area of pulp and paper design, process and product development, and manufacturing, as well as the production of chemicals, energy, and other products from sustainable raw

material sources using both chemical and biological methods. The overall objective of the option is to educate students at the M.P.S., M.S., and Ph.D. level in the development of new processes and products that can be produced in an ecologically sound and sustainable manner.

Many research projects are carried out under the auspices of one of the premier research institutes of the world, the Empire State Paper Research Institute (ESPRI), a renowned organization supported jointly by ESF and the Empire State Paper Research Associates, an international consortium of leading industrial companies. ESPRI's research activities aim to generate new information regarding the fundamentals, science, engineering and technology of the production of products and chemicals, especially paper, from renewable resources such as wood in an ecologically sound manner. Recent work has been directed to fundamental investigations of pulping, bleaching, co-products from wood, additives, paper recycling, effluent disposal, the papermaking process, the properties of paper, reactions of wood components during mechanical and chemical treatments, novel wood component separation techniques, new biotechnologically based pulping methods, process modeling paradigms, the structure of wood and wood fibers, evaporation, fluid dynamics, heat transfer, and chemical recovery. Pilot scale equipment in Walters Hall is often used as an integral part of these research programs.

Examples of inter- and intra-institutional collaborations include the Department of Environmental and Forest Biology and the Department of Chemistry, as well as many industrial cooperators. Cooperative studies enable access to the latest equipment in the computer field, including supercomputers. The department enjoys excellent external support in the form of graduate assistantships, fellowships, and grants from ESPRI, and other industry sources, as well as a number of government granting agencies.

Students can be accepted into the program from a variety of backgrounds. Successful students who have pursued advanced degrees in the Department of Paper and Bioprocess Engineering have had backgrounds in chemical engineering, pulp and paper engineering, civil engineering, mechanical engineering, environmental engineering, chemistry, biological engineering, biology, biotechnology, and manufacturing, among many others. Students planning to obtain graduate degrees in Paper and Bioprocess Engineering should have strong undergraduate preparation in some of the following areas, depending on the particular area of study chosen: mathematics, chemistry, physics, engineering, biological sciences, and computer science.

### **Paper Science and Engineering Option**

The PSE option in the Paper and Bioprocess Engineering program offers areas of study in:

#### **Pulping and Bleaching Processes (M.S., Ph.D.)**

- Reaction mechanisms and kinetics
- Applications of biotechnology
- Lignin and carbohydrate chemistry
- Chemicals from wood and pulping residues
- Energy from wood and pulping residues
- Chemical modification in mechanical pulping
- Catalytic and activation effects

This area of study focuses on chemical relationships and reactions basic to the manufacture and bleaching of pulp, as well as some papermaking operations. Courses in theoretical and applied chemistry are indicated, as well as specialized courses addressed directly to pulping and bleaching. Research centers on these same topics, currently stressing new and improved processes to increase energy efficiency and reduce environmental impact. These include studies on the pre-extraction of wood chips to produce acetic acid from acetyl groups, production of hydrogen and carbon monoxide from gasification of wood and pulping effluents, delignification and brightening with oxygen, hydrogen peroxide and ozone, enzyme treatment of effluent streams, mechanisms of carbohydrate reactions, and photosensitization of bleached pulps.

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#### **Colloidal Chemistry and Fiber Flocculation (M.S., Ph.D.)**

- Paper sheet formation mechanisms
- Wet-end chemistry and physics
- Effects of additives in fiber networks

This study area deals with colloidal phenomena in the papermaking process, in particular the interaction among fibers, fine particles, polymeric additives, and electrolytes in stock preparation and sheet formation. Research topics fall into two categories: fundamental colloidal behavior of particles and behavior of paper stock on the paper machine. In the latter, extensive use is made of pilot plant facilities in Walters Hall. Current research projects include non-sulfur pulping, biopulping, chemicals and energy as byproducts, effects of wet pressing and press drying on sheet properties, pulping of tropical woods, and computer simulation and control of papermaking. Supporting this work is an experimental pulp and paper mill with two complete paper machines, a pressurized refiner and extensive auxiliary equipment.

PARTICIPATING FACULTY: AMIDON, BUJANOVIC, DOELLE, FRANCIS, RAMARAO, SCOTT.

#### **Fiber and Paper Physics (M.S., Ph.D.)**

- Fiber orientation and sheet properties
- Adsorption and transport of moisture in paper materials
- Mechano-sorptive phenomena

Mechanical behavior of fibers, paper and board, and other fiber networks and composites depends upon variables of material, process and structure at all levels, especially structural anisotropy. Recommended courses focus on mechanical and chemical engineering, mechanics of materials, physics, mathematics and statistics, microscopy, and wood and fiber properties. Research topics are basic in nature, designed to describe and model quantitatively the properties and behavior of fibers and fibrous structures. Current projects include studies of transient

moisture sorption by paper materials, the effect of moisture on mechanical properties, influence of sheet structure on properties, use of image processing to characterize deformational behavior of paper, and determination of elastic constants of paper.  
PARTICIPATING FACULTY: DOELLE, HANNA, RAMARAO, SCOTT.

#### **Process and Environmental Systems Engineering (M.P.S., M.S., Ph.D.)**

- Energy from biomass and other renewable sources
- Bioseparations of lignocellulosic materials into useful components
- Bioprocessing of renewable materials
- Creation of new bioproducts using ecologically sustainable processes

Process engineering links research with development, design, operation, and optimization of manufacturing methods and equipment, seeking improvement through technological innovation consistent with environmental and resource stewardship. Principles of engineering science and mathematics are applied to analysis and dynamic modeling of units and systems, with increasing use of computers in both research and professional practice. Research here includes process dynamics and control, studies of new pulping and bleaching processes, characterization and treatment of waste streams, byproduct recovery, and computer simulation of paper-processing systems. The extensive laboratories and pilot plant in Walters Hall are strongly supported by computing facilities and expertise on campus. Appropriate advanced courses in engineering, mathematics and computer science are available to suit individual student interests and needs.

PARTICIPATING FACULTY: CHATTERJEE, FRANCIS, LIU, RAMARAO, SCOTT.

#### **Pulp and Paper Technology (M.P.S.)**

- Pulping conditions and fiber properties
- Fungal and enzymatic treatments
- Chemicals and energy as byproducts
- Statistical analysis of paper structure
- Recycling of papermaking fibers

Studies in this area deal closely with processes involved in the manufacture of pulp and paper. Courses concerned with this subject are central to a student's program, extended and enriched with selected courses in chemistry, polymers, chemical engineering, process control, applied mathematics, and computer applications. Current research projects include non-sulfur pulping, biopulping, chemicals and energy as byproducts, effects of wet pressing and press drying on sheet properties, pulping of tropical woods, and computer simulation and control of papermaking. Supporting this work is an experimental pulp and paper mill with two complete paper machines, a pressurized refiner and extensive auxiliary equipment.

PARTICIPATING FACULTY: AMIDON, BUJANOVIC, DOELLE, FRANCIS, HANNA, LAI, LIU, SCOTT.

#### **Bioprocess Engineering Option**

Projects conducted in the department under this option develop fundamental knowledge of biorefinery processes for application in the production of a wide spectrum of industrial products and fuels from bioresources, primarily lignocellulosics. Research is also supported by various U.S. federal and N.Y. state governmental agencies, sometimes in conjunction with private industrial partners.

The BPE option in the Paper and Bioprocess Engineering program offers areas of study in:

#### **Biocatalysis and Bioreaction Engineering (M.S., Ph.D.)**

- Reaction mechanisms and kinetics
- Catalytic and activation effects
- Enzyme Chemistry, Engineering
- Fermentation Engineering
- Engineering of Bioreactors

Biocatalysis is the study of biological and chemical processes involving biocatalysts, enzymes and proteins. This area of study prepares students for traditional "upstream" operations: principles of design and operation of bioreactors and fermenters. Chemical and biological processes often involve reactions at the interfaces of liquid and solid, and are frequently diffusion limited. Understanding of surface activities as well as effective modeling of the process kinetics enables the engineer to design processes with optimal yield, rate of reaction using appropriately sized equipment. These form the core of most bioprocesses in the industry. Pilot plant facilities in these areas are also available.

PARTICIPATING FACULTY: AMIDON, CHATTERJEE, LIU, FIESCHKO, SCOTT.

#### **Bioseparations Engineering (M.S., Ph.D.)**

- Membrane-based separations: micro, ultra and nanofiltration; functionalized membranes
- Adsorptive, extractive and reactive separations
- Solid liquid separations: filtration, centrifugation
- Chromatographic separations
- Novel separation technologies: simulated moving bed and expanded bed adsorption and chromatography

Bioseparations is the study of separation of valuable products from the output of bioreactors using the wide spectrum of unit operations. Traditional "downstream" operations include membrane and chromatography processes. This area encompasses study of unit operations, separations, transport phenomena, thermodynamics, colloid and surface science and process engineering. There is extensive research effort and focus in this area. Current projects include membrane separations, adsorption, filtration, centrifugation, and novel separations based on functional materials. Pilot plant facilities in these areas are also available.

PARTICIPATING FACULTY: AMIDON, CHATTERJEE, DOELLE, LIU, FIESCHKO, FRANCIS, RAMARAO, SCOTT.

#### **Bioprocess Design, Simulation and Control (M.S., Ph.D.)**

- Process design
- Process simulation, dynamics, control
- Batch process scheduling

This area of study involves the design, simulation and control of batch and continuous processes. Coursework is concentrated in process simulation, process analysis and dynamics and control. This is supplemented by studies in downstream and upstream processing. The dynamic operation and scheduling of batch plants is an important aspect of bioprocesses. Process economics are an important adjunct to the modeling of manufacturing processes. Pilot plant facilities in these areas are also available.

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#### **Bioenvironmental Engineering (M.S., Ph.D.)**

- Anaerobic and aerobic bioreactors
- Sludge and wastewater treatments
- Bacterial and enzymatic processes in environmental remediation

Bioenvironmental engineering links research with environmental and bioresource stewardship. Research here includes process dynamics and control, characterization and treatment of waste streams from bioprocesses, byproduct recovery, and computer simulation of environmental processing systems. The extensive laboratories and pilot plant in Walters Hall are strongly supported by computing facilities and expertise on campus. Pilot plant facilities in these areas are also available.

PARTICIPATING FACULTY: AMIDON, CHATTERJEE, FRANCIS, LIU, RAMARAO, SCOTT.

#### **Renewable Energy & Biofuels (M.S., Ph.D.)**

- Energy from biomass and other renewable sources
- Bioseparations of lignocellulosic materials into useful components
- Bioprocessing of renewable materials
- Creation of new bioproducts using ecologically sustainable processes

This area of study encompasses both the use of renewable and sustainable resources (e.g., wood) for the production of chemicals, advanced materials, fuel, and energy, as well as the use of bioprocessing technology to produce such products. Such bioproducts extend to the production of energy from renewable resources including the use of gasification, co-firing of byproducts, anaerobic digestion, solar, and the production of ethanol. Courses include chemical engineering, advanced chemistry, biotechnology, and bioengineering, building on a strong base of mathematics, chemistry, and biology. Current research projects in this area include the bioseparation of xylan from hardwoods, the production of ethanol and acetic acid from wood hemicelluloses, development of separation processes for various bioproducts, gasification, enzymatic processing of lignocellulosic materials, and chemical production from sustainable resources as a replacement for non-renewable fossil fuels. Pilot plant facilities in these areas are also available. Many research projects in this area have extensive connections to industrial organizations.

PARTICIPATING FACULTY: AMIDON, BUJANOVIC, CHATTERJEE, DOELLE, LAI, LIU, FIESCHKO, FRANCIS, RAMARAO, SCOTT.

#### **Biopharmaceuticals (M.S., Ph.D.)**

- Upstream processing, bioreactors
- Downstream processing

Biopharmaceuticals are typically biologically active proteins produced by using recombinant bacterial and mammalian cells. Bioprocesses to produce biopharmaceuticals typically utilize microbial and mammalian cell culture fermentation processes, tangential flow filtration, centrifugation and a variety of chromatographic separations. Principles of microbiology, fermentation technology, reaction kinetics, separation science, as well as statistical process control are used to develop highly reproducible processes that can produce consistent products necessary to meet GMP (good manufacturing practice) production requirements.

PARTICIPATING FACULTY: LIU, FIESCHKO, RAMARAO, SCOTT

#### **Industrial Biological Processes (M.S., Ph.D.)**

- Biological processes in food and beverage manufacturing
- Industrial fermentation processes

Biological processes have been used for centuries to produce wine, beer and fermented foods. As processes and manufacturing efficiencies have improved, products such as antibiotics, vitamins, enzymes, specialty chemicals and even commodity chemicals have and are being produced using bioprocesses. Bioprocesses for these applications typically employ microbial fermentation processes, filtration or centrifugation, precipitation and/or crystallization and drying. Principles of microbiology, fermentation technology, reaction kinetics, separation science and process economics are typically required to develop large cost efficient manufacturing processes.



PARTICIPATING FACULTY: LIU, FIESCHKO, RAMARAO, SCOTT

#### **Bioprocess Engineering (M.P.S.)**

- Energy from biomass and other renewable sources
- Bioseparations of lignocellulosic materials into useful components
- Bioprocessing of renewable materials
- Creation of new bioproducts using ecologically sustainable processes

This area of study encompasses both the use of renewable and sustainable resources (e.g., wood) for the production of chemicals, advanced materials, fuel, and energy, as well as the use of bioprocessing technology to produce such products. Such bioproducts extend to the production of energy from renewable resources including the use of gasification, co-firing of byproducts, anaerobic digestion, solar, and the production of ethanol. Courses include chemical engineering, advanced chemistry, biotechnology, and bioengineering, building on a strong base of mathematics, chemistry, and biology. Current research projects in this area include the bioseparation of xylan from hardwoods, the production of ethanol and acetic acid from wood hemicelluloses, development of separation processes for various bioproducts, gasification, enzymatic processing of lignocellulosic materials, and chemical production from sustainable resources as a replacement for non-renewable fossil fuels.

PARTICIPATING FACULTY: AMIDON, BUJANOVIC, S. CHATTERJEE, DOELLE, FRANCIS, LAI, LIU, RAMARAO, SCOTT

#### **Biomaterials Engineering (BME) Option**

The BME option in the Paper and Bioprocess Engineering program offers areas of study in:

##### **Biocomposite Materials, Biopolymers (M.S., Ph.D.)**

- Paper, cellulosic and natural fibrous materials
- Natural rolled erosion control products
- Bacterial cellulose and polyesters
- Wood, lignocellulosics-based composites, fiber-based composites

Various composites incorporating materials derived from bioresources such as lignocellulosics are critical to the future of sustainable development. This research area is focused toward training students on the design and performance of various composites engineered from sustainable and renewable materials. Biopolymers such as polylactic acid (PLA) and polyhydroxyalkanoates (PHA) are of particular interest for production from plant- or tree-based resources. These polymers, besides being produced from sustainable resources, degrade quickly in the environment and reduce the environmental footprint of the products. Therefore they contribute to sustainable living besides incorporating green processing principles. They also avoid the use of fossil carbon sources helping mitigate climate change effects in the environment.

PARTICIPATING FACULTY: AMIDON, BUJANOVIC, LAI, LIU, FIESCHKO, FRANCIS, RAMARAO;

##### **Bioactive Materials and biosensors (M.S., Ph.D.)**

- Bioactive paper, cellulosic and natural fibrous materials
- E-paper
- Photosensitive polymers, fibers and materials
- Antimicrobial coatings, fibrous and nonwoven products

Novel and designed materials displaying significant biological activity, e.g. antibody binding, antimicrobials, photosensitive or other kinds of stimuli responsive are being applied for a wide array of sensors and uniquely functional products. Wound and hygiene care, protective materials, identification materials are of interest.

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##### **Nanocomposites and nanostructured materials (M.S., Ph.D.)**

- Nanocrystallites of cellulose from wood
- Nanostructured fibrous materials from lignocellulosics
- Functionalized nanomaterials from lignocellulosic raw materials

A new area of research is nanocomposites and nanostructured materials. Many components of plants and trees are nanostructured. For example, cellulose microfibrils liberated from wood and plant cell walls can be incorporated into different polymers to yield composites of unique properties. These materials are usually derived from natural and renewable resources and contribute to sustainability.

PARTICIPATING FACULTY: AMIDON, LAI, LIU, FIESCHKO, FRANCIS, RAMARAO

### **Graduate Program in Sustainable Engineering Management**

The PBE Department also participates in the M.P.S. program in Sustainable Engineering Management (SEM) that is administered by the Division of Engineering and offers two options within this program:

- Bioprocess Engineering
- Paper Engineering

The educational objectives of the M.P.S. in Sustainable Engineering Management are to:

- Produce graduates who effectively practice engineering for the design and operation of systems in their particular area of Sustainable Engineering Management.
- Produce graduates who can apply their knowledge of business, management, policy, and other areas to their particular area of Sustainable Engineering Management.
- Produce graduates who successfully obtain professional positions requiring a strong understanding of the knowledge and skills of the engineering profession.
- Produce graduates who are prepared to advance in the engineering profession and be successful in employment and academic opportunities.

The program in Sustainable Engineering Management allows students to investigate a variety of science and engineering topics together with courses in business, management, policy, law, and other fields to form a Professional Science Master's program (P.S.M.) recognized by the Council of Graduate Schools. The P.S.M. concept is an innovative graduate degree designed to allow students to pursue advanced training in science or engineering while also developing skills in the areas of business, management, and other professional skills. The educational objectives of the M.P.S. in Sustainable Engineering Management are to produce graduates who effectively practice engineering for the design and operation of systems and can also apply their knowledge of business, management, policy, and other areas to their particular area of Sustainable Engineering Management.

Students in this program must complete a total of 36 credit hours. The topical core of the program consists of 21 credit hours of courses in their technical field. An additional 12 credits of courses in business, management, policy, law and other areas constitute the "plus" courses in the degree. An integrative experience (3 credit hours) in the form of an internship or research experience is also required. The selection of the "plus" courses as well as technical electives allows students to develop study programs tailored to their individual interests and strengths.

The M.P.S. program in Sustainable Engineering Management is intended for students who:

- have a B.S. degree in an appropriate STEM field and wish to extend their technical knowledge in this area together with obtaining professional skills characterized by the "plus" courses
- have worked in the industry and wish to return for a professional degree that incorporates business skills into the program.

Students entering the M.P.S. program should have a B.S. degree in a science- or engineering- related field. In terms of coursework, students should have the necessary prerequisites to take the courses that are required for the degree or be prepared to take these courses prior to taking the required courses. In general, students should have taken as part of their undergraduate program at least two semesters of calculus, two semesters of general chemistry, a semester of physics, and a semester of biology. Additional chemistry, biology, and computer science courses, while not required, would be helpful.

### **Bioprocess Engineering Option (M.P.S.)**

This option encompasses both the use of renewable and sustainable resources (e.g., wood) for the production of chemicals, advanced materials, fuel, and energy, as well as the use of bioprocessing technology to produce such products. Such bioproducts extend to the production of energy from renewable resources including the use of gasification, co-firing of byproducts, anaerobic digestion, solar, and the production of ethanol. Courses include chemical engineering, advanced chemistry, biotechnology, and bioengineering, building on a strong base of mathematics, chemistry, and biology. Graduates of this program will have an understanding of the technical field of bioprocess engineering together with a background in business and management.

### **Paper Engineering Option (M.P.S.)**

Studies in this option deal closely with processes involved in the manufacture of pulp and paper as well as the allied industries. Courses concerned with this subject are central to a student's program, extended and enriched with selected courses in chemistry, polymers, chemical engineering, process control, applied mathematics, and computer applications. Supporting this work is an experimental pulp and paper mill with two complete paper machines, a pressurized refiner and extensive auxiliary equipment. Graduates of this program will have an understanding of the pulp, paper, and allied industries together with a background in business and management to understand the context of the industry in society.

### **Advanced (Graduate) Certificate in Bioprocessing**

This bioprocessing certificate program was developed through a collaborative and interdisciplinary effort between business and academia to take advantage of this region's unique expertise and resources. Graduates of the program will support the development and manufacture of products produced through bioprocesses, such as those produced in the pharmaceutical and fermentation industries, and biorefineries.

The purpose of the certificate program is to provide:

- Graduate education in bioprocessing that leads to a documented level of competency for practice;
- A structured and documented course of study at the graduate level; and
- A means for students to improve their competitive position in the employment marketplace.

Applicants must hold a bachelor's degree from an accredited institution in engineering, science or a related area. The student must have the required prerequisite background in topics that are fundamental to bioprocessing guided from previous coursework or professional experience. Applicants must demonstrate competence in pre-calculus and quantitative problem solving, preferably with calculus. Students who are matriculated in ESF graduate degree programs are not eligible to earn the Advanced Certificate in Bioprocessing.

Application and admissions procedures, compliance with college requirements for successful graduate-level study, and the awarding of advanced certificates are administered by the dean of Instruction and Graduate Studies. Applicants should complete and submit the application form to the Office of Instruction and Graduate Studies. Upon completion of program credit hour requirements, students will file a certificate request form that identifies completed coursework and initiates actions to produce official transcripts, leading to the award of the certificate. The curriculum consists of five technical courses including a capstone professional experience/synthesis course that will provide participants

with a variety of skills supporting the technical aspects of the program. The capstone course will challenge students to use the skills they learned throughout the program and apply those skills to relevant business settings. Students will complete 15 credits hours of specific graduate coursework with an average grade of B or better.

# The Ranger School

CHRISTOPHER L. WESTBROOK, Director  
Wanakena Campus, 315-848-2566 FAX 315-848-3249  
[www.esf.edu/rangerschool](http://www.esf.edu/rangerschool)

## Participating Faculty

Staff (Fire Control), BRIDGEN (Silviculture, Dendrology, Aerial Photogrammetry, Utilization, Timber Harvesting), JOHNSTON (Ecology, Forest Management, Forest Protection) SAVAGE (Forest Measurements, Recreation, Wildlife, Dendrology), WEBB (Surveying, Transportation), WESTBROOK, Director (Surveying, Leadership and Problem Solving, Water)

## Visiting Faculty

BENZEL, ROZESKI, ALLEN, SEHNERT

## About The Ranger School

In 1912, approximately 2,800 acres of land in the Adirondack Mountains were donated to the College as a site for the development of a ranger school. Since that time, The Ranger School has trained nearly 4,000 students, most of whom went on to work in a variety of forestry and surveying positions, and it has earned a national reputation for excellence. The program is administered by and is an integral part of the SUNY-ESF Department of Forest and Natural Resources Management. This unique model of a single professional faculty offering all levels of study from technical through postdoctoral emphasizes the teamwork approach to forest resource science and management espoused by the faculty.

The Ranger School curriculum educates students for careers in the areas of environmental conservation, forestry and surveying, while also providing preparation for continued education in related bachelor's degree programs. The degree of associate in applied science (A.A.S.) is awarded. Within the curriculum there are three areas of study: forest technology, land surveying technology and environmental and natural resources conservation.

Since The Ranger School is situated within a forest, some applicants may mistakenly believe that the experience is one of forest lore and wilderness survival. We strongly emphasize that the curricula demand high-quality academic achievement. Program completion requires concentrated and consistent study. Classes are scheduled from 8 a.m. to 5 p.m. Monday through Friday, with classroom and laboratory or field time equally divided. The intensity of the program normally requires a minimum of 70 hours a week of evening and weekend study, daily classes, and laboratory/field exercises. Several short trips are made during the year in connection with courses in dendrology, silviculture, forest management, forest recreation, wildlife ecology and surveying.

## Associate of Applied Science in Environmental and Natural Resources Conservation

The environmental and natural resources conservation program provides students with the scientific theory and applied skills necessary for a technical career in the environmental and natural resources sector. This program will provide students with a solid grounding in applied ecological and sociopolitical concepts, accompanied by technical training in plant and tree identification, land surveying, natural resources measurements, geospatial applications, soil and water monitoring, wildlife techniques and forest recreation.

Students interested in a baccalaureate degree should investigate the [Department of Forest and Natural Resources Management's bachelor's degree curriculum](#). Transfer is possible upon completion of the A.A.S. degree at Wanakena. Transfer into other baccalaureate programs at ESF may be possible, but students should consult with an advisor in the Undergraduate Admissions office as soon as possible. Students who may consider transferring to a baccalaureate program after graduation from the environmental and natural resources conservation program should pay close attention to the footnotes under "freshman year."

The freshman year environmental and natural resources conservation curriculum consists of general studies courses which may be taken at any accredited four-year, community, or agricultural college, or college of technology.

## Program Requirements

### First Year Required Courses (30 credits)

Completed at a college of the student's choice

COURSES	Credits
General Biology	4
Science Course (Biology, Chemistry, or Physics)	4
English with a Focus on Writing	6
Trigonometry	3
Policy/Government	3
Electives Students intending to apply to a four-year program after earning an A.A.S. degree should use electives to meet lower-division requirements	10

## Second Year Required Courses (48 credits)

COURSES		Credits
FTC 200	Dendrology	3
FTC 202	Introduction to Surveying	3
FTC 204	Introduction to Natural Resources Measurements	4
FTC 206	Forest Ecology	4
FTC 207	Forest Safety	1
FTC 208	Geographic Information Technology	3
FTC 209	Adirondack Cultural Ecology	3
FTC 211	Silviculture	4
FTC 219	Introduction to Forest Recreation	1
FTC 221	Natural Resources Management	3
FTC 223	Water Measurements	1
FTC 232	Wildlife Techniques	2
FTC 234	Wildlife Conservation	3
FTC 236	Interpretive Techniques in Forest Recreation	2
FTC 237	Introduction to Water and Soil Resources	3
FTC 238	Forest Insects and Disease	3
FTC 239	GIS Applications	2

Total minimum credits for the degree 75 credits

## Associate of Applied Science in Forest Technology

This degree provides students with knowledge of the field practice of forest management, the ability to work and communicate effectively with professional and paraprofessional personnel, and an understanding of the physical, biological and quantitative aspects that form the basis of forestry.

Graduates immediately find jobs at the technical level and are generally classified as forest technicians or forestry aides in initial employment positions. Forestry agencies and wood-using industries employ forest technicians as an important part of their forest management teams, usually as the “people on the ground” who plan and execute the field practice of forestry, normally under the supervision of a professional forester.

Students interested in a baccalaureate degree should investigate the [Department of Forest and Natural Resources Management’s bachelor’s degree curriculum](#). Transfer is possible upon completion of the A.A.S. degree at Wanakena. Transfer into other baccalaureate programs at ESF may be possible, but students should consult with an advisor in the Undergraduate Admissions office as soon as possible. Students who may consider transferring to a baccalaureate program after graduation from the forest technology program should pay close attention to the footnotes under “freshman year.”

The freshman year forest technology curriculum consists of general studies courses which may be taken at any accredited four-year, community, or agricultural college, or college of technology.

The second year of the curriculum is offered at the Wanakena Campus. Presented in a varied forest environment, the curriculum’s emphasis is on fundamental forestry knowledge and applied field training as well as the relationship between forest technology and managerial needs. About 50 percent of studies are devoted to field exercises, most of which are held at the school’s James F. Dubuar Forest. This excellent forest backdrop for the technology program provides a diverse laboratory for instructional purposes.

## Program Requirements

### First Year Required Courses (30 credits)

Completed at a college of the student’s choice

COURSES		Credits
General Biology		4
Science Course (Biology, Chemistry, or Physics)		4
English with a Focus on Writing		6

Trigonometry	3
Economics	3
Electives Students intending to apply to a four-year program after earning an A.A.S. degree should use electives to meet lower-division requirements	10

### Second Year Required Courses (48 credits)

COURSES		Credits
FTC 200	Dendrology	3
FTC 202	Introduction to Surveying	3
FTC 204	Introduction to Natural Resources Measurements	4
FTC 206	Forest Ecology	4
FTC 207	Forest Safety	1
FTC 208	Geographic Information Technology	3
FTC 210	Leadership and Forest Technology	3
FTC 211	Silviculture	4
FTC 213	Forest Inventory Practicum	2
FTC 215	Timber Harvesting	2
FTC 217	Wildland Firefighting and Ecology	2
FTC 219	Introduction to Forest Recreation	1
FTC 221	Natural Resources Management	3
FTC 223	Water Measurements	1
FTC 225	Timber Transportation and Utilization	3
FTC 234	Wildlife Conservation	3
FTC 238	Forest Insects and Disease	3

Total minimum credits for the degree 78 credits

### Associate of Applied Science in Land Surveying Technology

Many graduates of The Ranger School find the land surveying profession to be an exciting, challenging and rewarding career choice. As land values increase, technology advances, and laws and regulations become more complex, the education of land surveyors has become increasingly important. This degree was developed to address the current educational needs of the student interested in pursuing a career in surveying, as well as the needs of surveying employers. Students who choose this program will be exposed to the fundamentals of forest technology that are important to the land surveyor and will receive a more in-depth education in the area of surveying technology.

This degree was designed to provide the student with knowledge and skills in surveying measurements and computations; the ability to work and communicate effectively with professional land surveyors, survey technicians, lawyers, and the general public; an understanding of the principles and practices of surveying with particular emphasis on boundary surveying; and an understanding of land resource concepts important to the surveyor. Students graduate with an A.A.S. degree in land surveying technology.

Generally, graduates are employed by privately owned, small- to mid-size surveying firms specializing in boundary, construction, and topographic surveying. Graduates are employed as entry-level technicians performing a variety of tasks, including operating various surveying instruments, note keeping, drafting, and computer operation. Employment is also available with local, state and federal agencies such as the state Department of Transportation, state Department of Environmental Conservation, U.S. Forest Service, and Bureau of Land Management.

Two years of educational credit is given toward land surveying licensure in New York. Additional field and office experience under the direct supervision of a licensed land surveyor is needed prior to application to obtain a license.

Transfer into other baccalaureate programs at a variety of institutions is possible; however, students are encouraged to consult with the appropriate admissions office to discuss transfer options.

During the first year, students who plan on enrolling are encouraged to take small business management and additional mathematics as electives.

Given the nature of the curriculum, the availability of high-tech equipment, and the necessity of individualized instruction, entry into this area of study is limited to 15 students.

## Program Requirements

### First Year Required Courses (30 credits)

Completed at a college of the student's choice

COURSES	Credits
General Biology	4
Physics	4
English with a Focus on Writing	6
Trigonometry	3
Economics	3
Electives Students intending to apply to a four-year program after earning an A.A.S. degree should use electives to meet lower-division requirements	10

### Second Year Required Courses (45 credits)

COURSES	Credits
FTC 200 Dendrology	3
FTC 202 Introduction to Surveying	3
FTC 204 Introduction to Natural Resources Measurements	4
FTC 206 Forest Ecology	4
FTC 207 Forest Safety	1
FTC 208 Geographic Information Technology	3
FTC 210 Leadership and Forest Technology	3
FTC 223 Water Measurements	1
FTC 225 Timber Transportation and Utilization	3
FTC 251 Advanced Surveying Measurements and Computations	5
FTC 253 Surveying Law	3
FTC 255 Boundary Surveying	3
FTC 256 Subdivision Surveys	2
FTC 257 Construction and Topographic Surveys	3
FTC 259 Introduction to Computer Aided Drafting and Design	4

Total minimum credits for the degree 75 credits

## Combining Forest Technology and Forest Resources Management

There are several advantages of combining a Ranger School forest technology or environmental and natural resources associate's degree with a four-year B.S. degree in professional forestry. Ranger School graduates who go on to pursue the bachelor's degree have a solid field education as well as a managerial orientation and the deeper ecological and social understanding provided by the professional curriculum.

Students wishing to transfer from the forest technology concentration to the forest resources management program at the Syracuse campus will be admitted as juniors. They will be given credit for the summer session in field forestry. They will still have to complete some physical sciences, social sciences, and humanities requirements while in residence at Syracuse, depending on prior preparation. A maximum of 32 transfer credit hours from the sophomore year of the forest technology program will be counted toward the B.S. degree. All other requirements as set forth in the forest resources management program option must be met.

**Students contemplating subsequent transfer should concentrate their freshman year electives in the social sciences and humanities. Students should also complete the first semester in chemistry, one semester in physics, and a course in calculus prior to transferring. It is possible to be admitted without these courses, but subsequent progress in the program becomes more difficult.**

## DUAL MAJORS

Students who are pursuing the associate degree may pursue a dual major. Program requirements must be satisfied concurrently (i.e., a student cannot graduate from ESF and return later to complete coursework for a second major). Students may petition for admission to a dual major

A.A.S. degree after completing 18 credits and before 45 credits with an unambiguous GPA of 2.000 or greater (no grades of incomplete or missing grades). The diploma will state the completion of a single A.A.S. degree. The transcript will state the completion of two majors.

## **Life at Wanakena**

The Ranger School of the College of Environmental Science and Forestry is located on the banks of the Oswegatchie River near the hamlet of Wanakena, approximately 65 miles northeast of Watertown and 35 miles west of Tupper Lake. The program's buildings and its surrounding forest border on the river, which flows directly into Cranberry Lake. This managed forest, containing both hardwood and coniferous species, covers an area some three miles long with widths varying up to two miles. On two sides, state forest preserve lands bound the forest. The forest is also adjacent to several square miles of virgin timber within the Adirondack Forest Preserve.

The main building consists of a central service unit with two dormitory wings. The central unit contains classrooms, laboratories, computer room, a student lounge and kitchen, faculty offices, library, kitchen and dining hall, student exercise and recreation room, and conference room. Faculty and staff houses are nearby on the campus. Other buildings include a maintenance shop, garages, a sugarhouse, and storage buildings.

The close proximity of faculty offices and student quarters and the intensive fieldwork in the program enables students to consult easily and frequently with the faculty. The program considers this traditional close student-faculty association to be of major benefit in its educational program.

A small library of approximately 1,500 volumes consists of highly specialized materials required for the teaching and study programs of the curriculum.

Students taking the second year of the curriculum at The Ranger School are required to live in the campus dormitories. Married students may request an exception to bring their families and rent private accommodations in the vicinity. Such accommodations are not plentiful. Each married student should make rental arrangements well in advance of the registration date.

The Ranger School does not maintain an infirmary, nor does it employ a physician or nurse. There are two physicians as well as an excellent community hospital and clinic in nearby Star Lake, N.Y. In emergency situations, the program transports sick or injured students to the local physician of their choice or to the hospital. Health and accident insurance policies for students are available through Syracuse University. Application forms are available at the Syracuse University Health Center, 111 Waverly Ave., 315-443-2666. All students must show proof of health insurance coverage before reporting to the campus.

Because of the comparatively isolated location of The Ranger School, a stock of books and supplies used in connection with the program is maintained on campus for sale to students.

While in residence at The Ranger School, students are held to the general rules and regulations of the College of Environmental Science and Forestry and an additional set of Ranger School "house rules."

## **Admission**

### **Requirements**

Admission to a Ranger School associate degree program requires the following high school units: English (4 units), social science (3 units), science (2 units, including biology), mathematics (3 units, college preparatory), and electives. Technical report writing and computer science are suggested electives.

In addition to the academic requirements, all applicants must also meet the following:

1. The applicant must be strongly motivated toward a career in field forestry or surveying.
2. The applicant must be willing and able to meet the physical requirements of the program, which include walking 2 to 6 miles through forest areas, often carrying 15 to 20 pounds of equipment, and using a wide array of hand tools and power equipment.
3. The applicant's parents (if the applicant is under 18 years of age) must be fully aware of the field nature of the study program, its rigorous study-work regimen and supporting academic facilities.
4. A physician certification must be submitted. Copies of the certification form are available from The Ranger School.

Questions concerning any of these requirements should be referred to the ESF Office of Undergraduate Admissions, 106 Bray Hall, 315-470-6600.

### **Procedures**

The decision to admit any student to the forest technology, land surveying technology or environmental and natural resources conservation program rests solely with the College of Environmental Science and Forestry. Some openings in the program are filled by students who are accepted to the program under the guaranteed transfer option while still seniors in high school, contingent on successful completion of the first year of college. Remaining openings are filled by transfer students who already have attended college. Therefore, it is suggested the potential student, while still a high school senior, follow these procedures:

1. Submit a regular SUNY freshman application for the College of Environmental Science and Forestry, using Curriculum Code 620 (Forest Technology), Curriculum Code 1843 (Environmental and Natural Resources Conservation) or Curriculum Code 1825 (Land Surveying Technology). The entry date on the ESF application should be the fall following the expected completion of the first 30 credit hours.
2. Submit a regular application to that school selected for the first year of study, using Curriculum Code 620, 1843 or 1825. It is important that students gain entry on their own for the first year of studies. ESF will request information at a later date concerning what institution the student will be attending.



A limited number of outstanding students are admitted directly from high school. For further information, contact the ESF Office of Undergraduate Admissions, 106 Bray Hall, 315-470-6600.

### **Transfer Students**

Students with previous college experience or students who are currently enrolled at another college may apply for transfer. However, courses transferred for credit can be applied only to the freshman year course of study, and they must be comparable in subject matter, content, and level. All second-year courses must be taken at The Ranger School, and, therefore, a student cannot transfer any previously earned credit toward the second year. Transfer applicants must submit a recent official copy of their college transcript and a list of courses they anticipate completing prior to enrollment.

### **International Students**

Please note that international students are not eligible for admission to programs at The Ranger School, however we encourage international students to inquire about ESF's bachelor degree programs in Forest and Natural Resources Management.

### **Expenses and Financial Aid**

Costs for the first year will vary with the specific institution attended.

Estimated costs for the second year of the program at The Ranger School are as follows:

	Tuition	Board, Room	Books, Supplies
N.Y. Resident	\$5,270	\$10,380	Approx. \$2,500
Nonresident	\$14,320	\$10,380	Approx. \$2,500

### **College Fees**

The College fee is \$12.50 per semester for full-time students.

An expense of approximately \$350 for laundry and clothing should be anticipated. There is also a \$20 graduation fee, a student support services fee of \$407, a \$100 student activity fee, a transcript fee of \$10, a technology fee of \$314, and student transportation fees of \$420. There are a limited number of single dorm rooms available for an additional fee. There is also a \$100 resident deposit and a \$100 equipment deposit. The latter two fees are fully or partially refundable, depending on breakage charged to a student during the year.

### **Financial Aid**

Financial aid is available upon acceptance to the College of Environmental Science and Forestry. There are three types of financial aid: loans, scholarships or grants, and part-time employment.

More detailed information on these financial aid opportunities can be found under [Financial Aid](#) and in the publication Financial Aid and Scholarships at ESF.

### **Placement**

The Ranger School assists in placement of graduates. The excellent reputation that the graduates of The Ranger School at Wanakena have developed in all types of conservation, forestry and surveying jobs greatly assists today's graduates to find employment. Employment is common with local, state and federal forestry and land resource agencies, private forestry enterprises, and surveying firms. Positions most frequently filled by recent graduates include state forest ranger, state forest technician, forest aide, industrial forest district supervisor, timber inventory specialist, timber sales supervisor, forest surveyor, forest engineering aide, survey technician, forest protection technician, forest research technician, forest equipment salesman, tree service technician, and urban park ranger.

# Department of Sustainable Construction Management and Engineering

SUSAN E. ANAGNOST, Chair  
204 Baker Laboratory, 315-470-6880; FAX 315-470-6879  
[www.esf.edu/scme/](http://www.esf.edu/scme/)

## Participating Faculty

ANAGNOST, Chair, (Wood Anatomy, Microscopy, Biodegradation of Wood, Micro-technique); CROVELLA (Residential Construction, Sustainable Construction Management); KYANKA (Construction, Applied Mechanics, Engineering Design); MEYER (Wood Properties, Wood Utilization, Anatomy); MORSI-HUSSEIN (Construction Engineering, Applied Mechanics, Structures); SMITH, J. (Cost Engineering, Construction Management, Sustainable Construction); SMITH, W. (Wood Preservation and Protection, Wood Moisture Relations and Drying, Composite Products, Manufacturing and Processing, Marketing); TISS (Construction Safety, Estimating, Planning and Scheduling, Construction Management)

The Department of Sustainable Construction Management and Engineering offers a bachelor of science in construction management and graduate education in Sustainable Construction Management and Wood Science leading to the master of science, master of professional studies, and doctor of philosophy degrees.

The degree programs emphasize principles and practices of sustainable construction. By learning sustainable construction and construction management, the use of renewable resources in construction, and methods to ensure energy efficiency, ESF graduates can literally build a sustainable future. They can also learn how to produce products from wood, be it furniture, construction material, or utility poles — in the most energy efficient way possible. Students take classes, labs and lectures in the newly renovated Baker Laboratory that features high-tech lecture halls, pilot-scale manufacturing equipment for building materials and wood products, an accredited engineering test facility, and computer labs equipped with the latest commercial software for planning, scheduling, project management and estimating. Instruction is tailored to the interests of individual students through the selection of electives.

At the undergraduate level, two concentration areas are available: wood products engineering and sustainable construction and renewable materials. Minors that enhance business skills in general management studies, marketing, and entrepreneurship are available for qualified students. Students interested in these or other minors should meet with their advisors as soon as possible.

Professional growth of students is stimulated by active membership in student chapters of professional construction and wood science organizations. Students are encouraged to join at least one organization that is of particular interest to them. Student organizations associated with our department include the Green Construction Group (formerly the Student Construction Association) affiliated with National Association of Home Builders, The Associated General Contractors of America and General Building Contractors of New York State, and the Forest Products Society student chapter.

Many students who enter the undergraduate program in construction management are transfer students. Graduates of A.S. programs in liberal arts, math/science, and engineering/science as well as A.A.S. programs in architectural, civil, construction, mechanical, and wood technologies are encouraged to apply. Students with or without two-year degrees who meet all lower-division requirements and have 62 credits in acceptable coursework transfer as juniors for a four-semester program. Transfer students who have completed pre-calculus, but have not completed calculus, chemistry and/or physics or have not met most of their general education requirements generally finish in five or six semesters.

## Bachelor of Science in Construction Management

The construction industry represents about ten percent of the world's gross domestic product, while the entire construction industry represents 20 percent of the nation's GDP. The U.S. Bureau of Labor Statistics projects employment in the construction industry will increase by 17 percent between 2008 and 2018. With more construction companies bidding on jobs, organizations with the best-prepared professionals using the latest technology are the most successful. This competition applies not only to contractors, but also many others involved in construction operations such as engineers, human resource managers, and material and equipment suppliers. People engaged in this industry must have state-of-the-art skills and knowledge to thrive.

The construction management degree prepares students for management careers in the construction industry. The objectives of the program are to provide the management skills to effectively deliver construction projects in a timely manner, within budget, safely and in accordance with the clients' objectives; to study the various methods used to take a design into the field and construct a quality structure in the most efficient and effective manner with minimal environmental impacts; and to provide an understanding of basic engineering and environmental considerations in construction.

The curriculum offers several opportunities for professional certification or for obtaining professional credentials. Through successful completion of course requirements, students obtain the OSHA 30-hour card in Construction Safety. During their last semester, students take the Associate Constructor Examination, part 1 of the two-step examination process to become a Certified Professional Constructor. Students learn the fundamentals of the various rating systems for buildings (LEED, Green Globes, and others), which can prepare them to take the LEED AP exam. Students interested in pursuing a career in engineering have coursework that partially fulfills the preparation required for the fundamentals in engineering examination.

The core of the curriculum includes topics in construction management: light construction, construction safety, construction equipment, construction methods, building codes and zoning, contracts and specifications, planning and scheduling, estimating, construction project management, applied structural analysis, soil mechanics, composite materials, and computer applications including building information modeling (BIM). Aspects of green construction and sustainability are incorporated into these courses. Students learn the properties and

behavior of construction materials: steel, concrete, wood and engineered wood products, as well as non-traditional materials, and the analysis of various structural components and systems. The curriculum also includes courses that address the expanding field of sustainable construction and the “greening” of the industry. Students are introduced to sustainable construction in a sophomore-level overview course. More advanced courses include renewable materials for sustainable construction, energy systems in buildings, and environmental performance of buildings as related to certification programs.

Environmental and safety aspects of construction are addressed in the program with course topics on workplace safety, environmental impact evaluation, and building codes that cover structural, fire, and hazardous material requirements. Emphasis on environmental and personal safety includes asbestos mitigation, noise pollution, air monitoring and sampling techniques.

A concentration in wood products engineering provides additional courses in the manufacturing, properties, and marketing of wood products. Wood is a premier sustainable material for manufacturing, building and construction. It is renewable and produced from a sustainable natural resource. Wood is strong, lightweight, economical, long lasting and attractive and is made into countless products desired by society. In combination with required coursework (renewable materials for sustainable construction, composite products, applied structures) students are prepared for employment in wood products industries, as well as construction management firms and building materials companies.

Graduates of the construction management program are well prepared for careers in a very challenging and dynamic field. Positions held by alumni include construction project manager, safety director, OSHA compliance officer, construction engineer, estimator, company executive, and planner/scheduler. Students who choose the concentration elective coursework in wood products engineering are also prepared for employment in wood products manufacturing and marketing.

Students may enter the bachelor of science program as first-year students or as transfer students. Students who are preparing to transfer to ESF as juniors must have earned at least 62 credits of college coursework, in courses comparable to the lower-division course requirements.

## Undergraduate Program Requirements

### Lower Division Required Courses (45 or 48 credits)

Students who take pre-calculus receive 48 credits; students who do not take pre-calculus receive 45 credits of required lower division courses.

Courses			Credits
CME	132	Orientation Seminar: Wood Products Engineering <i>Required for all students.</i>	1
APM	105	Calculus I Meets the requirements for general education skills and knowledge area. A complete listing of courses that meet general education standards established by SUNY is listed in <a href="#">Undergraduate Education</a> .	G 4
APM	106	Calculus II	4
CME	202	Introduction to Professional Communications	3
EWP	190	Writing and the Environment	G 3
EWP	290	Writing, Humanities and the Environment	G 3
FCH	150/ 151	General Chemistry I and Laboratory	G 4
FOR	207	Introduction to Economics	G 3
CME	255	Plan Interpretation and Quantity Takeoff	3
CME	215	Sustainable Construction	3
CME	226	Statics and Mechanics	4
CME	342	Light Construction	3
CME	306	Engineering Materials for Sustainable Construction	3
PHY	211/ 221	General Physics I and Laboratory Meets a second general education requirement in the Natural Sciences category.	G 4

### Lower Division Electives (12 or 15 credits; 12 credits if a student is required to take APM 104 Precalculus)

Students may use elective credits to pursue a concentration in Wood Products Engineering or Sustainable Construction and Renewable Materials.

Electives Required for students who enter as transfer students.	12 or 15
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### General Education courses (6 credits).

Students must select two additional general education courses from two of the following categories: American History, Other World Civilizations, Western Civilization, and the Arts:

General Education Course: American History, Other World Civilizations, Western Civilization, or the Arts	G	3
General Education Course: American History, Other World Civilizations, Western Civilization, or the Arts <i>Excluding the category chosen above.</i>	G	3

### Upper Division Required Courses (53 credits):

APM	391	Introduction to Probability and Statistics	3
CIE	337	Soil Mechanics and Foundations I	4
ERE	371	Surveying for Engineers	4
FOR	360	Principles of Management	3
CME	304	Environmental Performance Measures for Buildings	3
CME	305	Sustainable Energy Systems for Buildings	3
CME	331	Construction Safety	3
CME	335	Cost Engineering	3
CME	343	Construction Estimating	3
CME	387	Renewable Materials for Sustainable Construction	3
CME	404	Applied Structures	3
CME	405	Building Information Modeling for Construction Management	3
CME	422	Composite Materials for Sustainable Construction	3
CME	453	Construction Planning and Scheduling	3
CME	454	Construction Project Management	3
CME	455	Construction Contracts and Specifications	3
CME	497	Senior Seminar	3

### Upper Division Electives (9 credits)

Total minimum credits for the degree 128 credits

#### Concentration in Wood Products Engineering (14 credits)

CME 322 Mechanical Processing  
CME 326 Fluid Treatments  
CME 376 Decay of Wood Products  
CME 388 Wood Identification  
CME 444 Materials Marketing

#### Concentration in Sustainable Construction and Renewable Materials (12 credits from the following for students who entered the program prior to 2010-11)

CIE 326 Engineering Materials  
CIE 478 Rehab of Civil Structures  
ERE 519 Green Entrepreneurship  
EST 426 Community Planning and Sustainability  
EST 550 Environmental Impact Analysis  
CME 330 Building Codes  
CME 376 Decay of Wood Products  
CME 388 Wood Identification  
CME 444 Materials Marketing

### Graduate Program in Sustainable Construction Management and Wood Science

Graduate areas of study related to sustainable construction management and wood science allow students with technical degrees to engage specific topics of current interest. There is an overall objective of having students look at the broad environmental implications of the construction process and the use of wood as a material, to be efficient and environmentally correct in their use of materials, and to integrate current technology to a practicum, thesis or dissertation, as appropriate to the graduate degree. The department offers three degrees: the Master of Professional Studies (M.P.S.), the Master of Science (M.S.), and the Doctor of Philosophy (Ph.D.).

General entry requirements to the Sustainable Construction Management and Wood Science program follow those described in the catalog for the Graduate School at SUNY-ESF. The Option in Sustainable Construction Management and Wood Science (SCMWS) offers three areas of study:

- Construction Management
- Sustainable Construction
- Wood Science

Entry requirements to the Option in Sustainable Construction Management and Wood Science are specific to each area of study. Students are accepted into our programs from a variety of backgrounds. When the Department of Sustainable Construction Management and Engineering (SCME) reviews an applicant's academic and professional experience, it may determine that preparatory coursework is required before entry into the program. Either undergraduate or graduate courses may be recommended to remedy deficiencies depending on circumstances. In some cases, remedial coursework should be completed prior to matriculation.

**Entry requirements for Construction Management:** applicants for the Master of Science or Ph.D. degrees in the construction management area of study are required to have a bachelor's degree in one of the following: science, construction management, business, management, architecture, or engineering.

Applicants for the M.P.S. degree in the construction management area of study are required to have a minimum of five years' experience in the construction management industry plus a bachelor's degree in one of the following: science, construction management, business, management, architecture, or engineering.

**Entry requirements for Sustainable Construction:** Applicants for the Master of Science or Ph.D. degrees in sustainable construction are required to have a bachelor's degree in one of the following: science, construction management, architecture, or engineering. Students must have completed courses in physics, chemistry, and calculus.

Applicants for the M.P.S. degree in sustainable construction are required to have a minimum of two years' experience in the construction management industry plus a bachelor's degree in one of the following: science, construction management, architecture, or engineering. Students must have completed courses in physics, chemistry, and calculus.

**Entry requirements for Wood Science:** Applicants for the Master of Science or Ph.D. degrees in the wood science area of study are required to have a bachelor's degree in science or engineering. Applicants must have the appropriate undergraduate degree for the area of study they pursue. Applicants must have completed at least one semester of coursework in chemistry, biology, physics, and calculus.

Applicants for the M.P.S. degree in wood science are required to have a minimum of two years' experience in the wood products engineering or related industry plus a bachelor's degree in science or engineering. Applicants to the M.P.S. in wood science and technology must have completed at least one semester of coursework in chemistry, biology, physics, and calculus.

## Degree requirements

The Ph.D. degree requires a minimum total of 60 graduate credits. These credits must include a minimum of 30 credits of coursework, and include not more than 30 credits for dissertation. As tool requirements, students must demonstrate competence in one of the three following areas: computer science, statistics or advanced mathematics, or a language other than English commonly used in science or engineering practice. A study plan that formally identifies an individual's program requirements is developed for each student as soon as possible, but at least during the first year of graduate study. This plan includes all required and elective courses as well as a tentative schedule for completion.

The M.S. degree requires a minimum of 30 credit hours. A minimum of 18 credits of coursework and a minimum of 6 thesis credits are required to complete the M.S. degree. Undergraduate courses do not meet the requirements for minimum number of graduate credit hours. Students select a study area at the time of application for admission to the program. Specific areas of study may require specific coursework requirements. If so, they are listed under that area of study. The student's study plan (Form 3B) must be approved by the steering committee and graduate coordinator or department chair by the end of the first semester in residence.

The purpose of the M.P.S. degree is to update current professional skills and/or to prepare graduate students for higher levels of management in their general area of expertise. The M.P.S. degree is intended to be a terminal degree, therefore acceptance to the M.P.S. degree does not guarantee admission to the M.S. or Ph.D. programs and *vice versa*. A minimum of 30 credit hours are required for the M.P.S. degree. The degree requires 24-27 credits of graduate-level course work, a 3-6 credit practicum or synthesis based on professional experience, and a capstone seminar. Specific coursework requirements are listed under each area of study.

### Construction Management (M.S., M.P.S., Ph.D.)

Participating Faculty: CROVELLA; KYANKA; MORSI-HUSSEIN; SMITH, J.; TISS

**Ph.D./M.S. in Construction Management.** Topics for the M.S. or Ph.D. research may include the following:

- Construction project management
- Estimating, cost engineering, building codes and zoning
- Green construction
- Production management
- Computer graphics and computer applications in engineering
- Structural design

For the M.S. or Ph.D. degree in Construction Management the following courses are required (or their equivalent with committee approval):

CME 543 Construction Estimating (3)  
CME 653 Construction Planning and Scheduling (3)  
CME 654 Construction Project Management (3)

**M.P.S. in Construction Management:** Requirements include 24-27 credit hours of required and elective coursework in three categories plus 3-6 credit hours of a practicum or professional experience/synthesis. Two coursework options are available, the M.P.S. coursework and practicum option, or the M.P.S. coursework and synthesis option.

**M.P.S. coursework and practicum option** (total minimum of 30 credits): Engineering/construction management courses (12-21 credits), resource management courses (3-6 credits), environmental studies courses (3-6 credits), practicum (3-6 credits). Engineering/construction management courses (12-21 credits). These courses (group A or group B) are required: (Students who plan to complete their degree in one calendar year should select group B)

A:

CME 543 Construction Estimating (3)  
CME 653 Construction Planning and Scheduling (3)  
CME 654 Construction Project Management (3)

OR

B:

CME 643 Estimating for Construction in a Green Global Economy (3)  
CME 663 Managing a Construction Project through Construction Planning and Scheduling (3)  
CME 664 Urban Project Management (3)

Select additional courses from the following or similar courses with committee approval:

CME 525 Construction Methods and Equipment (3)  
CME 531 Construction Safety (3)  
CME 535 Cost Engineering (3)  
CME 658 Construction Contracts and Specifications (3)

Resource management courses (3-6 credits) from the following or similar courses with committee approval:

FOR 665 Natural Resources Policy (3)  
FOR 670 Resource and Environmental Economics (3)  
FOR 680 Urban Forestry (3)  
FOR 685 Business and Managerial Law (3)  
FOR 687 Environmental Law and Policy (3)  
FOR 689 Natural Resources Law and Policy (3)  
FOR 770 Ecological Economics and Policy (3)

Environmental studies courses (3-6 credits) from the following or similar courses with committee approval:

EST 550 Environmental Impact Analysis (3)  
EST 603 Research Methods and Design (3)  
EST 604 Social Survey Research Methods for Environmental Issues (3)  
EST 605 Qualitative Methods (3)  
EST 626 Concepts and Principles of Sustainable Development (3)  
EST 627 Environmental and Energy Auditing (3)  
EST 635 Public Participation and Decision Making: Theory and Application (3)  
EST 640 Environmental Thought and Ethics (3)  
EST 660 Land Use Law (3)

Practicum (3-6 credits):

**CME 898 Professional Experience/Synthesis (3-6)**

**M.P.S. coursework and synthesis option:** Core courses (10 credits), engineering/construction management courses (9 credits), application electives (5-8 credits), professional experience/synthesis (3-6 credits). Total minimum of 30 credits.

Core courses (minimum 10 credits): These courses are required (group A or group B): Students who plan to complete the degree in one calendar year should select group B.

A:

CME 543 Construction Estimating (3)  
CME 653 Construction Planning and Scheduling (3)  
CME 654 Construction Project Management (3)  
CME 658 Construction Contracts and Specifications (3)

OR

B:

CME 643 Estimating for Construction in a Green Global Economy (3)  
CME 663 Managing a Construction Project through Construction Planning and Scheduling (3)  
CME 664 Urban Project Management (3)  
CME 658 Construction Contracts and Specifications (3)

Engineering/construction management courses (9 credits) from the following or similar with committee approval:

CME 525 Construction Methods and Equipment (3)  
CME 531 Construction Safety (3)  
CME 535 Cost Engineering (3)  
CME 605 Building Information Modeling/ Construction Management (3)

Application electives (5-8 credits):

As approved by the steering committee

Professional experience/synthesis (3-6 credits):

CME 898 Professional Experience/Synthesis (3 - 6)

#### **Sustainable Construction (M.S., M.P.S., Ph.D.)**

Participating Faculty: CROVELLA; KYANKA; MORSI-HUSSEIN; MEYER; SMITH, J.; SMITH, W.; TISS. This area of study is for students interested in sustainable construction practices including topics such as energy use in buildings, material use in sustainable construction, life cycle analysis, environmental rating systems and environmental performance measures.

**Ph.D./M.S. in Sustainable Construction:** Topics for the M.S. or Ph.D. research may include the following:

- Energy systems in buildings
- Sustainable materials
- Environmental performance measures
- Building codes
- Renewable materials
- Deconstruction and reuse
- Life cycle analysis
- Structural design

Required coursework: For the M.S. degree in Sustainable Construction, students must complete coursework in construction project management if this was not part of their undergraduate degree. For the M.S. degree and Ph.D. degree, the student's study plan is developed with the steering committee according to the general college guidelines described earlier.

**M.P.S. in Sustainable Construction:** 24-27 credit hours of coursework plus 3-6 credit hours of a practicum or professional experience/synthesis. Two coursework options are available, the M.P.S. coursework and practicum option, or the M.P.S. coursework and synthesis option. Total minimum of 30 credits

**M.P.S. coursework and practicum option:** Engineering/construction management courses (12-21 credits), resource management courses (3-6 credits), environmental studies courses (3-6 credits), practicum (3-6 credits). Total minimum of 30 credits.

Engineering/construction management courses (12-21 credits) from the following or similar courses with committee approval:

CME 605 Building Information Modeling /Construction Management (3)  
CME 543 Construction Estimating (3)  
CME 653 Construction Planning and Scheduling (3)  
CME 654 Construction Project Management (3)  
CIE 678 Rehab of Civil Structures (3)

Resource management courses (3-6 credits) from the following or similar courses with committee approval:

FOR 665 Natural Resources Policy (3)  
FOR 670 Resource and Environmental Economics (3)  
FOR 680 Urban Forestry (3)  
FOR 685 Business and Managerial Law (3)  
FOR 687 Environmental Law and Policy (3)  
FOR 689 Natural Resources Law and Policy (3)  
FOR 770 Ecological Economics and Policy (3)

Environmental studies courses (3-6 credits) from the following or similar courses with committee approval:

EST 550 Environmental Impact Analysis (3)  
EST 603 Research Methods and Design (3)  
EST 604 Social Survey Research Methods for Environmental Issues (3)

EST 605 Qualitative Methods (3)  
EST 626 Concepts and Principles of Sustainable Development (3)  
EST 627 Environmental and Energy Auditing (3)  
EST 635 Public Participation and Decision Making: Theory and Application (3)  
EST 640 Environmental Thought and Ethics (3)  
EST 660 Land Use Law (3)

Practicum (3-6 credits):

CME 898 Professional Experience/Synthesis (3 - 6)

**M.P.S. coursework and synthesis option:** Core courses (10 credits), engineering/construction management courses (9 credits), application electives (5-8 credits), professional experience/synthesis (3-6 credits). Total minimum of 30 credits.

Core courses (10 credits) from the following or similar with committee approval:

CME 532 Mechanical/Electrical Equipment (3)  
CME 565 Sustainable Innovations for Residential Construction (3)  
CME 596 Sustainable Energy Systems for Buildings (3)  
CME 596 Environmental Performance Measures for Buildings (3)  
ERE 519 Green Entrepreneurship (3)

Engineering/construction management courses (9 credits) from the following or similar with committee approval:

CME 605 Building Information Modeling /Construction Management (3)  
CME 543 Construction Estimating (3)  
CME 653 Construction Planning and Scheduling (3)  
CME 654 Construction Project Management (3)  
CIE 678 Rehab of Civil Structures (3)

Application electives (5-8 credits):

As approved by the committee

Synthesis (3-6 credits):

CME 898 Professional Experience/Synthesis (3-6)

#### **Wood Science (M.S., M.P.S., Ph.D.)**

Participating Faculty: ANAGNOST; CROVELLA; KYANKA; MEYER; MORSI-HUSSEIN; SMITH, J.; SMITH, W. Students entering this area of study should have an undergraduate degree in wood science or a related area of science or engineering.

**M.P.S. in Wood Science and Technology:** 24-27 credit hours of coursework plus 3-6 credit hours of a practicum or professional experience/synthesis. Two coursework options are available, the MPS coursework and practicum option and the MPS coursework and synthesis option.

1. **M.P.S. coursework and practicum option:** Engineering/construction management courses (12-21 credits), resource management courses (3-6 credits), environmental studies courses (3-6 credits), practicum (3-6 credits). Total minimum of 30 credits. Courses are selected in consultation with the steering committee.
2. **M.P.S. coursework and synthesis option:** Core courses (10 credits), engineering/construction management courses (9 credits), application electives (5-8 credits), professional experience/synthesis (3-6 credits). Total minimum of 30 credits. Courses are selected in consultation with the steering committee.

#### **Ph.D./M.S. in Wood Science**

Topics for the M.S. or Ph.D. research may include the following:

- Wood Science and Technology (adhesives and finishing, processing and machining, mechanical and physical properties, wood anatomy and wood properties, wood biodegradation, wood composites). Because wood is renewable, it will meet the needs of modern society for a perpetually available, carbon dioxide-neutral material perfectly suited for a vast array of products. The study area Wood Science and Technology includes detailed research on physical, mechanical, or anatomical aspects of wood and its utilization and leads to the M.S., M.P.S., or Ph.D. degree. Wood science stresses research on the material science of wood, dealing with properties important to its use, or to solve problems in wood utilization by practical applications of such knowledge.
- Engineered Wood Products and Structures (M.S., Ph.D.) (materials science, engineering mechanics and elasticity, engineering properties of wood composites, computer-aided design, static and dynamic properties of wood) Students with interest in Engineered Wood Products and Structures should have a strong background in integral calculus, statics, mechanics, and mechanical and physical properties of wood. The behavior of wood and wood-based components under loads and the effects of duration of the loads are critical elements when developing engineering codes. Wooden components as small as dowels or as large as bridge beams are considered, using elements of materials science, engineering mechanics and structural engineering. Basic property knowledge, employing theories of elasticity, visco-elasticity and fracture mechanics, is coupled with computer-aided design data to analyze the performance of wood and to solve application problems, such as those encountered in wood-frame construction and timber utility structures. How such factors as chemical fire retardant treatments, adhesive performance and mechanical fastener design interact with use requirements is considered. National and international design codes and their development play an important role in



specifying research areas of current interest and need. Fabrication and testing of actual components such as trusses, composite beams, and furniture connections are completed in the department's Wood Engineering Laboratory.

- **Wood Anatomy and Ultrastructure** (wood formation and cell wall organization, cytoskeleton of plant cells, properties related to anatomy and ultrastructure, electron, light and video microscopy). Students with interest in Wood Anatomy and Ultrastructure should have an undergraduate degree in wood anatomy or the biological sciences. Students are required to develop an extensive background in all aspects of microscopy: light, scanning electron, transmission electron, video microscopy and image analysis, including micro-techniques for effective preparation of specimens for the appropriate instrument. Wood anatomy studies are basic to wood identification, wood utilization, and physical/mechanical properties. These studies may include woods from other continents. The field of ultrastructure is very broad with applications in many biological, chemical and materials sciences. Applied to wood, it emphasizes the sub-light microscopic structures (smaller than 0.2 micrometers) found in this natural material, either in the mature form or in its formative stages where various organelles of the living cell may be studied for their roles in producing the mature wood cell. The behavior of wood in its many applications can be observed and explained via microscopy and related instrumentation such as EDXA (energy-dispersive x-ray analysis). State-of-the-art resources and facilities are concentrated in the Center for Ultrastructure Studies, which provides instruction and research support staff.
- **Wood Treatments** (wood-water relationships and wood drying, preservative treatments, polymer treatments, sealants and coatings). Students with an interest in wood treatments and preservation should have an undergraduate degree in wood science or a closely related field. Graduate study in the area of wood treatments allows the student to investigate the scientific basis for the improvement of wood and wood products with various treatments, which include drying, preservative treatments and coatings. Preparation for research includes graduate coursework in wood-water relationships and transport processes and additional study in areas such as wood anatomy and ultrastructure, mechanical properties, wood chemistry, wood microbiology, thermodynamics, and engineering economics. Current research interests include use of innovative techniques to dry and preserve wood, effects of drying method on the subsequent treatability of wood, evaluation of energy usage in lumber drying technologies, improving wood properties with polymer treatments, and moisture migration studies.
- **Tropical Timbers** (identification keys and systematics, wood properties and end use suitability, life zone analyses, expert systems). Studies of tropical timbers take many forms, depending on individual student interests. Often students from other countries bring specific problems and materials with them so their thesis will find immediate application when they return home. The holdings of the C. deZeeuw Memorial Library and reference wood specimens of the H.P. Brown Memorial Wood Collection of the Tropical Timber Information Center (TTIC), housed in Baker Laboratory facilities, are vital to this work. Research topics may be formulated to answer questions dealing with anatomy, identification, properties or uses of various woods from around the world, using the TTIC reference materials. These studies may be quite narrow, such as anatomy and physical properties of woods from a particular region, or much broader, such as regional distribution of species and species groups based on life zone research throughout a country or larger geographic area.

## Facilities

A major renovation to the teaching and research laboratories in Baker Laboratory has been completed with a computer facility for estimating, scheduling, project management, wood engineering design, computer-aided design and drafting, finite element analysis and other specialized software. The Wood Products Engineering Laboratory TL-317 (WPEL), is an IAS accredited laboratory (ANS/ISO/IEC 17025:2005) for mechanical testing and includes a wide range of equipment for mechanical testing and wood processing, including electronic data acquisition capabilities, a dry kiln, wood preservation equipment, a wood machining lab, and sawmill.

Construction Management facilities for research and teaching include laboratories for construction safety, building materials and green construction. A dedicated computer laboratory, the Construction Management Laboratory, provides specialized software for construction estimating, scheduling, project management, wood engineering design, computer-aided design and drafting, finite element analysis and other specialized software.

The C.J.K. Wang Wood Biodegradation Laboratory includes mycology culturing facilities and a modern molecular analysis laboratory; research microscopes, image analysis system and wood micro-technique equipment.

One of the largest wood collections in the world, the H. P. Brown Memorial Wood Collection is used to support the graduate research program of the Tropical Timber Information Center. The center also maintains the Carl deZeeuw Memorial Library.

A complete microscopy and image analysis laboratory is provided by the N.C. Brown Center for Ultrastructure Studies. This equipment includes a JEOL JSM-2000EX transmission electron microscope, JEOL JSM-5800LV scanning electron microscope with energy dispersive x-ray analysis and particulate analysis accessories, and a wide variety of light microscopes equipped with image enhancement and various video image analysis capabilities. Graduate students in wood science using this equipment have the best available systems to relate the macroscopic behavior of wood to its anatomical characteristics. The facility is available for students and faculty at all departments at SUNY-ESF and neighboring colleges and universities.

The Renewable Materials Institute conducts research in the broad area of sustainable development of wood resources and the uses of wood products.

# ESF Directory

## ESF Board of Trustees

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- **Chair:** William L. McGarry, Jr., Fayetteville
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### College Administration

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Vice President for Administration: Joseph L. Rufo

Vice President for Enrollment Management and Marketing: Robert C. French

### Admissions

Admissions and Inter-Institutional Relations: Susan H. Sanford, Director

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### Academic Department Offices

Chemistry: Gregory L. Boyer, Chair

Division of Environmental Science: Russell D. Briggs, Director

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Environmental Studies: Valerie A. Luzadis, Chair

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Sustainable Construction Management and Engineering: Susan E. Anagnost, Chair

Thousand Islands Biological Station: John Farrell, Director

### Student Services Offices

Academic Support Services: Scott J. Blair, Coordinator

Alumni Relations: Justin F. Culkowski, Director

Career Services: John E. Turbeville, Career Planning and Development Officer

Counseling and Disability Services: Heather Rice, Senior Counselor

Financial Aid and Scholarships: John E. View, Director

Judicial Affairs: Anne E. Lombard, Dean of Student Life and Experiential Learning

Multicultural Affairs: Raydora Drummer-Francis, Director

Registrar: Raymond W. Blaskiewicz, College Registrar

Student Activities: Laura Crandall, Director  
Student Life and Experiential Learning: Anne E. Lombard, Dean

### **Campus Administrative Offices**

Business Affairs: David R. Dzwonkowski, Director  
Communications: Claire B. Dunn, Director  
Computing and Network Services: James M. Sahn, Supervisor  
Development: Brenda Greenfield, Director of Development and Executive Director, ESF College Foundation  
Environmental Health and Safety: John R. Waisel, Officer  
Forest Properties: Robert S. Davis, Director  
Governmental Relations and Institutional Planning: Maureen O. Fellows, Director  
Human Resources: Marcia A. Barber, Director  
Information Systems: David J. Soderberg, Director  
Information Technology: Yuming Tung, Director  
Physical Plant and Facilities: Amy K. Ritter, Director  
Syracuse Pulp and Paper Foundation: Linda A. Fagan, Project Staff Associate  
University Police: Scott M. Becksted, Chief of University Police

### **Academic and Research Program Units**

Analytical and Technical Services: Arthur J. Stipanovic, Director  
College Libraries: Stephen Weiter, Director  
Cranberry Lake Biological Station: Alexander Weir, Director  
Outreach and Instructional Quality: Charles M. Spuches, Associate Dean  
EnSPIRE Office of Environment and Society: Rachel May, Director  
ESF in the High School: Charles M. Spuches, Director  
Honors Programs: William M. Shields, Director  
Research Programs: Neil H. Ringler, Dean  
Summer Program in Field Forestry: Christopher A. Nowak, Director

### **Institutes and Centers for Research and Service**

Adirondack Ecological Center: TBA, Director  
American Chestnut Research and Restoration Center: Charles A. Maynard, Director  
Applied Microbiology, SUNY Center for: James P. Nakas, Director  
Biotechnology in Forestry, Council on: William A. Powell, Director  
Brownfield Studies, SUNY Center for: Douglas J. Daley, Director  
Cellulose Research Institute: William T. Winter, Director  
Center for the Urban Environment: Myrna H. Hall, Director  
Community Design Research, Center for: Maren C. King, Director  
Empire State Paper Research Institute: Thomas E. Amidon, Director  
Geospatial Modeling and Analysis, Council for: Eddie Bevilacqua, Director  
Great Lakes Research Consortium: Gregory L. Boyer, Director  
Hydrologic Systems Science, Council on: Myron J. Mitchell, Director  
Joachim Center for Forest Industry, Economy and the Environment: Bruce C. Bongarten, Director  
McIntire-Stennis Forestry Research, Council on: Neil H. Ringler, Director  
Michael M. Szwarc Polymer Research Institute: Israel Cabasso, Director  
Native Peoples, Center for: Robin W. Kimmerer, Director  
Randolph G. Pack Environmental Institute: David A. Sonnenfeld, Director  
Renewable Materials Institute: George H. Kyanka, Director  
Roosevelt Wild Life Station: James P. Gibbs, Director  
Salix Consortium: Lawrence P. Abrahamson, Director  
Sustainable and Renewable Energy, SUNY Center for: Michael J. Kelleher and Timothy A. Volk, Co-Directors  
Tree Pest Information Service: Lawrence P. Abrahamson, Director  
Tropical Timber Information Center: Robert W. Meyer, Director  
Ultrastructure Studies, N.C. Brown Center for: Susan E. Anagnost, Director  
Wood Utilization Service: William B. Smith, Director

# Faculty and Professional Staff

## DISTINGUISHED PROFESSOR

MYRON J. MITCHELL, Environmental and Forest Biology

## DISTINGUISHED TEACHING PROFESSOR

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ROBIN W. KIMMERER, Environmental and Forest Biology

DONALD J. LEOPOLD, Environmental and Forest Biology

NEIL H. RINGLER, Environmental and Forest Biology

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LEE P. HERRINGTON, Forest and Natural Resources Management

DUDLEY J. RAYNAL, Environmental and Forest Biology

## FACULTY AND PROFESSIONAL STAFF

This listing represents an official record of the State University of New York College of Environmental Science and Forestry faculty and professional staff for 2011. It is designed for use in 2011-2012.

The date in parentheses after each name denotes the first year of service, two or more dates, the term of service.

**NASRI ABDEL-AZIZ** (2001), *Instructor*, Forest and Natural Resources Management; B.A., Syracuse University, 1998; M.S., 2001

**JERROLD L. ABRAHAM** (2006), *Adjunct Professor*, Environmental Studies; B.S., Massachusetts Institute of Technology, 1966; M.D., University of California, San Francisco, 1970

**NEAL M. ABRAMS** (2007), *Assistant Professor*, Chemistry; *Participant*, Environmental Science; B.S., Ithaca College, 2000; Ph.D., Pennsylvania State University, 2005

**KIM B. ADAMS** (1993), *Instructional Support Specialist*, Environmental and Forest Biology; B.S., State University of New York College of Environmental Science and Forestry, 1991; M.S., 1993

**WAYNE S. AMATO** (1995), *Adjunct Professor*, Paper and Bioprocess Engineering; B.S., Newark College of Engineering, 1963; M.S., State University of New York at Buffalo, 1965; Ph.D., Syracuse University, 1970

**THOMAS E. AMIDON** (2000), *Professor*, Paper and Bioprocess Engineering; *Director*, Empire State Paper Research Institute; B.S., State University of New York College of Environmental Science and Forestry, 1968; M.S., 1972; Ph.D., 1975

**SUSAN E. ANAGNOST** (1991), *Chair and Associate Professor*, Sustainable Construction Management and Engineering; *Assistant Director*, N.C. Brown Center for Ultrastructure Studies; B.A., Gettysburg College, 1977; M.S., State University of New York College of Environmental Science and Forestry, 1982; Ph.D., 1990

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**JAMES F. PALMER** (1980-2006), *Professor Emeritus*, Landscape Architecture; B.A., University of California, 1972; M.L.A., University of Massachusetts, 1976; Ph.D., 1979

**NICK J. PARADISO, JR.** (1988-1996), *Vice President for Administration Emeritus*; B.A., Syracuse University, 1965

**JANIS PETRICEKS** (1968-1991), *Professor Emeritus*, Forest and Natural Resources Management; Diploma in Forestry, University of Freiburg, 1950; M. Agr., Interamerican Institute of Agricultural Sciences, 1956; Ph.D., State University College of Forestry at Syracuse University, 1968

**GUY L. PIROLA** (1979-2010), *Instructional Support Specialist Emeritus*, Chemistry; B.S., State University College of Forestry at Syracuse University, 1963

**DUDLEY J. RAYNAL** (1974-2009), *Dean of Instruction and Graduate Studies Emeritus*; *Distinguished Teaching Professor Emeritus*, Environmental and Forest Biology; B.S., Clemson University, 1969; Ph.D., University of Illinois, 1974

**NORMAN A. RICHARDS** (1963-1997), *Professor Emeritus*, Forest and Natural Resources Management; B.S., State University College of Forestry at Syracuse University, 1957; M.S., Cornell University, 1959; Ph.D., State University College of Forestry at Syracuse University, 1968

**ANATOLE SARCO** (1967-1997), *Professor Emeritus*, Chemistry; Cellulose Research Institute; B.S., Upsala College, 1952; M.S., New York University, 1960; Ph.D., State University College of Forestry at Syracuse University, 1966

**D. ANDREW SAUNDERS** (1985-2010), *Research Associate Emeritus*, Environmental and Forest Biology; *Associate Director for Educational Outreach*, Roosevelt Wild Life Station; B.S., University of Missouri, 1967; M.S., Utah State University, 1970; Chancellor's Award for Excellence in Teaching, 1999

**MICHAEL SCHAEDEL** (1965-1994), *Professor Emeritus*, Environmental and Forest Biology; B.S., University of British Columbia, 1957; M.S., 1959; Ph.D., University of California, 1964

**LELAND R. SCHROEDER** (1986-2004), *Professor Emeritus*, Paper and Bioprocess Engineering; A.B., Ripon College, 1960; M.S., Lawrence University (The Institute of Paper Chemistry), 1962; Ph.D., 1965

**SUSAN L. SENECAH** (1993-2011), *Associate Professor Emeritus*, Environmental Studies; *Participant*, Environmental Science; B.S., Bemidji State University, 1972; M.A., University of Minnesota, 1987; Ph.D., 1992; President's ESF Public Service Award, 1999, 2005

**THOMAS O. SLOCUM** (1977-2008), *Director of Career and Counseling Service Emeritus*; B.S., State University of New York College at Brockport, 1967; M.S., State University of New York at Albany, 1968; Chancellor's Award for Excellence in Professional Service, 1991

**JOHANNES SMID** (1956-57) (1960-1995), *Professor Emeritus*, Chemistry; B.Sc., Free University, Amsterdam, 1952; M.Sc., 1954; Ph.D., State University College of Forestry at Syracuse University, 1957

**KENNETH J. SMITH, JR.** (1968-1995), *Professor Emeritus*, Chemistry; B.A., East Carolina University, 1957; M.A., Duke University, 1959; Ph.D., 1962

**LEONARD A. SMITH** (1964-2006), *Associate Professor Emeritus*, Sustainable Construction Management and Engineering; B.S., Ch.E., University of Dayton, 1962; M.S., Ch.E., Case Institute of Technology, 1964; Ph.D., State University of New York College of Environmental Science and Forestry, 1972

**DENNIS O. STRATTON** (1978-1997), *Director of Admissions and Inter-Institutional Relations Emeritus*, Student Affairs and Educational Services; B.S., State University of New York College at Cortland, 1965; M.S., 1966; Chancellor's Award for Excellence in Professional Service, 1995

**KATHLEEN A. STRIBLEY** (1981-2010), *Professor Emeritus*, Landscape Architecture; B.A., University of Michigan, 1973; M.L.A., 1976

**WESLEY E. SUHR** (1974-1988), *Associate Professor Emeritus*, Forest Technology Program of the Forest and Natural Resources Management Department; B.S., University of Minnesota, 1958; M.S., University of Arizona, 1965

**STUART W. TANENBAUM** (1973-1993), *Collegewide Professor Emeritus*; B.S., City College of New York, 1944; Ph.D., Columbia University, 1951; NYS/UUP Excellence Award, 1990

**JAMES L. THORPE** (1965-2000), *Research Associate Emeritus*, Paper and Bioprocess Engineering; B.S., State University College of Forestry at Syracuse University, 1965; M.S., 1967

**WILLIAM C. TIERSON** (1949-1983), *Director of Wildlife Research Emeritus*; B.S., State University College of Forestry at Syracuse University, 1949; M.F., 1967

**WILLIAM P. TULLY** (1966-2002), *Provost/Vice President Academic Affairs Emeritus and Professor Emeritus*, Environmental Resources Engineering; B.S.C.E., Northeastern University, 1964; M.S., C.E., 1966; Ph.D., Syracuse University, 1978

**FREDRICK A. VALENTINE** (1956-1995), *Professor Emeritus*, Environmental and Forest Biology; B.S., St. Cloud State Teachers College, 1949; M.S., University of Wisconsin, 1953; Ph.D., 1957; NYS/UUP Excellence Award, 1990

**LARRY W. VANDRUFF** (1970-2000), *Professor Emeritus*, Environmental and Forest Biology; B.S., Mansfield State College, 1964; M.S., Cornell University, 1966; Ph.D., 1970

**DANIEL C. WALTON** (1963-1991), *Professor Emeritus*, Chemistry; B.Ch.E., University of Delaware, 1955; Ph.D., State University College of Forestry at Syracuse University, 1962

**CHUN-JUAN K. WANG** (1959-1997), *Professor Emeritus*, Environmental and Forest Biology; B.S., Taiwan University, 1950; M.S., Vassar College, 1952; Ph.D., State University of Iowa, 1955; Chancellor's Award for Excellence in Teaching, 1990

**SARAH P. WEBSTER** (1990-2000), *Associate Professor Emeritus*, Environmental Studies; B.A., Duke University, 1959; M.A., Syracuse University, 1961

**ROBERT G. WERNER** (1966-69) (1970-1998), *Professor Emeritus*, Environmental and Forest Biology; B.S., Purdue University, 1958; M.A., University of California, 1963; Ph.D., Indiana University, 1966

**ROSS S. WHALEY** (1984-2003), *President Emeritus* and *Professor Emeritus*, Forest and Natural Resources Management; B.S., University of Michigan, 1959; M.S., Colorado State University, 1961; Ph.D., University of Michigan, 1969

**EDWIN H. WHITE** (1980-2007), *Professor Emeritus*, Forest and Natural Resources Management; *Director*, State University of New York Center for Sustainable and Renewable Energy; Certificate, State University College of Forestry (Ranger School), 1959; B.S., State University College of Forestry at Syracuse University, 1962; M.S., 1964; Ph.D., Auburn University, 1969

**HUGH E. WILCOX** (1954-1986), *Professor Emeritus*, Environmental and Forest Biology; University of California, 1938; M.S., New York State College of Forestry, 1940; Ph.D., University of California, 1950

# Course Descriptions

The courses offered by the College are grouped by general subject areas and the number of credit hours appears after the course title. A credit hour means one recitation (or lecture) hour per week. Three laboratory hours are equivalent to one lecture hour.

The semester(s) after each course indicates when it is normally offered. The College reserves the right to alter the scheduled offering of a course when its enrollment is too small or when there is no qualified faculty member available to teach it.

Courses listed in this catalog are subject to change through normal academic channels. New courses, course deletions and changes in courses are initiated by the relevant departments and the College faculty.

## Course Numbering System

100-499: Undergraduate courses for which no graduate credit may be given.

500-599: Graduate courses designed expressly for areas of specialization in post-baccalaureate programs. Qualified undergraduate students may enroll by permission of the instructor.

600-699: Graduate courses designed expressly for advanced levels of specialization. Undergraduate students with a cumulative grade point average of 3.000 or better may enroll in these courses with an approved petition.

700-999: Advanced graduate-level courses for which no under-graduate students may register. Shared resources courses, designated as 400/500 or 400/600, are designed when the topic coverage of both courses is the same. Separate course syllabuses are developed expressly differentiating the requirements and evaluative criteria between the undergraduate course and the graduate course. No type of cross listing may be offered unless approved by the ESF faculty.

## ESF Subject Areas

APM	Applied Mathematics
BPE	Bioprocess Engineering
BTC	Biotechnology
CMN	Communications (Environmental Studies)
EFB	Environmental and Forest Biology
ENS	Environmental Science (Graduate)
ERE	Environmental and Resource Engineering
ESC	Environmental Science
ESF	Collegewide
EST	Environmental Studies
EWP	Environmental Writing Program
FCH	Chemistry
FEG	Forest Engineering
FOR	Forestry (Resources Management)
FTC	Forest Technology
LSA	Landscape Architecture
PSE	Paper Science and Engineering
WPE	Wood Products Engineering

## Syracuse University Subject Areas

These courses are taught at Syracuse University's College of Arts and Sciences. Descriptions will be found at <http://coursecatalog.syr.edu/>.

AAS	African American Studies
ANT	Anthropology
APH	Art Photography
CHE	Chemistry
CIE	Civil Engineering
ELE	Electrical Engineering

ETS	English and Textual Studies
GEO	Geography
HST	History
LIN	Linguistics
LIT	Literature in Translation
MAT	Mathematics
MAX	Maxwell School
PAF	Public Affairs
PHI	Philosophy
PHY	Physics
PSC	Political Science
REL	Religion
SOC	Sociology

## APM - Applied Mathematics

### APM 101 Fundamentals of College Algebra (3)

Three hours of lecture/discussion per week. Algebraic operations on polynomials and rational functions as expressions, in equations, or inequalities. Graphing of linear and polynomial equations. An emphasis is placed on algebraic operations of expressions with rational exponents. Fall.

### APM 103 Applied College Algebra and Trigonometry (3)

Three hours of lecture per week. This course is designed to enable non-science students to solve practical problems in their specific areas of study. Topics include algebraic, exponential, logarithmic, and trigonometric functions used in measurement and modeling. Applications include percents, scaling, slopes, and contour mapping. Spring, Fall.

Prerequisite(s): Math Placement or Consent of Instructor.

### APM 104 College Algebra and Precalculus (3)

Three hours of lecture/discussion per week. Course meets the SUNY general education requirement for mathematics. Elements of analytic geometry. Emphasis on the concepts of polynomial and rational functions, exponential and logarithmic functions, trigonometry and trigonometric functions and their application to design and life and management sciences. Fall and Spring.

Prerequisite: Three years of high school mathematics.

### APM 105 Survey of Calculus and Its Applications I (4)

Four hours of lecture per week. Introduction to calculus for students in the life and management sciences. Elements of analytic geometry, functions and their graphs, with an emphasis on the concepts of limits, and differentiation techniques for algebraic, exponential and logarithmic functions and their application to economics, and the life and management sciences. Some multivariable calculus including constrained optimization. Fall and Spring.

Prerequisite: Precalculus or 3 1/2 years of high school mathematics. Note: Credit will not be granted for APM 105 after successful completion of MAT 284, MAT 285, or MAT 295 at SU.

### APM 106 Survey of Calculus and Its Applications II (4)

Four hours of lecture per week. A continuation of calculus for students in the life and management sciences. Elements of analytic geometry. An introduction to integration and applications of the definite integral. Differentiation and integration of trigonometric functions. Applications of first order differential equations and partial derivatives. Spring.

Prerequisite: APM 105 or permission of the instructor. Note: Credit will not be granted for APM 106 after successful completion of MAT 286 or MAT 296 at SU.

### APM 205 Calculus I for Science and Engineering (4)

Four hours of lecture/discussion per week. Analytic geometry, limits, derivatives of functions and equations, optimization, rates, graphs, differentials, mean-value theorem, and applications of the derivative. Fall.

Prerequisite: APM 104 or permission of instructor.

### APM 206 Calculus for Science and Engineering II (4)

Four hours of lecture/discussion per week. This course is a one semester continuation of differential calculus. Integral calculus is used to describe growth and size. Topics include: techniques of integration and their application, convergence of sequences and series, separable and first-order differential equations, and polar coordinates. Spring.

Prerequisite(s): Successful completion of a differential calculus course such as APM205 or MAT295.

### APM 255 Computing Applications (3)

Three hours of lecture per week. Introduction to computing resources: timeshared and personal computers. Introduction to basic computing concepts. Introduction to computing and computer networks. Introduction to applications computing: word processing, spreadsheets and communications (electronic mail and other Internet services). Spring.

### APM 360 Introduction to Computer Programming (3)

Three hours of lecture per week. The basic course in computer programming offered by the college, giving the student the skill and

understanding to write computer programs to solve problems. The course will cover instruction in a commonly used programming language such as Pascal or FORTRAN; will cover basic hardware and software concepts; will make use of electronic mail and computer networks; will introduce applications software, such as spreadsheets, statistical software or other appropriate types. No prior experience with computers or programming is required. Fall.

**APM 391 Introduction to Probability and Statistics (3)**

Three hours of lecture per week. Introduction to concepts and methods of statistics as applied to problems in environmental science and forestry. Topics include inference (confidence intervals and hypothesis testing), sampling distributions, descriptive statistics, exploratory data analysis, comparison of population means and proportions, categorical data analysis, regression and correlation, and nonparametric methods. Fall or Spring.

**APM 395 Probability and Statistics for Engineers (3)**

Three hours of lecture per week. This course provides a rigorous introduction to calculus-based probability and statistical theory, with applications primarily drawn from engineering and the environmental sciences. Topics include: descriptive statistics and data presentation, probability, the theory and use of discrete and continuous probability distributions, confidence intervals, classical and distributional hypothesis testing, and regression analyses. Spring.

Prerequisite(s): One year of Calculus. Note: Credit will not be granted for both APM 395 and APM 595.

**APM 485 Differential Equations for Engineers and Scientists (3)**

Three hours of lecture per week. First and second order ordinary differential equations, matrix algebra, eigen values and eigen vectors, linear systems of ordinary differential equations, numerical solution techniques and an introduction to partial differential equations. Spring.

Prerequisite: MAT 295, MAT 296, MAT 397.

**APM 500 Introduction to Computer Programming for Graduate Students (3)**

Three hours of lecture per week. A basic course in computer usage. Provides the skill needed to utilize digital computer languages for problem solving. Includes a study of FORTRAN with a discussion of APL and Assembly Language. Other topics include representation of information, management of files, error control, operational systems and job control. Fall.

**APM 510 Statistical Analysis (3)**

Three hours of lecture per week. Applications of descriptive and inferential statistics to natural resource problems. Basic concepts and techniques of estimation, confidence intervals, and hypothesis testing applied to one- and two-sample settings, paired designs, simple linear regression and correlation, contingency tables, and goodness of fit tests. Statistical software used to enhance data analysis skills. Fall.

Prerequisite(s): Graduate standing.

**APM 595 Probability and Statistics for Engineers (3)**

Three hours of lecture per week. This course provides a rigorous introduction to calculus-based probability and statistical theory, with applications primarily drawn from engineering and the environmental sciences. Topics include: descriptive statistics and data presentation, probability, the theory and use of discrete and continuous probability distributions, confidence intervals, classical and distributional hypothesis testing, and regression analyses. Spring.

Prerequisite(s): One year of Calculus. Note: Credit will not be granted for both APM 395 and APM 595.

**APM 620 Experimental Design and ANOVA (3)**

Three hours of lecture per week. Designing and analyzing experiments and observational studies; completely randomized, split plot, randomized complete block, and nested experiment designs; single-factor, factorial, and repeated measures treatment designs; expected mean squares and variance components; fixed, random, and mixed effects models; multiple comparison and contrast analyses; analysis of covariance; statistical computing. Spring.

Prerequisites: Graduate status and an introductory course in statistics covering material through the one-way analysis of variance.

**APM 625 Sampling Methods (3)**

Three hours of lecture per week. Application of probability sampling methods to environmental science and forestry. Simple random, stratified, cluster, systematic, two-phase, line-intercept, point, variable radius plot, adaptive cluster, and other variable probability sampling designs; model-assisted ratio and regression estimators; inclusion probabilities; properties of estimators for design-based inference; Horvitz-Thompson estimation as a unifying theory. Fall.

**APM 630 Regression Analysis (3)**

Three hours of lecture per week. Review of basic statistical concepts and matrix algebra. Classical simple and multiple linear models, indicator or dummy variables, residual analysis, transformation and weighted least squares, influence diagnostics, multicollinearity, nonlinear models and linear mixed models. Statistical computing using SAS and applications in forestry, biology, engineering, and social sciences. Spring.

Prerequisite: APM 391 or equivalent.

**APM 635 Multivariate Statistical Methods (3)**

Three hours of lecture per week. Review of basic statistical concepts and matrix algebra. Multivariate normal distribution, Hotelling's T<sup>2</sup>, multivariate analysis of variances, principal component analysis, factor analysis, discrimination and classification, cluster analysis, and canonical correlation analysis. Statistical computing using SAS and applications in forestry, biology, engineering, and social sciences. Fall.

Prerequisites: APM 391 or equivalent.

**APM 645 Nonparametric Statistics and Categorical Data Analysis (3)**

Three hours of lecture per week. Topics include: review of basic statistics, sign and ranked sign tests, median and Wilcoxon tests, c<sup>2</sup> binomial tests, -test and contingency tables (with correspondence analysis), goodness-of-fit, nonparametric correlation and association analysis, logistic and Poisson regression, nonparametric regression techniques such as LOESS, GAM, and robust regression, bootstrapping and jackknifing. Fall (even years).

Prerequisite: APM 391 or equivalent.

**APM 650 Operations Research (3)**

Three hours of lecture per week. A survey of optimization techniques to support decision making in the management of natural resources. Techniques examined include linear programming, integer programming, network analysis, nonlinear programming, dynamic programming, and Markov chains. Fall (odd years).

Pre- or co-requisite(s): Calculus and Probability and Statistics.

**APM 653 Simulation Design and Analysis (3)**

Three hours of lecture per week. Statistical aspects of computer simulation. Topics examined include: identification and parameterization of probability distributions, evaluation of random number generators, random variate generation, and statistical analysis of simulation output. Fall (even years).

Prerequisite: Probability and Statistics.

**APM 671 Map Accuracy Assessment (1)**

One hour of lecture per week. Statistical concepts and methods for quantifying the accuracy of maps. Sampling design and analysis for assessing accuracy of categorical attributes (e.g. land cover) is emphasized, with some discussion of continuous variables. Spring, even numbered years.

**APM 696 Special Topics in Quantitative Methods (1 - 3)**

Experimental and developmental courses in areas of quantitative methods not covered in regularly scheduled courses. A course syllabus will be available to students and faculty advisors prior to registration. Fall or Spring.

**BPE - Bioprocess Engineering****BPE 132 Orientation Seminar: Bioprocess Engineering (1)**

One hour lecture per week or three-hour lab/field trip per week. Introduction to campus resources available to ensure academic success. Introduction to bioprocess engineering as a field of inquiry and career path. Fall.

Note: Credit will not be granted for both BPE 132 and PSE 132.

**BPE 230 China Experience (3)**

Forty five hours (equivalent) of lecture and field studies. General survey of the history of China from ancient societies through the current time, with attention to cultural, ecological and natural resource issues focused on selected localities of China. The locality and/or hot spots will be selected from: the invention of paper; printing technology; renewable energy; anaerobic digestion of animal / plant biomass; wastewater treatment; Great Walls; Forbidden City; Three Gorges area; Canals; Chinese gardens; Sichuan; Dujiangyan Irrigation Dam/Channels; Panda preservation; Hakka culture; Tibetan culture; plants and vegetation, etc. Analysis of the evolution of the Chinese culture. Historical and contemporary influences of China. Spring, Fall or Summer.

**BPE 296 Special Topics in Engineering (1 - 3)**

Provides experimental, interdisciplinary, or special coursework at the freshman and sophomore levels within the field of environmental resources engineering. Subject matter and course format vary from semester to semester and section to section. Fall and Spring.

**BPE 300 Introduction to Industrial Bioprocessing (3)**

Three hours of lecture and discussions per week. Industrial examples of biotechnology and bioprocessing will be reviewed. Topics include applications of biotechnology and bioprocessing to the food, water and wastewater treatment, industrial biotechnology, biopharmaceutical and biofuel industries. Through case studies of process flow sheets for different products students will develop an understanding of unit operations typically utilized in bioprocessing manufacturing operations. Fall.

Prerequisite(s): Cell biology and organic chemistry.

**BPE 304 Summer Internship in Bioprocess Engineering (2)**

Twelve weeks full time bioprocessing employment approved by the Department between the junior and senior years. The student must submit a comprehensive report and give a presentation to fulfill this requirement. Summer.

Prerequisite: PSE 370 or equivalent.

**BPE 305 Co-op Experience in Bioprocess Engineering (2)**

One semester full-time bioprocessing experience as an engineering intern on company-assigned projects. Typically, the student works for a semester and adjacent summer also taking BPE 304. The student must submit a comprehensive report and give a presentation to fulfill this requirement. Fall and Spring.

Prerequisite: PSE 370 or equivalent.

**BPE 310 Colloid and Interface Science (3)**

Three hours of lecture per week. This course will cover the basic principles of colloidal and interfacial science as applied to bioprocesses. It will provide a foundation and theoretical understanding that will be applied in bioseparations, transport phenomena, biochemical/bioprocess engineering and other advanced courses in the bioprocess engineering curriculum. Fall.

Prerequisites: PSE 370, PSE 361, FCH 150, FCH 152. Note: Credit will not be granted for both BPE 310 and PSE 467.

**BPE 335 Transport Phenomena (3)**

Three hours of lecture per week. Principles of heat and mass transfer as applied to the bioprocess industries. Topics include conduction, convective heat and mass transfer, diffusion of both steady-state and transient situations, analogies for heat and mass transfer, boundary layers, porous media transport, heat and mass transfer analyses. Discussion of specific bioprocess examples. Spring.

Prerequisites: PSE 370, PSE 371. Note: Credit will not be granted for both BPE 335 and ERE 534.

**BPE 336 Transport Phenomena Laboratory (1)**

Three hours of laboratory per week. Introduction to report writing and laboratory safety. Experiments on fluid mechanics, heat transfer, diffusion, and convective mass transfer as applied to the bioprocess industries. Data analysis and data presentation in oral and written form are required. Spring.

Prerequisites: PSE 370 and PSE 371 or equivalents. Co-requisite: BPE 335 (or prerequisite).

**BPE 420 Bioseparations (3)**

Three hours of lecture per week. Major unit operations used for the separation, purification and recovery of products from complex mixtures. Separation processes including sedimentation, filtration, centrifugation, membrane ultra-filtration, nanofiltration, ion exchange processes, chromatographic separations. Fall.

Prerequisite: BPE 310. Note: Credit will not be granted for both BPE 420 and BPE 620.

**BPE 421 Bioprocess Kinetics and Systems Engineering (3)**

Three hours of lecture per week. Topics in biochemical kinetics and reaction engineering are discussed including their application to



microbiological systems used for bioprocessing. Batch and continuous biochemical reactor designs. The role of agitation in gas and solids delivery and heat removal for inclusion in design decisions. Impact of engineering parameters and design decisions on operability and economics. Fall.

Prerequisite: BPE 335. Co-requisite: BPE 420. Note: Credit will not be granted for both BPE 421 and BPE 621.

### **BPE 435 Unit Process Operations (3)**

Two hours of lecture and three hours of laboratory and/or recitation, discussions per week. Topics include packed towers, tray columns, fluidized bed, fluid mechanic limitations, pressure drop, mass transfer coefficient, mass transfer limits, thermodynamic limits, equilibrium stage calculations, packed tower and tray column design and performance analysis. Fall.

Prerequisite(s): BPE 335/336.

### **BPE 438 Introduction to Biorefinery Processes (3)**

Three hours of lecture and discussions per week. Topics covered include chemical and physical properties of biomass feedstocks; sustainable biomass production/utilization, chemical and biological processes of converting plant biomass to chemicals, liquid fuels, and materials. Focus on green chemistry and/or environmentally benign processes, with some discussions on political and social aspects of sustainability and renewability. Fall.

Prerequisite(s): Cell biology and BPE 335 Transport Phenomena. Note: Credit will not be granted for both BPE 438 and BPE 638.

### **BPE 440 Bioprocess and Systems Laboratory (3)**

One hour of lecture and six hours of laboratory per week. Measurement and analysis of bioprocess systems, including steady-state and dynamic modeling of systems. Investigation of various bioprocesses including fermentation, enzymatic reactions, and reactive processes involving lignocellulosic materials. Spring.

Prerequisite: BPE 420 and BPE 421.

### **BPE 441 Biomass Energy (3)**

Three hours of lecture per week. Historical, current and future uses of biomass as a source of renewable energy for the production of bioenergy, biofuels and bioproducts. Characteristics of biomass, their conversion to different forms of energy and end products, and an assessment of their sustainability. Spring.

Prerequisite: ESC 325, ESC 335 or permission of instructor; one semester of freshman chemistry or permission of instructor. Note: Credit will not be granted for both BPE 441 and BPE 641.

### **BPE 480 Introduction to Biorefinery Processes (3)**

Forty five hours of lecture and discussions. Topics covered in this course include chemical and physical properties of biomass feedstocks; chemical processes and biological processes associated with converting plant biomass and agricultural residues to chemicals, liquid fuels, and materials. Discussions will be more geared towards green chemistry and/or environmentally benign processes. While discussions will lead to political and policy trends on sustainability and renewability, more engineering and engineering science aspects will be covered. Fall.

Prerequisite(s): BPE 421 Co-requisite(s): BPE 421

### **BPE 481 Bioprocess Engineering Design (3)**

Three hours of lecture per week. Methods for estimating capital investment, operating costs and return on investment for bioprocesses. Bioprocess flow sheet synthesis, operability, process simulation, optimization techniques, and preparation for a bioprocess design project. Spring.

Prerequisite: PSE 480.

### **BPE 496 Special Topics (1 - 3)**

Lectures, readings, problems and discussions. Topics in environmental or resource engineering as announced. Fall and/or Spring.

### **BPE 498 Research Problem in Bioprocess Engineering (1 - 4)**

Independent study. The student is assigned a research problem in bioprocess engineering. The student must make a systematic survey of available literature on the assigned problem. Emphasis is on application of correct research techniques rather than on discovery of results of commercial importance. The information obtained in the literature survey, along with the data developed as a result of the investigation, is to be presented as a technical report. Fall, Spring, and Summer.

### **BPE 501 Bioprocess Microbiology (3)**

Two hours of lecture and three hours of laboratory/discussion per week. Topics include general microbiology, enzymology, enzyme kinetics, biochemistry, metabolic regulation, microbial growth and product formation (with general stoichiometry), media formulation and bioprocess design including batch, fed-batch, and continuous modes, techniques for product recovery and purification, and mammalian cell lines/culture. Microbiological growth media, batching, and the operation of bench-top bioreactors and various analytical instrumentation. Fall.

Prerequisites: Permission of instructor; basic understanding of chemistry and biology; appropriate quantitative skills.

### **BPE 535 Transport Phenomena (3)**

Three hours of lecture per week. Principles of heat and mass transfer as applied to the bioprocess industries. Topics include conduction, convective heat and mass transfer, diffusion of both steady-state and transient situations, analogies for heat and mass transfer, boundary layers, porous media transport, heat and mass transfer analysis. Discussion of specific bioprocess examples. Spring.

Note: Credit will not be granted for both BPE 335 and BPE 535.

### **BPE 596 Special Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Topics in environmental and resource engineering not covered in established courses. Designed for the beginning graduate student or selected upper-division undergraduate. Fall and/or Spring.

### **BPE 620 Bioseparations (3)**

Three hours of lecture per week. Cell disruption, solid liquid separations, centrifugation, chromatographic techniques (gel filtration, affinity, ion exchange), and membrane processes. Extraction. Crystallization and drying. Aseptic filtration. Fall.

Prerequisite: BPE 501. Note: Credit will not be granted for both BPE 620 and BPE 420.

### **BPE 621 Bioreaction Engineering (3)**

Three hours of lecture/discussion per week. Bioprocess kinetics, reaction engineering, mass and energy balances, stoichiometry, enzyme kinetics, growth and product synthesis kinetics, mass transfer effects, bioreactor analysis and design, instrumentation and control, batch

processing, bioreactor scale-up, agitation, oxygen delivery, heat removal and kinetics of sterilization (clean and sterilization in place (CIP and SIP). Spring.

Prerequisites: Mass and Heat Transfer, or Transport Phenomena. Note: Credit will not be granted for both BPE 621 and PBE 421.

### **BPE 635 Unit Process Operations (3)**

Two hours of lecture and three hours of laboratory and/or recitation, discussions. Topics include packed towers, tray columns, fluidized bed, fluid mechanic limitations, pressure drop, mass transfer coefficient, mass transfer limits, thermodynamic limits, equilibrium stage calculations, packed tower and tray column design and performance analysis. Fall.

### **BPE 638 Introduction to Biorefinery Processes (3)**

Three hours of lecture and discussions per week. Topics covered include chemical and physical properties of biomass feedstocks; sustainable biomass production/utilization, chemical and biological processes of converting plant biomass to chemicals, liquid fuels, and materials. Focus on green chemistry and/or environmentally benign processes, with some discussions on political and social aspects of sustainability and renewability. Fall.

Note: Credit will not be granted for both BPE 438 and BPE 638.

### **BPE 641 Biomass Energy (3)**

Three hours of lecture per week. Historical, current and future uses of biomass as a source of renewable energy for the production of bioenergy, biofuels and bioproducts. Characteristics of biomass, their conversion to different forms of energy and end products and an assessment of their sustainability. Spring.

Prerequisite: ESC 525, ESC 535 or permission of instructor; one semester of freshman chemistry or permission of instructor.

### **BPE 681 Bioprocess Plant Design (3)**

Three hours of lecture per week. Topics covered include integration of process and support systems and equipment; concepts of facility design integrating Good Manufacturing Practice (GMP), equipment and systems cleanability, people flow, product protection, capital investment, and operating costs. This course will focus towards facility design in the biopharmaceutical industry. Spring.

Prerequisites: BPE 620, BPE 621 or equivalents.

### **BPE 796 Advanced Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Advanced topics in forest engineering, paper science and engineering, and wood products engineering. Fall and/or Spring.

Prerequisite: Permission of instructor.

### **BPE 797 Seminar (1 - 3)**

Discussion of assigned topics in the fields related to Bioprocess Engineering. Spring and Fall.

### **BPE 798 Research in Bioprocess Engineering (1 - 12)**

Independent research topics in Bioprocess Engineering. Fall, Spring or Summer.

Credit hours to be arranged.

### **BPE 898 Professional Experience/Synthesis (1 - 6)**

A supervised, documented professional work experience in the Master of Professional Studies degree program. Fall, Spring, or Summer.

Pre- or co-requisite(s): Approval of proposed study plan by advisor, Faculty, and any sponsoring organization.

### **BPE 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's thesis. Fall, Spring or Summer.

Credit hours to be arranged.

### **BPE 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral dissertation. Fall, Spring or Summer.

Credit hours to be arranged.

## **BTC - Biotechnology**

### **BTC 132 Orientation Seminar (1)**

One hour of lecture or discussion per week. Occasional tour of laboratories or field trips. Introduction to campus facilities, personnel, lower-division curriculum, and upper-division study options to facilitate transition of students into the program and assist them in making informed decisions on course selection and future career directions. Fall.

### **BTC 401 Molecular Biology Techniques (4)**

Two hours lecture and six hours laboratory per week. Theories behind techniques in molecular biology are introduced in lecture. Laboratory includes the extraction and quantification of genomic and plasmid DNA, agarose gel electrophoresis, restriction digestion, ligation, bacterial transformation, DNA sequencing and PCR. Additional topics in molecular biology are presented by the students. Fall.

Prerequisite(s): EFB 307, 308, 325, or equivalents. Note: Credit will not be granted for both BTC 401 and EFB 601.

### **BTC 420 Internship in Biotechnology (3 - 5)**

Full- or part-time employment or volunteer work with an agency, institution, clinic, professional group, business, or individual involved in activities consistent with the student's educational and professional goals. The extent of the internship activities shall be commensurate with the credits undertaken. A resident faculty member must serve as the student's academic sponsor. A study plan outlining the internship's educational goals must be completed prior to its commencement. Grading will be based on a written report from the student and submitted to the sponsoring faculty member and on an evaluation of the student's performance written by the site supervisor to the sponsoring faculty member. Fall, Spring, Summer.

Prerequisite: Consent of a faculty sponsor.

### **BTC 425 Plant Biotechnology (3)**

Two hours of lecture and three hours of laboratory per week. The use of transgenic plants to improve the human condition and remediate environmental problems is a rapidly growing field of study. Students are taught the principles of gene structure and regulation, gene cloning, transformation of plant species, and current applications. Format includes lectures, discussions, student presentations, and a laboratory

project. Spring.

Note: Credit will not be granted for both BTC 425 and EFB 625.

### **BTC 426 Plant Tissue Culture Methods (3)**

Two hours of lecture and discussion and three hours of laboratory per week. Introduction to plant tissue culture for biotechnology research and as a propagation method. Emphasis will be on learning laboratory instrumentation and techniques for establishing cell cultures, producing transgenic cell lines, and regenerating whole plants. Fall.

Prerequisites: One course in botany, microbiology, or genetics; or permission of instructor. Note: Credit will not be granted for BTC 426 and FOR 626/EFB 626.

### **BTC 496 Topics in Biotechnology (1 - 3)**

Experimental, interdisciplinary, or special topic coursework in biotechnology for undergraduate students. Subject matter and method of presentation varies from semester to semester. May be repeated for additional credit if topic changes. Fall or Spring.

### **BTC 497 Research Design and Professional Development (1)**

One hour of discussion or seminar each week covering the scientific method, professional ethics and responsibilities of the practicing scientist. Employment opportunities, future career choices, safety considerations, and use of the scientific literature are covered. Students will select a research topic and prepare a proposal, which may be applied to BTC 498 or BTC 420. Spring.

Pre- or co-requisite: Biotechnology major or permission of instructor.

### **BTC 498 Research Problems in Biotechnology (1 - 9)**

Laboratory research experience with research time agreed upon by student and instructor. Independent research experience covering biotechnological topics. Specific topics determined through consultation between student and appropriate faculty member. Tutorial conferences, discussions, and critiques scheduled as necessary. Grading determined by the instructor and could include, but not required, evaluation of skills learned, data obtained, and laboratory notebook record keeping. A final written report is required. Fall or Spring.

Prerequisite: Permission of instructor.

### **BTC 499 Senior Project Synthesis (1)**

One hour of discussion or seminar each week. Students will learn to synthesize results gained from their own independent research and present those data in a scientific poster at a research symposium. Topics of professional preparation will also be discussed. Spring.

## **CME - Construction Management and Engineering**

### **CME 132 Orientation Seminar: Sustainable Construction Management and Engineering (1)**

One hour of lecture and discussion per week. Introduction to campus resources available to ensure academic success in the area of Sustainable Construction Management and Engineering. Fall.

### **CME 202 Introduction to Professional Communications (3)**

Three hours of lecture per week. Introduction to intermediate-level use and understanding of Microsoft Office Word, Excel, PowerPoint, and Access applications for data analysis, presentations, and report preparation. Focused on developing the ability to prepare reports and presentations including preparation of documents, data analysis, and verbal, written and digital presentations. Fall.

### **CME 215 Sustainable Construction (3)**

Three hours of lecture/discussion per week. Overview of sustainable design and construction concepts and practices. The emergence of green building, issues, and rating systems. Sources of chemicals in buildings, indoor air quality, and human comfort. Basic energy principles and energy-efficient technologies. Selection of materials. Role of the contractor in the management and construction of green projects. Spring.

### **CME 226 Statics and Mechanics of Materials (4)**

Four hours of lecture/discussion per week. Equilibrium systems of forces in two and three dimensions. Analysis of structural components for stresses and deformations. Stability and design of beams and columns made of common engineering materials. Design methods and safety considerations. Spring and Fall.

Prerequisite: Calculus I, Physics I.

### **CME 255 Plan Interpretation and Quantity Takeoff (3)**

Three hours of lecture/discussion per week. Introductory course in construction plan interpretation and quantity takeoff. Will address how to read and interpret construction plans and introduce basic quantity takeoff skills. Fall.

### **CME 303 Sustainable Construction Management and Engineering Internship (1 - 3)**

Full or part-time employment with an organization that involves the student in an educational experience in a professional establishment. A resident faculty member must serve as the student's academic sponsor. A study plan that describes the internship's educational goals must be submitted prior to its commencement. Fall and Spring.

Prerequisite: Upper-division status.

### **CME 304 Environmental Performance Measures for Buildings (3)**

An overview of how building rating systems for green construction have developed, their present application, and future directions for growth. The course will explore the process for development of individual standards, the different building certification systems that have been developed using these standards, and long-term development and code adoption of such certification systems.

### **CME 305 Sustainable Energy Systems for Buildings (3)**

Three hours of lecture/discussion per week. Exploration of construction management-related issues in creating a more sustainable energy use in our building stock. Integrating sustainable energy sources in construction as well as issues related to using energy more efficiently. Fall.

### **CME 306 Engineering Materials for Sustainable Construction (3)**

Two hours of lecture/discussion per week and one lab per week. Introduction to the principal structural materials used for building construction and their engineering properties and environmental impacts. The production and performance of these materials will be explored through class discussion and laboratory experiments. The application of each of the materials during sustainable construction processes will be emphasized. Spring.

**CME 315 Production and Operation Management (3)**

Three hours of lecture per week. Basic productivity issues and simulation modeling. Students will learn basic productivity theories, construction productivity tools, and discrete-event simulation modeling. In addition to basic lectures, students are asked to select construction activities and develop computer simulation models to optimize construction operations by optimizing resource allocation. Spring.  
Prerequisite: Junior or senior status. Note: Credit will not be granted for both CME 515 and CME 315.

**CME 322 Mechanical Processing (3)**

Two hours of lecture and three hours of laboratory per week. Primary log reduction methods and industry practices. Lumber grading. Wood cutting principles. Machining practice in secondary wood-using industries. Experience in the operation of certain primary and secondary machining equipment. Fall.

**CME 326 Fluid Treatment of Wood (3)**

Two hours of lecture, three hours of laboratory per week. Basic wood-moisture relationships, wood shrinkage and swelling, permeability, thermal conductivity, wood drying and preservation treatments, and fire retardancy. Flow of fluids, heat and water vapor are treated as analogous phenomena related to the cellular structure of wood. Laboratory studies in relative humidity measurement, wood-moisture relations, relationships between wood permeability and drying and treatability, industrial wood drying, dry kiln operation and preservation treatments, and fire retardancy. Spring.

Prerequisite: CME 387 or permission of instructor. Note: Credit will not be granted for both CME 326 and CME 682.

**CME 330 Building Code of New York State (3)**

Three hours of lecture/discussion per week. Introduction to the Building Code that legally governs the design and construction of all building types within New York State. The course includes a basic understanding of the Code including history and origin, legal enforcement, basic definitions, and terminologies. Fall.

**CME 331 Construction Safety (3)**

Occupational Safety and Health Practices in the construction industry with coverage of the U. S. Department of Labor, Occupational Safety and Health Regulations (CFR 1910 and 1926 Standards). Detailed study of Construction Safety and Hazardous Communications programs, personal protective equipment, tools, electrical power, ladders, and scaffolding, floor and wall openings, cranes and power equipment. Special problems related to concrete work, erection and demolition. OSHA 30 Hr. card earned. Fall.

Note: Credit will not be granted for both CME 331 and CME 531.

**CME 332 Mechanical and Electrical Equipment (3)**

Three hours of lecture per week. The course introduces the basic concepts of mechanical systems design and construction for residential and commercial buildings. Simplified design and construction estimates are performed for heating, cooling, plumbing, sanitation, electrical, and lighting systems. Relevant code requirements are stressed. Fall.

**CME 335 Cost Engineering (3)**

Three hours of lecture/discussion per week. Statistics, cost of money, rates of return, cash flow, budget development, cost tracking, productivity and progress, constructability and value engineering, change control and risk analysis. Fall.

Prerequisite: Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 335 and CME 535.

**CME 342 Light Construction (3)**

Three hours of lecture per week. An introduction to the construction process with an emphasis on the unique aspects of light construction. Introduces construction management principles related to material properties, building science, structural design, estimating, and scheduling. Fall.

**CME 343 Construction Estimating (3)**

Three hours of lecture/discussion per week. Basic estimating/bidding theory and process. The processes for reviewing and interpreting contracts, specifications and blueprints and their role in the estimating/bidding process. How to perform a quantity takeoff, be able to create a final estimate/bid including the appropriate General Conditions and Markups. Several projects based upon the concepts are assigned on the material listed above as well as utilizing either a spreadsheet or Timberline Precision Computer Estimating. Spring.

Prerequisite(s): CME 255 Plan Interpretation and QTO or permission of instructor. Note: Credit will not be granted for both CME 343 and CME 543.

**CME 350 Construction Methods and Equipment (3)**

Three hours of lecture/discussion per week. The study of production, methods of operation and costs of heavy construction equipment. Analysis of heavy construction operations. Economics of equipment use. The fundamentals of decision making involved in the selection of methods and equipment that will result in the most effective and efficient performance on a project. Spring.

Note: Credit will not be granted for both CME 350 and CME 525.

**CME 376 Decay of Wood Products (3)**

Three hours of lecture/laboratory/demonstration per week. Degradation of wood by fungi and other biological agents. Emphasis on the effects of decay on wood properties, methods of decay detection in wood products and decay prevention. Spring.

Prerequisite(s): CME 386 or CME 387.

**CME 386 Structure and Properties of Wood (3)**

Two hours of lecture per week. Structure of wood in relation to defects, properties and uses. The variability of wood. Spring.

**CME 387 Sustainable Structural Materials for Construction (3)**

Three hours of discussion, lecture and demonstration per week. Properties and uses of major structural construction materials. Identification and knowledge of the major wood species and their applications in construction. Fall.

**CME 388 Wood and Fiber Identification Laboratory (2)**

Six hours of laboratory per week. Wood and papermaking fiber identification using both gross and microscopic features. Fall.

Prerequisite: CME 387 to be taken concurrently or previously.

**CME 389 Wood Identification Laboratory (1)**

Three hours of laboratory per week. Identification of principal commercial timbers of United States on gross characteristics. Spring.

Prerequisite: CME 387.

**CME 390 Fiber Identification Laboratory (1)**

Three hours of laboratory per week. Identification of woody and nonwoody papermaking fibers. Spring.  
Prerequisite: CME 387.

**CME 400 Introduction to Forest Products (3)**

Three hours of lecture per week. Characteristics of the products of the forest tree and manufacture of wood products. Spring.

**CME 404 Applied Structures (3)**

Three hours of lecture/discussion/demonstration per week. Applications of statics/mechanics to common engineering structures. Analysis and design of wood, concrete and steel systems considering sustainability and life-cycle analysis. Spring.

Prerequisite(s): CME 226, Statics and Mechanics of Materials.

**CME 405 Building Information Modeling for Construction Management (3)**

Three hours of lecture per week. An introduction to the basic concepts of building information modeling as a construction approach, and an exploration of its application to construction management. Emphasis on the use of building information modeling for estimation, scheduling, clash detection, and project communication. Spring.

Prerequisite(s): CME 255 Plan Interpretation and Quantity Takeoff. Co-requisite: CME 343 Construction Estimating.

**CME 410 Computer-Aided Design and Drafting (3)**

One-half hour lecture, two-and-one-half hours lab, and a minimum of six hours additional lab is required. This course introduces the student to the fundamentals of computer-aided design and drafting. It covers the commands needed to create a two-dimensional drawing, with particular emphasis on techniques used in the design profession applications. The requirements for the course include completing self-tutorials, creating drawings, and the completion of two major projects. Spring.

Note: Credit will not be granted for both CME 410 and CME 610.

**CME 413 Computer-Aided Senior Project (3)**

Three hours of lecture per week. Open-ended real-life design projects with microcomputer aids. Systems approach is emphasized. Project requirements, system selection, approximate design, value engineering and final design are among design aspects considered. Analytical and model analysis. Spring.

**CME 414 Computer Applications in Engineering (3)**

Three hours of lecture per week. Microcomputer applications in a broad spectrum of selected topics in engineering sciences and practice. Hands-on experience is emphasized. Coursework is directed toward solving real-life engineering problems. Software is provided and used. No computer programming or skills are required. Spring.

**CME 415 Lean Project Management (3)**

Three hours of lecture per week. Overview of Lean production theory and the Lean project management system and their relations to the AEC (Architect, Engineering, and Construction) industries. Topics include the Toyota production system, lean principles, the Last Planner System, and supply chain management. Fall.

Prerequisite: Junior or senior status. Note: Credit will not be granted for both CME 615 and CME 415.

**CME 422 Composite Materials for Sustainable Construction (3)**

Two hours of lecture, three hours of laboratory per week. Properties, manufacture and design of multiphase materials. Applications and testing for service in sustainable construction systems and life-cycle analysis. Fall.

Prerequisite(s): CME 226, Statics and Mechanics of Materials and CME 387, Renewable Materials for Sustainable Construction.

**CME 430 Computer Applications in Construction Management (1 - 3)**

Guided individual study. Projects are estimated, scheduled and/or managed exclusively by industry standard construction-related software, including Timberline Precision Estimating, Quest Earthworks, Quest for Contractors, Primavera Project Planner, SureTrak Project Manager by Primavera and Expedition by Primavera. Final report covers entire project. Fall and Spring.

Prerequisite: Senior standing or permission of instructor. Note: Credit will not be granted for both CME 430 and CME 630.

**CME 444 Materials Marketing (3)**

Three hours of lecture and discussion per week. Fundamentals of marketing forest products, building and construction industry materials, including products, markets, distribution, segmentation, pricing, promotion and sales. Specific focus is on the unique nature and issues of forest products and building materials; vertical and horizontal integration, distribution channels, market segmentation and product positioning strategies. Fall.

Prerequisite: FOR 207 Introduction to Economics or equivalent.

**CME 453 Construction Planning and Scheduling (3)**

Three hours of lecture per week. The use of common types of schedules: Gantt, Activity on Node, Precedence Diagram, PERT and Linear. Identification of activities and performance duration analyses of these activities. Updating of schedules, resource planning and assignment, cost planning and scheduling are all covered. Schedule development is performed both manually and with industry-accepted software. Fall.

Prerequisite(s): CME 343 or permission of instructor. Note: Credit will not be granted for both CME 453 and CME 653.

**CME 454 Construction Project Management (3)**

Three hours of lecture/discussion and three hours of laboratory per week. How to define and properly identify company organizational structures and project delivery systems. Integration of estimating, bidding, scheduling and cost control into the management process. Safety, quality control, value engineering, procurement, labor relations and insurance and bonding requirements as integral parts of a construction project. Projects based upon Expedition project management software. Spring.

Prerequisites: CME 343, CME 453, senior standing or permission of instructor. Note: Credit will not be granted for both CME 454 and CME 654.

**CME 455 Construction Contracts and Specifications (3)**

Three hours of lecture/discussion per week. The types of contracts used in the construction industry. Analysis of the contractor, designer and owner duties and obligations as determined by the construction contract documents. Study of concepts, language, formats and procedures for project manual organization practice and the general conditions of the contract for construction. Spring.

Prerequisite(s): Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 455 and CME 658.

**CME 480 Fundamentals of Microscopy (3)**

Three hours of lecture/demonstration per week. Introduction to light microscopy, electron microscopy, atomic force, confocal, Raman, Near Field Optical, Correlative and other microscopic methods and their newest applications. Light microscopic techniques include brightfield, phase contrast, polarized light, Nomarski, Kohler illumination. Imaging and recording methods. Fall.  
Note: Credit will not be granted for both CME 480 and CME 680.

**CME 487 Wood Chemistry and Physics (3)**

Two hours of lecture and three hours of laboratory per week. Wood chemistry and physical properties described in relation to the practical function of wood products. The methodologies used to explore these relationships; including microscopy, mechanical testing, and chemical analysis and their interpretation. Fall.  
Prerequisite: CME 387.

**CME 488 Professional Construction Project Management Presentation Seminar (2)**

Two hours of lecture/seminar/preparation per week. A preparatory course for participation in a professional construction management proposal process including proposal development and professional presentation of the proposal. The course culminates in participation at a regional construction management competition sponsored by the Associated Schools of Construction Region 1. Fall.  
Prerequisites: Junior or Senior standing and permission of the instructor.

**CME 497 Senior Seminar (3)**

Three hours of lecture/discussion per week. Student papers/presentations are directed toward professional issues in career preparation, ethics and presentation skills. Fall.  
Prerequisite(s): Senior status in SCME.

**CME 498 Research or Design Problem (1 - 3)**

Conferences, library, laboratory and/or field research on a specific problem in wood products engineering. Written report required. Fall, Spring and Summer.  
Prerequisite: Permission of instructor and advisor.

**CME 515 Production and Operation Management (3)**

Three hours of lecture/discussion per week. Basic productivity issues and simulation modeling. Topics include basic productivity theories, construction productivity tools, and the discrete-event simulation model. Through independent research students select construction activities and develop a computer simulation model to optimize construction operations by identifying and correcting inefficient operation. Spring.  
Prerequisite: Three credits of any physical or analytical engineering, or permission of instructor. Note: Credit will not be granted for both CME 515 and CME 315.

**CME 525 Construction Methods and Equipment (3)**

Three hours of lecture/discussion per week. Analysis of heavy construction operations and related environmental concerns. Production calculations, means and methods selection and operating costs of heavy construction equipment are addressed. The economics of equipment use are analyzed. The use of a digitizer in earthwork quantity takeoff is explored. The outcome of the course is to select the most cost efficient and performance efficient method and equipment. A term paper is required. Spring.  
Note: Credit will not be granted for both CME 525 and CME 350.

**CME 531 Construction Safety (3)**

Three hours of lecture per week. Occupational Safety and Health practices in the construction industry. An overview of the US Department of Labor, Occupational Safety and Health Regulations, 29 CFR 1910 and 29 CFR 1926. Comprehensive review of: general safety and health requirements, hazard communication, confined space entry, lockout/tagout programs, workplace violence, personal protective equipment, fire protection, signs and barricades, rigging, small tools – hand and power, welding and cutting, electrical, fall protection, scaffolding, cranes, mobile equipment, excavation and trenching, steel erection, stairways and ladders and permissible exposure limits. A term paper is required. Fall.  
Note: Credit will not be granted for both CME 531 and CME 331.

**CME 532 Mechanical and Electrical Equipment (3)**

Three hours of lecture per week. The course introduces the basic concepts of mechanical systems design and construction for residential and commercial buildings. Simplified design and construction estimates are performed for heating, cooling, plumbing, sanitation, electrical, and lighting systems. Relevant code requirements are stressed. An experiment-based project is required. Fall.  
Note: Credit will not be given for both CME 332 and CME 532.

**CME 535 Cost Engineering (3)**

Three hours of lecture/discussion per week. Statistics, cost of money, rates of return, cash flow, budget development, cost tracking, productivity and progress, constructability and value engineering, change control and risk analysis.  
Prerequisite: Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 535 and CME 335.

**CME 543 Construction Estimating (3)**

Three hours of lecture/discussion per week. Definition and explanation of estimating/bidding theory and process. The processes for reviewing and interpreting contracts, specifications and blueprints as well as their role in the estimating/bidding process. Perform a quantity takeoff. Create a final estimate/bid, including the appropriate General Conditions and Markups. Several projects based on the concepts listed above as well as utilizing either a spreadsheet or Timberline Precision Estimating. A term paper describing how the relevant topics of the course fit a specific industry application, and production of an additional project based on Timberline Precision estimating software or equivalent are required. Spring.  
Prerequisites: CME 255 Plan Interpretation and QTO or basic estimating experience and permission of the instructor. Note: Credit will not be granted for both CME 543 and CME 343.

**CME 565 Sustainable Innovations in Residential Construction (3)**

Three hours of lecture per week. Principles of sustainable residential construction; the adaptation of biological, ecological, and cultural elements into building performance standards, practical building specifications, standards and systems. Spring.

**CME 580 Microtechnique of Wood (3)**

Three hours of laboratory per week. Instruction on the use of the sliding microtome to slice thin sections of wood for light microscopy and for

sample surface preparation of wood for scanning electron microscopy. Care of the microtome blade, staining of wood sections and preparation of microscope slides. Fall or Spring.

Pre- or co-requisite: permission of instructor.

**CME 585 Light Microscopy for Research Applications (3)**

Two hours of lecture/three hours of laboratory per week. Principles of light microscopy and photomicrographic digital imagery using Spot camera and Image Pro 7.0 software. Extensive laboratory component. Spring.

Prerequisite: Permission of instructor.

**CME 610 Computer-Aided Design and Drafting (3)**

One-half hour lecture, two-and-one-half hours lab, and a minimum of six hours additional lab is required. This course introduces the student to the fundamentals of computer-aided design and drafting. It covers the commands needed to create a two-dimensional drawing, with particular emphasis on techniques used in the design profession applications. The requirements for the course include completing self-tutorials, creating drawings, and the completion of two major projects at an advanced level. Spring.

Note: Credit will not be granted for both CME 410 and CME 610.

**CME 615 Lean Project Management (3)**

Three hours of lecture/discussion per week. Lean production theory and the Lean project management system and their relations to the architecture, engineering, and construction industries. Topics include the Toyota production system, lean principles, the Last Planner System, and supply chain management. Through independent research students learn how to identify and improve the value stream of the construction process. Fall.

Prerequisite: Three credits of management or permission of instructor. Note: Credit will not be granted for both CME 615 and CME 415.

**CME 630 Computer Applications in Construction Management (1 - 3)**

Guided individual study. Projects that will be estimated, scheduled or managed exclusively by industry-standard, construction-related software, including Timberline Precision Estimating, Quest Earthworks, Quest for Contractors, Primavera Project Planner, SureTrak Project Manager by Primavera and Expedition by Primavera. A final report with annotated bibliography is required. Spring.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both CME 630 and CME 430.

**CME 643 Estimating for Construction in a Green Global Economy (3)**

Three hours of lecture per week. Building upon the estimating skills developed through undergraduate coursework and professional experience this course will look at how to address global estimating concerns such as monetary value between various currencies, how the purchase of commodities futures affects material pricing, the linkages between financial, real estate development and policies and their effects on the construction markets. How to price multi-year projects addressing the previous issues and how to construct an estimate that will convey the information relative to green construction costs to the client in a proper manner will also be addressed. Fall or Spring.

Prerequisites: CME 543 or equivalent or 3 to 5 years of professional estimating experience and permission of instructor.

**CME 653 Construction Planning and Scheduling (3)**

Three hours of lecture/discussion per week. The use of Gantt, Activity on Node, Precedence Diagram, PERT and Linear schedules. Identification of activities and duration analyses of these activities. Update schedules, plan and assign resources, plan cost and schedule. Schedule development is performed both manually and with industry accepted software. A term paper describing how the relevant topics of the course fit a specific industry application and an additional project utilizing the software are required. Fall.

Prerequisites: Estimating experience and/or equivalent scheduling experience. Note: Credit will not be granted for both CME 653 and CME 453.

**CME 654 Construction Project Management (3)**

Three hours of lecture/discussion per week. How to define and properly identify company organizational structures. Project delivery systems, integration of estimating, bidding, scheduling and cost control into the management process. How safety, quality control, value engineering, procurement, labor relations and insurance and bonding requirements are integral parts of a construction project. A term paper describing how the relevant topics of the course fit a specific industry application is required. Spring.

Prerequisite(s): CME 543, CME 653, or equivalent experience and permission of the instructor. Note: Credit will not be granted for both CME 654 and CME 454.

**CME 658 Construction Contracts and Specifications (3)**

Three hours of lecture/discussion per week. The types of construction contracts used in the construction industry from the Owner, Contractor, Subcontractor and Supplier viewpoints. Types of required insurance and the remedies available to contractors are presented. The process of bidding and negotiating from the legal perspective is covered along with contract administration. Specifications are introduced by type and the requirements of each type are discussed, based on current industry-accepted standards. A term paper describing how the relevant topics of the course fit a specific industry application is required. Spring.

Prerequisite: Upper division standing or permission of instructor. Note: Credit will not be granted for both CME 658 and CME 455.

**CME 663 Managing a Construction Project through Construction Planning and Scheduling (3)**

Three hours of lecture per week. Building upon planning and scheduling skills developed through undergraduate coursework and professional experience this course will examine the use of project schedules as the means to manage construction projects. The relationships between project progress, labor, materials, equipment and the project timeline will be explored. The use of the project schedule as a revenue projection, revenue measuring device will be discussed. How the schedule is used to deal with major project changes such as scope reductions, natural disaster impacts and major site accidents will also be covered. Earned value will be discussed and how the schedule can assist in its determination. Fall or Spring.

Prerequisites: CME 653 or equivalent or 3 to 5 years of professional estimating experience and permission of instructor.

**CME 664 Urban Project Management (3)**

Three hours of lecture per week. Building upon project management skills developed through undergraduate coursework and professional experience this course will look at the unique challenges of construction projects in urban settings. Topics to be addressed include but are not limited to: site logistics and their importance to a successful project, the influence of permits and codes on the project, the growing use of technology to solve urban project problems, the issues related to labor, subcontractors and suppliers in this high intensity setting. The importance of communication and project documentation will be addressed as well. Fall or Spring.

Prerequisites: CME 654 or equivalent professional experience and permission of instructor.

**CME 680 Fundamentals of Microscopy (3)**

Three hours of lecture/demonstration per week. Introduction to light microscopy, electron microscopy, atomic force, confocal, Raman, Near Field Optical, Correlative and other microscopic methods and their newest applications. Light microscopic techniques include brightfield, phase contrast, polarized light, Nomarski, Kohler illumination. Imaging and recording methods. Fall.  
Note: Credit will not be granted for both CME 480 and CME 680.

**CME 682 Transport Processes (3)**

Two hours of lecture and three hours of laboratory per week. The relationship between wood structure and wood permeability, moisture movement, and heat transfer. Fire retardant and wood-preservation treatments. Wood drying. Unsteady-state transport processes. An advanced laboratory problem with report in wood-moisture relationships, wood drying, the relationship between wood permeability and treatability, or wood preservative treatments. Spring.

Prerequisite: CME 387 or permission of instructor. Note: Credit will not be granted for both CME 682 and CME 326.

**CME 685 Transmission Electron Microscopy (2 - 5)**

Two hours of lecture/two hours of laboratory/demonstration/minimum of four to ten hours of individual laboratory per week. The theory and operation of the transmission electron microscope including specimen preparation, photographic technique and interpretation of micrographs. 2 credit course Spring or Fall. Five-credit course offered in spring semester only.

Prerequisite: Permission of instructor.

**CME 686 Wood-Water Relationships (3)**

Two hours of lecture and three hours of laboratory per week. Relationship between wood moisture content and the environment, electrical and thermal properties, theories of moisture sorption, hygroscopic swelling and shrinking, thermodynamics of moisture sorption, mechanism of moisture movement as it relates to activation theory. Laboratory exercises will complement the theoretical topics discussed in the lecture. Fall.

Prerequisite: Permission of instructor.

**CME 770 Biodegradation of Wood (3)**

Two hours of lecture and 1 hour of laboratory/demonstration/discussion per week. Biology of lignicolous fungi and other microorganisms concerning their effects on wood properties. Anatomical, biological and chemical aspects of the major types of wood decay. Spring.

Prerequisite: Introductory biology and permission of instructor.

**CME 785 Scanning Electron Microscopy (5)**

Two hours of lecture/demonstration/laboratory per week. Ten hours of independent laboratory experience per week. Theory and operation of the scanning electron microscope, including specimen preparation, digital imaging, and interpretation of micrographs. Fall.

Prerequisite: Permission of instructor.

**CME 797 Seminar (1 - 3)**

Discussion of assigned topics in the fields related to Sustainable Construction Management and Wood Science. Spring and Fall.

**CME 798 RESEARCH IN RESEARCH IN SUSTAINABLE CONSTRUCTION MANAGEMENT AND WOOD SCIENCE (1 - 12)**

Independent research topics in Sustainable Construction Management and Wood Science. Fall, Spring or Summer.

Credit hours to be arranged.

**CME 898 Professional Experience/Synthesis (1 - 6)**

A supervised, documented professional work experience in the Master of Professional Studies degree program. Fall, Spring, or Summer.

Pre- or co-requisite(s): Approval of proposed study plan by advisor, Faculty, and any sponsoring organization.

**CME 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's thesis. Fall, Spring or Summer.

Credit hours to be arranged.

**CME 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral dissertation. Fall, Spring or Summer.

Credit hours to be arranged.

**CMN - Communications****CMN 220 Public Presentation Skills (3)**

Three hours of lecture per week. Development of skills and fluency needed by environmental professionals in preparing, delivering and evaluating effectiveness of expository and persuasive oral presentations. Communication theory, rhetorical analysis, and visualizations of complex and technical data, self and peer evaluation, listening skills. Fall and Spring.

**CMN 420 Advanced Public Presentation Skills (3)**

Three hours of lecture/discussion/student presentations per week. Emphasizes both theory and practice in effectively delivering, interpreting, and responding to public presentations. Social, cultural, and political dimensions of public addresses are examined. Issues of diversity and power are discussed. Small group communication is viewed as a site for creative problem solving. Audience analysis, adaptation, strategic arrangement, and concept development are explored. Fall and Spring.

Prerequisite: Junior or senior status, or permission of instructor.

**CMN 440 Environmental Visualization (3)**

Three hours of lecture and discussion per week. The course includes an overview of graphic perception and cognition, a theoretical framework for classifying graphics, and introductions to the use and misuse of visualizations in the effective communication of environmental processes and project proposals to multiple publics. Students will compile a critical workbook of examples and develop a series of preliminary visualizations. Fall.

Prerequisite: Senior status in environmental studies communication and information option or permission of instructor.

**CMN 493 Environmental Communication Workshop (3)**

Three hours of cooperative learning activities, lecture and discussion per week. A workshop format on a specified environmental program or issue introduces the theories and skills of alternative dispute resolution approaches, public participation structures and dynamics, public policy



decision making and implementation, risk communication, leadership styles, and small group dynamics. Spring.  
Prerequisite: Senior status or permission of instructor.

## **EFB-Environmental and Forest Biology**

The Department of Environmental and Forest Biology offers a diverse array of courses at both undergraduate and graduate levels. Based on student interest, curricula can be designed to accommodate a degree of specialization in one or more subdisciplines of biology. **NOTE:** All EFB courses of 300 level and above require a minimum prerequisite of one year of general biology or equivalent. A course at an appropriate level may be taken with permission of instructor.

### **EFB 101 General Biology I: Organismal Biology and Ecology (3)**

Three hours of lecture per week. Introductory exploration of biological principles at ecosystem, population, and organismal levels. Emphasis on form, function, diversity, ecology and evolution of living organisms. Fall.  
Co-requisite: EFB 102.

### **EFB 102 General Biology I Laboratory (1)**

Three hours of laboratory per week. Major concepts of organismal biology and ecology will be reinforced with hands-on laboratory exercises and required field trips exploring the form, function, diversity, ecology, and evolution of living organisms. Fall.  
Co-requisite: EFB 101.

### **EFB 103 General Biology II: Cell Biology and Genetics (3)**

Three hours of lecture per week. Organization and function of living cells. Key topics include biological molecules, organelle structure and function, gene expression, cell division, metabolism, photosynthesis, cell signaling, genomics, and population genetics. Spring.  
Co-requisite: EFB 104.

### **EFB 104 General Biology II Laboratory (1)**

Three hours of laboratory per week. Major concepts of cell biology and genetics will be reinforced with hands-on laboratory exercises using analytical and experimental techniques such as light microscopy, chromatography, electrophoresis, enzyme assays, aseptic culture techniques, and transformation of bacterial cells. Spring.  
Co-requisite: EFB 103.

### **EFB 120 The Global Environment and the Evolution of Human Society (3)**

Three hours of lecture per week. An integrated overview of large-scale environmental issues and their relation to the development of human societies and resource-use strategies over time. Focus is on population growth and societal pressures on physical and biotic resources. Topics include energy-use issues, causes and socio-economic implications of climate change, pollution, and loss of biodiversity. Fall and Spring.

### **EFB 132 Orientation Seminar: Environmental and Forest Biology (1)**

One hour of lecture, discussion and/or exercises per week. Introduction to campus resources available to ensure academic success. Introduction to EFB as a field of inquiry. Fall.

### **EFB 200 Physics of Life (3)**

Three hours of lecture and discussion per week. Introduction to basic principles of physics from a perspective of biological function, structure and adaptation. Fall.

### **EFB 202 Ecological Monitoring and Biodiversity Assessment (3)**

Forty-five hours of lecture, laboratory and field instruction per week for three weeks. An introduction to the biodiversity of northeastern North American terrestrial, wetland, and aquatic communities with a focus on vascular plants and invertebrate and vertebrate animals. Incorporates practical field exercises designed to acquaint the student with problem solving. Summer, Cranberry Lake Biological Station.

### **EFB 210 Diversity of Life I (3)**

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on viruses, fungi and plants. Fall.  
Prerequisite(s): One year of introductory biology.

### **EFB 211 Diversity of Life II (3)**

Two hours of lecture and 3 hours of laboratory instruction per week. Introductory exploration of the diversity of life at local, regional and global scales. Hands-on laboratory exercises explore the form, function, diversity, ecology, and evolution of living organisms, focusing on microbes, protists and animals. Spring.  
Prerequisite(s): EFB 101 and 102 or equivalent year of introductory Biology. Note: Credits will not be granted for both undergraduate and graduate versions of the same course.

### **EFB 215 Interpreting Science Through Art (3)**

Three hours of lecture per week. This course examines the intersections of art and science. Major reciprocal influences in both a historical and contemporary format are treated. Fundamental methods and skills of some artistic processes, e.g., nature illustration and photography, are introduced in a context of practical applications interpreting science. Fall.  
Prerequisite: General biology.

### **EFB 217 Peoples, Plagues, and Pests (3)**

Three hours of lecture/discussion per week. Impacts of selected diseases and pests on the development and course of human civilizations. Emphasis is on the impacts of plagues and pests on non-western civilizations. Spring.

### **EFB 220 Urban Ecology (3)**

Two hours lecture/discussion, three hours of outdoor laboratory per week. Explores the city from an ecosystems perspective. Addresses the role and importance of science, engineering, the design professions, and community participation in creating livable communities. Environmental equity and justice are addressed. Fall.

**EFB 296 Special Topics in Environmental and Forest Biology (1 - 3)**

Experimental, interdisciplinary or special coursework at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall or Spring.

**EFB 301 Latin for Scientists (1)**

One hour of lecture per week. Students are taught the basic principles of Latin noun declension and verb conjugation, as well as the general principles of Latin grammar. Students are required to develop a project identifying and deriving uses of Latin in their chosen field of science, usually biology. Fall.

**EFB 303 Introductory Environmental Microbiology (4)**

Three hours of lecture and three hours of laboratory per week. An introduction to the biology of microorganisms and viruses and a study of their interactions with other microbes and macroorganisms. Fall.

**EFB 305 Indigenous Issues and the Environment (3)**

Three hours of lecture and discussion per week. Introduction to perspectives of indigenous people on environmental and natural resources management issues, including tribal forestry, fisheries, biocultural restoration, conservation strategies, climate change and treaty rights. Integrates scientific and indigenous worldviews and knowledge systems. Spring.

Note: Credit will not be granted for both EFB 305 and EFB 605.

**EFB 307 Principles of Genetics (3)**

Three hours of lecture and discussion per week. A general course covering concepts of genetics and evolution basic to upper-division biology and biochemistry courses. Includes the inheritance and analysis of Mendelian and quantitative traits, the chemical nature of the gene and its action, genetic engineering, the genetic structure of populations and their evolution. Numerical methods for characterizing and analyzing genetic data are introduced. Fall.

**EFB 308 Principles of Genetics Laboratory (1)**

Three hours of auto-tutorial laboratory per week. Experiments with plants and animals and computer simulation exercises demonstrate the basic principles of inheritance of Mendelian traits and changes in populations caused by major forces in evolution or by breeding procedures. Numerical methods for characterizing quantitative traits and for testing hypotheses are introduced. Fall.

Co-requisite: EFB 307.

**EFB 311 Principles of Evolution (3)**

Three hours of lecture or discussion per week. An introduction to the fundamental processes driving evolution (genetic drift, gene flow, mutation, sexual selection, and natural selection), the evolution of life-histories, trade-offs, and phenotypic plasticity. Macroevolutionary concepts covered include speciation, extinction, co-evolution, and the reconstruction of phylogenies. Spring.

Prerequisites: EFB 307 and EFB 320, or equivalents.

**EFB 320 General Ecology (4)**

Three hours of lecture and one three-hour field trip/laboratory per week. An introduction to plant and animal ecology, including concepts and techniques in population ecology, community dynamics, physiological and behavioral ecology, biogeography, ecosystem ecology, nutrient cycling and energy flow. Ecological management applications, human ecological impacts and problems are considered. Fall.

**EFB 325 Cell Biology (3)**

Three hours of lecture per week. Morphology and physiology of cells. Emphasis on macromolecule structure and function, cell division, gene expression, cell signaling, biochemical pathways, transport, metabolism, and motility. Spring.

Prerequisite: One year of introductory biology, one semester of organic chemistry, Genetics.

**EFB 326 Diversity of Plants (3)**

Two hours of lecture and one three-hour laboratory per week. An evolutionary survey of plants from unicellular prokaryotes to multicellular eukaryotes. Coverage includes the algae, fungi, bryophytes, lower vascular plants, ferns, gymnosperms and angiosperms. Spring.

**EFB 327 Adirondack Flora (3)**

Two hours of lecture, and eight hours of field work and discussion each day for two weeks. An integrated field and laboratory course in the identification of vascular plants and recognition of ecological characteristics of major plant species and communities of the Adirondack Mountain region. Satisfies elective field study requirement in Environmental and Forest Biology. Appropriate for upper and lower division undergraduate students seeking instruction in plant identification and ecology. Summer, Cranberry Lake Biological Station.

Prerequisite: General botany or general biology.

**EFB 334 Woody Plants in the Natural and Built Landscape (2)**

One hour of lecture, followed by three hours of field or indoor laboratory each week. Required by, and restricted to, undergraduates in the Landscape Architecture program. An introduction to the identification, site requirements, natural history, community ecology, and landscape value of native and exotic trees and shrubs for landscape planting and restoration purposes. Fall.

Prerequisite: Undergraduate standing in the Landscape Architecture program.

**EFB 335 Dendrology (2)**

One hour of lecture per week and one three-hour laboratory/field trip. Field study, identification and major characteristics of important forest trees of North America. Fall.

Prerequisite: Open only to students in the forest engineering curriculum.

**EFB 336 Dendrology (3)**

Two hours of lecture per week and one three-hour laboratory/field trip. Field study, identification, natural history and elementary silvics of important forest trees of North America. Fall.

**EFB 337 Field Ethnobotany (3)**

Two hours of lecture per week and six to eight hours of field work and discussion each day for two weeks. A field-based introduction to the identification and traditional cultural uses of plants in the Adirondack region for food, medicine and fiber. Topics include plant identification, traditional ecological knowledge and use of ecological and ethnobotanical methods. Satisfies elective field course requirement in programs offered by Department of Environmental and Forest Biology. Cranberry Lake Biological Station. Summer.

Prerequisite: EFB 226 or equivalent.

**EFB 340 Forest and Shade Tree Pathology (3)**

Two hours of lecture per week and three hours of auto-tutorial laboratory. Major diseases of forest, shade and ornamental trees; and deterioration of forest products, with emphasis on disease identification, principles of disease development, effects of disease on the host, and practical control measures. Spring.

**EFB 342 Fungal Diversity and Ecology (3)**

Two hours of lecture, and eight hours of fieldwork and discussion each day for two weeks. An integrated field and laboratory course designed to provide an introduction to the collection, identification and ecology of fungi and fungal-like organisms. Included in the course are Oomycetes (Kingdom Straminipila) and Myxomycetes (Kingdom Protista), as well as the more familiar groups of Kingdom Fungi. Satisfies field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station.

Prerequisite: General biology or general botany.

**EFB 345 Forest Health (3)**

Seven and one-half hours of lecture and 45 hours of field exercises per week for two weeks. Required in the Forest Health major, but open to others. Examines the varied ecological roles and impacts of pests and pathogens in managed and unmanaged northern forests. Students learn to collect, identify, and study forest insects and pathogens using inventory, survey, analytic methods, and independent research. Summer, Cranberry Lake Biological Station.

Prerequisites: One year of general biology, and EFB 202 or equivalents.

**EFB 351 Forest Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on insect pests of forested ecosystems. Designed for students in Environmental Biology, Forest Health and Forest Resources Management. Fall, even years.

Note: Credit will not be granted for both EFB 351 and EFB 551.

**EFB 352 Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on common insect pests of the northeastern U.S. Designed for students in Environmental Biology and Forest Health. Fall, odd years.

Note: Credit will not be granted for both EFB 352 and EFB 552.

**EFB 355 Invertebrate Zoology (4)**

Three hours of lecture and three hours of laboratory per week. Structure, function, classification and evolution of invertebrates. Emphasis on functional biology and ecological interactions. Spring.

**EFB 360 Epidemiology (3)**

Three hours of lecture/discussion per week. Introduction to the study of disease in populations and factors influencing disease occurrence. Case studies explore population measures of disease, clinical measures and causation. Emphasizes quantitative approaches, study design, ethics, intervention and implementation. Spring.

Prerequisite(s): One year of Introductory Biology, one Statistics course or equivalent by permission.

**EFB 381 Vertebrate Museum Techniques (2)**

One hour of lecture and three hours of laboratory per week. Theory and practice of vertebrate museum methods, with emphasis on the preparation and curation of vertebrate specimens. Spring.

Prerequisites: At least junior status and permission of instructor. Limited to 10 students.

**EFB 384 Field Herpetology (3)**

Two hours of lecture, and eight hours of field work and discussion each day for two weeks. An integrated field and laboratory course in the identification, natural history, ecology, and conservation of amphibians and reptiles of the Adirondack region. Satisfies field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station.

Prerequisite: General biology or general zoology.

**EFB 385 Comparative Vertebrate Anatomy (4)**

Three hours of lecture and three hours of laboratory per week. Analysis of vertebrate structure, with emphasis on comparative study of organ systems. Includes evolution of form and function, major adaptive patterns and phylogenetic relationships in vertebrates. Spring.

**EFB 388 Ecology of Adirondack Fishes (3)**

Two hours of lecture, and eight hours of fieldwork and discussion each day for two weeks. An integrated field and laboratory course in the identification of fish and recognition of ecological characteristics of major fish species and communities of Adirondack waters. Satisfies a component of the field study elective requirement in Environmental and Forest Biology. Summer, Cranberry Lake Biological Station.

Prerequisite: General zoology or general biology.

**EFB 390 Wildlife Ecology and Management (4)**

Three hours of lecture and one hour of recitation per week. A study of the ecological principles governing wild animal populations and their habitats, and the relationship of these principles to management programs and decisions. Directed primarily toward students majoring in wildlife science, conservation biology, and forest resources management. Fall.

Prerequisite or co-requisite: General ecology.

**EFB 400 Toxic Health Hazards (3)**

Three hours of lecture per week. Introduction to contemporary concepts of toxicology and to scientific basis for regulations and personal decisions about toxic health hazards. For students in natural or social sciences of environmental relevance. Topics include xenobiotic load, co-evolution of plant/animal defenses, chemical interactions, animal tests and risk assessment. Fall.

Prerequisites: General biology and general chemistry. Note: Credit will not be granted for both EFB 400 and EFB 600.

**EFB 403 Microbiological Diseases of Fish and Wildlife (1)**

One hour lecture/discussion per week. Surveys microbial diseases with pervasive effects on fish or wildlife populations and those with potential or actual impact on human populations. An individual disease will be examined in detail each week. Spring.

Prerequisites: EFB 303 or equivalent microbiology course is highly recommended.

**EFB 404 Natural History Museums and Modern Science (3)**

Two hour lecture per week and a one-week spring break field trip. This course examines the major roles of contemporary natural history museums as places of research and public education. The contributions of these institutions to science and science education through research, exhibits, collections and programs are emphasized. Participation in an organized instructional visit to natural history museums during the Spring break is required. Travel expenses to be anticipated. Spring.

Prerequisites: General biology and ecology.

**EFB 405 Literature of Natural History (2)**

One hour lecture and one hour discussion/seminar per week. This course examines key examples of the literature of natural history from the late 18th century to present. Major influences, perspectives and contexts associated with each selection are treated. Spring.

Prerequisites: General biology and ecology.

**EFB 406 Great Naturalist Seminar (1)**

One hour of seminar per week. This course examines the lives and contributions of selected, significant naturalists from the late 18th century to present. Perspectives, contexts and contemporaries of the naturalists are treated in seminar format. Basic and enriched presentation skills are practiced to encourage personal understanding and enhance professionalism. Fall.

Prerequisites: General biology and ecology.

**EFB 409 Molecular Basis of Evolution (3)**

Two hours of lecture and one hour of discussion per week. The major processes of organic evolution (e.g., mutation, natural selection, speciation and extinction) are discussed in a molecular-level context. Coverage ranges from changes to genic and nongenic regions of the genome to the evolution of entire genomes. Methods used to study molecular evolution and to reconstruct phylogenies are described and demonstrated.

Prerequisites: EFB 307, EFB 308, EFB 325. Note: Credit will not be granted for both EFB 409 and EFB 609.

**EFB 412 Introduction to Chemical Ecology (3)**

Three hours of lecture with discussion per week. Centers on chemical signals among organisms from microbes to man as they affect ecology, physiology and behavior; and as they can be utilized for agriculture, pest management and animal husbandry. Spring.

Prerequisite: Organic chemistry (one year). Note: Credit will not be granted for both EFB 412 and FCH 440.

**EFB 413 Introduction to Conservation Biology (3)**

Two hours of lecture and one hour of discussion/recitation per week. As an introduction to the discipline of conservation biology, the course seeks to demonstrate how basic biological science can be integrated with social, economic and political perspectives to achieve the goals of biological conservation. Lectures will provide students with an understanding of processes that generate and erode biological diversity.

Discussion/recitation exercises will provide students with hands-on experience and skill development in solving the sorts of complex problems typically encountered by conservation biologists. Spring.

Pre- or co-requisite(s): EFB 307, EFB 320.

**EFB 414 Senior Synthesis in Conservation Biology (3)**

Three hours of discussion/seminar per week. Students research a topic in conservation biology, then practice critical thinking and discourse by presenting seminars and participating in discussions. The focus is on integrating knowledge from previous coursework in biology, management and policy for the wise use and conservation of biological diversity. Spring.

Pre- or co-requisite: EFB 413.

**EFB 415 Ecological Biogeochemistry (3)**

Three hours of lecture and discussion per week. Investigation of the principles of biogeochemistry in ecosystems. The transformations and fluxes of elements in terrestrial and aquatic ecosystems including global cycles are emphasized. Fall.

Prerequisites: Courses in general ecology and introductory chemistry.

**EFB 416 Introduction to Environmental Interpretation (3)**

Three hours of lecture and three hours of laboratory per week. Introductions to popular activities and products of nature interpretation such as nature trails and traditional nature walks to explore and illustrate the philosophy, principles and concepts of environmental interpretation. Fall.

Prerequisite: EFB 320. Note: Credit will not be granted for both EFB 416 and EFB 616.

**EFB 417 Perspectives of Interpretive Design (3)**

Three hours of lecture and three hours of laboratory per week. Applications of environmental interpretation theory and methods to nature center programming, science education, and various fields of resource management emphasizing procedures for creating and implementing products such as slide presentations, publications, exhibits, and nature walks. Spring.

Prerequisite: EFB 320. Note: Credit will not be granted for both EFB 417 and EFB 617.

**EFB 418 Interpretation of Field Biology (5)**

This five-week residential course offers introductions to Adirondack flora and fauna in a regional context as subjects for various interpretive programs and products such as nature walks and trailside presentations, and slide presentations. The application of professional interpretive techniques and the inclusion of natural history in science education are highlights. Summer.

Prerequisite: EFB 320 or permission of instructor. Note: Credit will not be granted for both EFB 418 and EFB 618.

**EFB 419 Problem-solving in Conservation Biology (3)**

Two hours of lecture/recitation and three hours of laboratory per week. "Hands-on" experience in problem-solving, using methods and concepts related to a wide range of biodiversity conservation issues. Includes management of genetic diversity, analysis and modeling of populations, ecosystem management, and the public policy process, and of methods of information management, analysis and communication used by conservation professionals. Spring.

Prerequisite: EFB 413 or equivalent; major in Conservation Biology or permission of instructor.

**EFB 420 Internship in Environmental and Forest Biology (3 - 5)**

Full- or part-time employment or volunteer work with an agency, institution, professional group or individual involved in activities consistent with the student's educational and professional goals. The extent of internship activities shall be commensurate with the credits undertaken. A resident faculty member must serve as the student's academic sponsor. A study plan outlining the internship's educational goals must be

completed prior to its commencement. Fall and Spring.

Prerequisite: Permission of an academic sponsor from the environmental and forest biology department.

#### **EFB 423 Marine Ecology (4)**

Three hours of lecture per week, two hours of laboratory per week and one weekend field trip. Introduction to marine organisms and systems using the principles of population, community and ecosystem ecology. Hands-on demonstrations, discussions, presentations, lectures, and field trip allow study of major marine habitats (e.g., intertidal, pelagic, coral reefs, deep sea), and the increasing human impact on marine environments. Small fee charged for mandatory weekend field trip. Spring, even years.

Prerequisites: One year general biology and general ecology or equivalents. Note: Credit will not be granted for both EFB 423 and EFB 623.

#### **EFB 424 Limnology: Study of Inland Waters (3)**

Three hours of lecture per week, with some additional hands-on activities during the semester. An introduction to the geology, physics, chemistry and biology of inland waters (lotic and lentic). The course focuses on inland waters as integrated ecosystems and explores the effects of natural and anthropogenic perturbations on these systems. Fall.

Prerequisites: Senior status, introductory courses in physics and chemistry, and EFB 320, or permission of instructor. Note: Credit will not be granted for both EFB 424 and EFB 624.

#### **EFB 427 Plant Anatomy and Development (3)**

Three hours of lecture and three hours of laboratory instruction per week. This course offers a dynamic approach to the study of plant anatomy by understanding how cells, tissues and organs are formed using concepts and tools from genetics and molecular biology. Laboratory involves hands-on activities using current techniques. Fall.

Prerequisite: one year introductory biology. Note: Credit will not be granted for both EFB 427 and EFB 627.

#### **EFB 428 Mycorrhizal Ecology (3)**

Two hours of combined lecture/discussion and 3 hours of laboratory per week. Introduction to mycorrhizal symbioses, their role in plant nutrient uptake, and function in plant community dynamics. Emphasis is on important historical and current literature, and on learning methodological approaches used in mycorrhizal research. Fall, even years.

Prerequisites: General ecology or plant ecology, genetics. Note: Credit will not be granted for both EFB 428 and EFB 628.

#### **EFB 439 Forest Health Monitoring (3)**

Three hours of lecture/discussion per week on theoretical and applied aspects of forest health monitoring including concepts, data acquisition, analysis, quality assurance, interpretation and reporting. Spring.

Pre- or co-requisite(s): Courses in forest resources management, ecology, pathology and entomology.

#### **EFB 440 Mycology (3)**

Two hours of lecture and three hours of laboratory per week. Fundamentals of the morphology, taxonomy, life histories, ecology and symbiotic relationships of fungi. Fall.

Note: Credit will not be granted for both EFB 440 and EFB 640.

#### **EFB 443 Plant Virology (3)**

Two hours of lecture and three hours of laboratory per week. History of plant virology, identification and characterization of plant viruses, including transmission mechanisms, vector relationships, purification and serology. Laboratory will present techniques for the identification and characterization of plant viruses. Spring, even years.

Prerequisite: EFB 303 or permission of instructor. Note: Credit will not be granted for both EFB 443 and EFB 643.

#### **EFB 444 Biodiversity and Geography of Nature (3)**

Three hours of lecture per week. Earth history (plate tectonics, etc.), topography and geographic variation in environmental conditions influence species and communities. Major geographic patterns in biological diversity and strategies for conserving native species are presented. Fall, even years.

Prerequisite: EFB 320 or permission of instructor. Note: Credit will not be granted for both EFB 444 and EFB 644.

#### **EFB 445 Plant Ecology and Global Change (3)**

Three hours of lecture and discussion per week. Impacts of global changes in climate, biodiversity, land-use, and biogeochemical cycles on structure and function of terrestrial plant communities and ecosystems. Examined scales range from ecophysiological processes occurring in individual leaves to global patterns of primary productivity and biodiversity. Spring.

Prerequisite: EFB 320 General Ecology or equivalent. Note: Credit will not be granted for both EFB 445 and EFB 645.

#### **EFB 446 Ecology of Mosses (3)**

Two hours of lecture and one three-hour laboratory or field trip per week. A study of taxonomic diversity, ecological adaptations and the roles of bryophytes in ecosystems. Spring.

Note: Credit will not be granted for both EFB 446 and EFB 646.

#### **EFB 453 Parasitology (3)**

Two hours of lecture/discussion per week, three hours laboratory per week. Diversity, ecology, and impact of parasites of ecological, medical, and veterinary importance. Emphasis on identification, life history, control, host-parasite interactions and evolution, population patterns, and parasite communities. Spring, even years.

Prerequisite(s): One year of Introductory Biology, Ecology. Note: Credit will not be granted for both EFB 453 and EFB 653.

#### **EFB 457 Fish and Wildlife Diseases (3)**

Two hours of lecture/discussion per week, three hours laboratory per week. Impacts and diversity of disease causing agents in fish and wildlife. Causation, epidemiology, and patterns of disease. Host pathogen interactions, disease dynamics, control and management in wild species. Fall, even years.

Prerequisite(s): One year of Introductory Biology, Ecology. Note: Credit will not be granted for both EFB 457 and EFB 657.

#### **EFB 462 Animal Physiology: Environmental and Ecological (3)**

Three hours of lecture, discussion and/or exercises per week. An introduction to the physiology of adaptation to the physical and biotic environments, including animal energetics, biology of body size and physiological constraints on animal life history. Fall.

Note: Credit will not be granted for both EFB 462 and EFB 662.

**EFB 480 Principles of Animal Behavior (4)**

Three hours of lecture and one hour of recitation per week. Basic principles of animal behavior and the scientific process. Proximate and ultimate mechanisms controlling the behavior of animals including humans, with an emphasis on evolution. Spring.  
Prerequisite(s): A full year of general biology.

**EFB 482 Ornithology (4)**

Three hours of lecture and discussion, three hours of laboratory/field trip per week and additional mandatory field trips. Students become familiar with all aspects of birds: taxonomy, structure, function, ecology, population dynamics, conservation and identification. Emphasizes identification of the birds of the eastern United States by sight, and the common species by sound. Exposure to birds worldwide. Fall.  
Prerequisite: General biology and general ecology.

**EFB 483 Mammal Diversity (4)**

Three hours of classroom instruction and three hours of laboratory per week. Describes the evolutionary development, ecology and diversity of mammals world-wide and within New York State. Laboratory exercises and discussions complement lectures, providing hands-on experience in identification, adaptive morphology, and techniques in field mammalogy. Spring.  
Prerequisites: Junior standing in EFB.

**EFB 484 Mammalian Winter Ecology (3)**

Ten-day field course conducted during one weekend in February and during March break in the Adirondack Mountains of New York. The course explores ecological adaptations of mammals for surviving the winter in northern latitudes. Students are in the field daily. There is a course fee. Spring.  
Prerequisites: EFB 202, EFB 320.

**EFB 485 Herpetology (3)**

Two hours of lecture and three hours of laboratory per week. An introduction to the structure, function, ecology, behavior, development and distribution of amphibians and reptiles as they relate to the systematics of the various groups. Fall.

**EFB 486 Ichthyology (3)**

Two hours of lecture and three hours of laboratory per week. An introduction to the anatomy, physiology, ecology, behavior and taxonomy of fishes. Spring.

**EFB 487 Fisheries Science and Management (3)**

Three hours of lecture per week. Introduction to biology, ecology, quantitative assessments, conservation, and management of fish species targeted in fisheries. Includes models and empirical studies of population dynamics, life history theory, bioenergetics, population sampling, growth, mortality, production, exploitation, ecological effects, and approaches to fisheries management. A practicum (EFB 488) is optional. Fall.  
Prerequisite: Calculus and either Limnology or Ichthyology or permission of instructor. Note: Credit will not be granted for both EFB 487 and EFB 687.

**EFB 488 Fisheries Science Practicum (1)**

Three hours of laboratory per week with 2 weekend field trips. Practical experience in fisheries science, including introduction to collecting techniques, data collection, analysis, and use of models. A nominal fee is charged to defray costs on weekend trips. Designed as a complement to EFB 487. Fall, even years.  
Co-requisite: EFB 487 (may be taken in a previous year).

**EFB 491 Applied Wildlife Science (3)**

Two hours of discussion and three hours of laboratory per week, plus a field project and professional experience. Practical experience with tools used to monitor and manage wildlife populations. Designed for biology students wishing to pursue careers as wildlife biologists. Spring.  
Prerequisite: EFB 390.

**EFB 492 Senior Synthesis in Aquatic and Fisheries Science (1)**

One hour of seminar per week. Students will develop a synthesis by defining a scientific hypothesis on an aquatic topic of interest, gathering/analyzing data from the literature or elsewhere, interpreting findings, and presenting their work both orally and in a written technical report. That synthesis will relate to prior coursework and current issues in aquatic sciences. Spring.  
Prerequisite: Senior standing in the Aquatic and Fisheries Science major.

**EFB 493 Wildlife Habitats and Populations (4)**

Three hours of lecture/discussion and one three-hour laboratory per week; one Saturday field trip required. Application of ecological concepts, including succession and population biology to wildlife management planning and program assessment. Students are exposed to U.S. Fish and Wildlife Service habitat evaluation procedures and fundamentals of population modeling. Fall.  
Prerequisites: EFB 491 or permission of instructor. Note: Credit will not be granted for both EFB 493 and EFB 693.

**EFB 495 Undergraduate Experience in College Teaching (1 - 3)**

An opportunity for qualified, senior undergraduate students to gain experience in fully supervised, college-level teaching of the type they can expect to perform in graduate school. Students assist the instructor in the preparation and presentation of laboratory or recitation material in an undergraduate course. A maximum of 6 credit hours of EFB 495, and 3 credit hours relating to any single assisted course, may apply toward graduation requirements. Fall and Spring.

Prerequisites: Previous completion of the course being assisted (with a grade of B or higher), a GPA at ESF of 3.0 or higher, and permission of instructor.

**EFB 496 Topics in Environmental and Forest Biology (1 - 3)**

Experimental, interdisciplinary or special coursework in biology for undergraduate students. Subject matter and method of presentation varies from semester to semester. May be repeated for additional credit. Fall or Spring.

**EFB 497 Seminar (1)**

One hour of presentations and discussion per week. A topic in environmental and forest biology will be emphasized and its importance to contemporary issues will be addressed. Fall or Spring.

**EFB 498 Research Problems in Environmental and Forest Biology (1 - 3)**

Independent research in topics in forest biology for the superior undergraduate student. Selection of subject area determined by the student in

conference with appropriate faculty member. Tutorial conferences, discussions and critiques scheduled as necessary. Final written report required for departmental record. Fall, Spring and/or Summer.

**EFB 500 Forest Biology Field Trip (1 - 3)**

A five- to 10-day trip to: 1) agencies engaged in biological research, management and administration; or 2) regions or areas of unusual biological interest. A final report is required. Additional fees required to cover cost of travel and lodging during field portion of course. Fall or Spring.

**EFB 502 Ecology and Management of Invasive Species (3)**

Three hours of discussion/lecture per week. Explores the growing problem of invasive species as a leading threat to global biodiversity. Topics include: invasion pathways and mechanisms, community resistance, biological control, effects on ecosystems, law and policy as management tools, prediction and risk assessment, and interactions with anthropogenic environmental change. Fall.

**EFB 505 Microbial Ecology (2)**

Two hours of lecture/discussion per week. An in-depth survey of contemporary topics in microbial ecology including carbon, nitrogen and sulfur cycling, microbial degradation of recalcitrant compounds, frost control, and utilization of wood-based feedstocks as carbon sources for bioconversion to bioenergy, biofuels, and biomaterials. Spring.

Prerequisite: EFB 303 or similar microbiology course is recommended.

**EFB 513 Adirondack Forest Ecology and Management (2 - 3)**

One-week, field-based examination of sustainable forest management in the Adirondacks, framed by concepts and issues associated with plant and wildlife ecology, silviculture, and forest management. Contemporary research on central Adirondack forests is featured based on work at the Huntington Wildlife Forest. Emphasis is on experiential learning via a series of trips to, and laboratories in, the forest. Fall (late summer).

Note: Credit will not be granted for both EFB 513 and FOR 513.

**EFB 516 Ecosystems (3)**

Three hours of lecture/discussion per week. Ecosystems emphasize the integration of biological, chemical and physical aspects of the environment applied in an integrative fashion to units of landscape and water. Major topics covered include a survey of ecosystem types, energy flow, nutrient cycles and the relation of ecosystem processes to plant and animal populations. Spring.

Prerequisite: EFB 320.

**EFB 518 Systems Ecology (4)**

Three hours of lecture and three hours of laboratory/field experience per week. Survey of history, literature and techniques of systems ecology, including, especially, the teaching of intellectual, basic mathematical and computer skills that allow the student to take an environmental problem of his or her choosing and simulate it on a computer. Fall.

Prerequisite: One course in ecology. It is also recommended that the student have at least some previous or concurrent experience with computers. Weekend field trip required.

**EFB 519 Geographic Modeling (3)**

Students learn how to interface the traditional tools of ecological modeling with the new tools of Geographic Information Systems. Geographical modeling involves the simulation of natural earth systems with special consideration given to spatial position, adjacency, clustering or distribution of system variables. Students will work on a project of their own choosing, learning to write FORTRAN code to model and display system dynamics in both space and time.

**EFB 521 Principles of Interpretive Programming (3)**

Three hours of lecture and three hours of laboratory per week. This course offers principles, methods, and marketing for comprehensive interpretive programming. Creative approaches to methods for establishing effective programming featuring natural history themes are emphasized. Spring, alternate years.

Prerequisite: EFB 416/EFB 616 or EFB 417/EFB 617.

**EFB 522 Biophysical Economics (3)**

Three hours of lecture per week. Approaches economics as a biophysical rather than social science, i.e., the ecology of human-dominated ecosystems. Reviews concepts of value and economics (physiocrat, classical and neoclassical approaches), and examines an alternative model emphasizing analysis of energy and material flows and their control instead. Focus is on the developing tropics. Spring.

Prerequisite: A course in ecology and a course in economics.

**EFB 523 Tropical Ecology (3)**

One hour of lecture coupled with a period of intensive field study over spring break on a tropical island in the Caribbean. Principles of tropical ecology, resource management and island biogeography are presented. Field trips to a variety of tropical ecosystems including: rain forest, coral reefs, crater lakes and montane rain forest. Comparisons with north temperate ecosystems are made. Additional fees required to cover cost of travel and lodging during field portion of course. Requires the ability to swim. Spring.

Prerequisite: EFB 320.

**EFB 525 Limnology Practicum (2)**

Three hours of field work or laboratory analysis each week. Two additional field trips on weekends; time outside of class devoted to an independent project. Students will become proficient in standard field and laboratory analyses used in limnology; field trips to diverse local aquatic habitats; development of an independent project. Fall.

Prerequisites: EFB 424, 624 or equivalent must be taken concurrently or previously.

**EFB 526 Introduction to Plant Tissue Culture (3)**

One hour of lecture and six hours of laboratory per week designed to introduce students to the scientific and commercial uses of plant tissue culture. Spring.

Prerequisite: EFB 226.

**EFB 530 Plant Physiology (3)**

Three hours of lecture per week. Internal processes and conditions in higher plants with emphasis on physiological and biochemical concepts. For students majoring in the biological sciences. Spring.

Prerequisites: EFB 325, EFB 326. Note: EFB 531 also required for plant sciences concentration students.

**EFB 531 Plant Physiology Laboratory (2)**

Two three-hour laboratory sessions per week. An introduction to methods and procedures of physiological research. Spring.  
Pre- or co-requisite: EFB 530 or permission of instructor.

**EFB 535 Flowering Plants: Diversity, Evolution, and Systematics (3)**

Two hours of lecture and three hours of laboratory per week. Diversity, evolution, and systematics of flowering plants with special emphasis on flower structures and reproductive strategies. Flowering plant identification skills are built from examination of a broad diversity of species from major globally-distributed families with particular focus on flora of the Northeastern U.S. Fall.

Prerequisites: Courses in organismal biology and senior standing.

**EFB 542 Freshwater Wetland Ecosystems (3) (3)**

Three hours of lecture per week. An examination of the structure and function of various freshwater wetlands. Ecologic principles that broadly apply to all wetland ecosystems are examined and contrasted with terrestrial systems. The effect of management activities on, and the management potential of, wetlands are also examined. Spring.

Prerequisite: EFB 320.

**EFB 551 Forest Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Diversity, ecology and integrated management of insect pests of forested ecosystems. Additional topics include invasive species, climate change and current research topics. Intended for students in Environmental and Forest Biology and Forest Resources Management. Fall, even years.

Note: Credit will not be granted for both EFB 351 and EFB 551.

**EFB 552 Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Basic insect diversity, ecology and pest management with an emphasis on common insect pests of the northeastern United States. Additional topics include invasive species, climate change and current research topics. Intended for students in Environmental Biology and Forest Health. Fall, odd years.

Note: Credit will not be granted for both EFB 352 and EFB 552.

**EFB 554 Aquatic Entomology (3)**

Two hours of lecture, three hours of laboratory/field work per week and a weekend field trip. An introduction to the identification, life histories and ecology of aquatic insects, with emphasis on genera found in the Northeastern United States. Includes a consideration of the functional role of insects in aquatic systems, and current avenues of research. Intended for seniors and graduate students pursuing interests in entomology, fisheries and wildlife, forestry, limnology and general ecology. Fall.

Prerequisite: One course in entomology or permission of instructor.

**EFB 555 Chemical Ecology of Vertebrates (3)**

Three hours of lecture per week. A survey of chemical interactions within and among species of fish, amphibia, reptiles, birds and mammals, including humans. Signal production, sensory processes, plant-animal interactions, practical applications of chemical ecology and effects of global and local change on chemical ecology processes. Fall and Spring.

Prerequisites: One semester of organic chemistry and at least two of the following: general ecology, animal behavior, introduction to chemical ecology, and a course in vertebrate biology.

**EFB 566 Systematic Entomology (3)**

Two hours of lecture and three hours of laboratory per week. Lectures introduce the identification and classification of the important orders and families of insects, along with the concepts and practice of systematics. In laboratories students become familiar with pertinent taxonomic literature and keys, based in part on a required collection. Fall.

Prerequisite: EFB 351 or EFB 352.

**EFB 570 Insect Physiology (3)**

Two hours of lecture and three hours of laboratory per week. Study of the life processes in insects; introduction to modern physiological instrumentation and laboratory methods. Spring.

Prerequisite: EFB 325.

**EFB 600 Toxic Health Hazards (4)**

Three hours of lecture and one hour discussion/seminar per week. Introduction to contemporary concepts of toxicology and to scientific basis for regulations and personal decisions about toxic health hazards. For students in natural or social sciences of environmental relevance. Topics include xenobiotic load, co-evolution of plant/animal defenses, chemical interactions, animal tests and risk assessment. Additional reading assignments and discussions. Fall.

Prerequisites: General biology and general chemistry. Note: Credit will not be granted for both EFB 400 and EFB 600.

**EFB 601 Molecular Biology Techniques (4)**

Two hours lecture and six hours laboratory per week. Theories behind techniques in molecular biology are introduced in lecture. Laboratory includes the extraction and quantification of genomic and plasmid DNA, agarose gel electrophoresis, restriction digestion, ligation, bacterial transformation, DNA sequencing and PCR. Additional topics in molecular biology are presented by the students. Fall.

Prerequisites: EFB 307, EFB 308, EFB 325 or equivalents. Note: Credit will not be granted for both BTC 401 and EFB 601.

**EFB 605 Indigenous Issues and the Environment (3)**

Three hours of lecture and discussion per week. Introduction to perspectives of indigenous people on environmental and natural resources management issues, including tribal forestry, fisheries, biocultural restoration, conservation strategies, climate change and treaty rights. Integrates scientific and indigenous worldviews and knowledge systems. Spring.

Note: Credit will not be granted for both EFB 305 and EFB 605.

**EFB 609 Molecular Basis of Evolution (3)**

Two hours of lecture and one hour of discussion per week. The major processes of organic evolution (e.g., such as mutation, natural selection, speciation and extinction) are discussed in a molecular-level context. Coverage ranges from changes to genic and nongenic regions of the genome to the evolution of entire genomes. Methods used to study molecular evolution and to reconstruct phylogenies are described and demonstrated. Students will organize and lead class discussions.



Prerequisites: EFB 307, EFB 308, EFB 325, or similar courses in genetics and cell physiology. Note: Credit will not be granted for both EFB 409 and EFB 609.

### **EFB 610 Ecological Biogeochemistry (3)**

Three hours of lecture and discussion per week. Investigation of the principles of biogeochemistry in ecosystems. The transformations and fluxes of elements in terrestrial and aquatic ecosystems including global cycles are emphasized. Fall.

Prerequisites: Courses in general ecology and introductory chemistry.

### **EFB 611 Topics in Environmental Toxicology (3)**

Three hours of lecture, discussion or seminar per week. In-depth exploration of selected contemporary topics of environmental toxicology in areas such as toxic hazards of societal importance, pollutant monitoring and remediation, fate and ecological impacts of environmental pollutants, biological basis of toxic hazards, and ecological and human risk assessment and regulations. A major term paper and oral presentation required. Spring.

Prerequisite: EFB 400, EFB 600 or an introductory course in toxicology.

### **EFB 612 Introduction to Chemical Ecology (3)**

Three hours of lecture with discussion per week. Centers on chemical signals among organisms from microbes to man as they affect ecology, physiology and behavior; and as they can be utilized for agriculture, pest management and animal husbandry. Spring.

Note: Credit will not be granted for both EFB 612 and EFB 412/ FCH 440.

### **EFB 616 Introduction to Environmental Interpretation (3)**

Three hours of lecture and three hours of laboratory per week. Introductions to popular activities, special projects, and products of nature interpretation such as nature trails and traditional nature walks to explore and illustrate the philosophy, principles and concepts of environmental interpretation. Requires analysis of several interpretive processes and completion of a paper. Fall.

Prerequisite: EFB 320. Note: Credit will not be granted for both EFB 416 and EFB 616.

### **EFB 617 Perspectives of Interpretive Design (3)**

Three hours of lecture and three hours of laboratory per week. Applications of environmental interpretation theory and methods to nature center programming, science education, and various fields of resource management emphasizing procedures for creating and implementing products such as slide presentations, publications, exhibits and nature walks. Includes analysis and articulation of some interpretive processes. Spring.

Prerequisite: EFB 320. Note: Credit will not be granted for both EFB 417 and EFB 617.

### **EFB 618 Interpretation of Field Biology (5)**

This five-week residential course offers introductions to Adirondack flora and fauna in a regional context as subjects for various interpretive programs and products such as nature walks and trailside presentations, and slide presentations. The course provides opportunities to select and test the application of professional interpretive techniques to activities promoting natural history and science education. Summer.

Prerequisite: EFB 320 or permission of instructor. Note: Credit will not be granted for both EFB 418 and EFB 618.

### **EFB 622 Applications of Interpretation to Science Education (3)**

Weeklong residency course with an external project. This course offers practical research strategies for science educators working with their students in local environments. The course builds on forest ecology and wildlife themes as vehicles to teach the process of science. Included within the field-oriented introductions to Adirondack birds, mammals and flora, are ideas to enhance most science curricula. Applications of nature interpretation are used to energize traditional strategies by using nature trails and walks, and trail leaflets, brochures, presentations, and exhibits. Participants must implement, test and document semester-length projects with their students. Summer.

### **EFB 623 Marine Ecology (5)**

Three hours of lecture per week, two hours of laboratory/recitation per week, one hour of graduate discussion per week and one weekend field trip. Introduction to marine organisms and systems, using the principles of population, community and ecosystem ecology. Hands-on demonstrations, discussions, presentations, lectures, and field trip allow study of major marine habitats (e.g., intertidal, pelagic, coral reefs, deep sea), and the increasing human impact on marine environments. Small fee charged for mandatory weekend field trip. Synthetic review paper and short presentation to the EFB 423 class are required. Spring, even years.

Prerequisites: One year general biology and general ecology or equivalents. Note: Credit will not be granted for both EFB 423 and EFB 623.

### **EFB 624 Limnology: Study of Inland Waters (3)**

Three hours of lecture per week, with additional hands-on activities during the semester. An introduction to the geology, physics, chemistry and biology of inland waters (lotic and lentic); effects of natural and anthropogenic perturbations are explored. Students develop a case study or exercise on a limnological issue. Fall.

Prerequisites: Introductory courses in physics, chemistry, and ecology, or permission of instructor. Note: Credit will not be granted for both EFB 424 and EFB 624.

### **EFB 625 Plant Biotechnology (3)**

Two hours of lecture and three hours of laboratory per week. Transgenic plants are currently being produced to improve agriculture, pharmaceuticals, and remediate environmental problems. Students are taught the principles of gene structure and regulation, gene cloning, transformation of plant species, and current applications. Format includes lectures, discussions, student presentations, literature review, and a detailed laboratory project. Spring.

Prerequisites: EFB 307 and EFB 325 or equivalents. Note: Credit will not be granted for both BTC 425 and EFB 625.

### **EFB 626 Plant Tissue Culture Methods (3)**

Two hours of lecture and discussion and three hours of laboratory per week. Introduction to plant tissue culture for biotechnology research and as a propagation method. Emphasis will be on learning laboratory instrumentation and techniques for establishing cell cultures, producing transgenic cell lines, and regenerating whole plants. In addition to the scheduled lab exercises, an independent micropropagation or transformation project will be required. Fall.

Prerequisite: Permission of instructor. Note: Credit will not be granted for BTC 426 and FOR/EFB 626.

### **EFB 627 Plant Anatomy and Development (3)**

Three hours of lecture and three hours of laboratory instruction per week. This course offers a dynamic approach to the study of plant structure by understanding how cells, tissues and organs are formed using concepts and tools from genetics and molecular biology. Laboratory

involves hands-on activities using current techniques. Students will give oral presentation on a topic relevant to the course. Fall.  
Prerequisite: one year introductory biology. Note: Credit will not be granted for both EFB 427 and EFB 627.

**EFB 628 Mycorrhizal Ecology (3)**

Two hours of combined lecture/discussion and three hours of laboratory per week. Introduction to mycorrhizal symbioses, their role in plant nutrient uptake and function in plant community dynamics. Emphasis is on important historical and current literature, and on learning methodological approaches used in mycorrhizal research. Students will present and lead discussions on papers from the primary literature. An independent project is required. Fall, even years.

Prerequisites: General ecology or plant ecology, genetics. Note: Credit will not be granted for both EFB 428 and EFB 628.

**EFB 640 Mycology (3)**

Two hours of lecture and three hours of laboratory per week. Fundamentals of the morphology, taxonomy, life histories, ecology and symbiotic relationships of fungi. Fall.

Note: Credit will not be granted for both EFB 440 and EFB 640.

**EFB 641 Phytopathology (3)**

Two hours of lecture and discussion, and three hours of autotutorial laboratory per week. Principles and concepts of plant pathology. Major diseases of ornamental plants, vegetable crops, fruit crops, field crops and trees. This is an introductory plant pathology course for graduate students in all departments. Spring.

**EFB 643 Plant Virology (3)**

Two hours of lecture and three hours of laboratory per week. History of plant virology, identification and characterization of plant viruses, including transmission mechanisms, vector relationships, purification and serology. Laboratory will present techniques for the identification and characterization of plant viruses. Spring, even years.

Prerequisite: EFB 303 or permission of instructor. Note: Credit will not be granted for both EFB 443 and EFB 643.

**EFB 644 Biogeography (4)**

Three hours of lecture per week. Earth history (plate tectonics, etc.), topography and geographic variation in environmental conditions influence species and communities. Major geographic patterns in biological diversity and strategies for conserving native species are presented. Students design and conduct independent biogeographic study utilizing information available in the literature. Fall, even years.

Prerequisite: General ecology or permission of instructor. Note: Credit will not be granted for both EFB 444 and EFB 644.

**EFB 645 Plant Ecology and Global Change (3)**

Three hours of lecture and discussion per week. Impacts of global changes in climate, biodiversity, land-use, and biogeochemical cycles on the structure and function of terrestrial plant communities and ecosystems. Global change impacts are examined across a wide range of spatial and temporal scales, from ecophysiological processes occurring at the scale of a leaf, to global patterns of primary productivity and biodiversity. Spring.

Prerequisite: EFB 320 General Ecology or equivalent. Note: Credit will not be granted for both EFB 445 and EFB 645.

**EFB 646 Ecology of Mosses (3)**

Two hours of lecture per week and one three-hour laboratory or field trip. A study of taxonomic diversity, ecological adaptations and the roles of bryophytes in ecosystems. Spring.

Note: Credit will not be granted for both EFB 446 and EFB 646.

**EFB 650 Landscape Ecology (3)**

Two hours of lecture/discussion and three hours of laboratory experience per week. Landscape Ecology focuses on spatial patterning – its development and relevance to ecological processes. Course introduces the foundations, issues, and analytical tools in Landscape Ecology through discussion of literature, GIS exercises, and an independent research project. Fall (even years).

Prerequisites: Introductory course in Geographic Information Systems, or equivalent.

**EFB 653 Parasitology (3)**

Two hours of lecture/discussion per week, three hours laboratory per week. Diversity, ecology, and impact of parasites of ecological, medical, and veterinary importance. Emphasis on identification, life history, control, host-parasite interactions and evolution, population patterns, and parasite communities. Students write a review paper and present on a parasitic disease. Spring, even years.

Prerequisite(s): One year of Introductory Biology, Ecology. Note: Credit will not be granted for both EFB 453 and EFB 653.

**EFB 657 Fish and Wildlife Diseases (3)**

Two hours of lecture/discussion per week, three hours laboratory per week. Impacts and diversity of disease causing agents in fish and wildlife. Causation, epidemiology, and patterns of disease. Host pathogen interactions, disease dynamics, control and management in wild species. Students will coordinate and lead a group project on an emerging disease of wild animals. Fall, even years.

Prerequisite(s): One year of Introductory Biology, Ecology. Note: Credit will not be granted for both EFB 457 and EFB 657.

**EFB 662 Animal Physiology: Environmental and Ecological (3) (3)**

Three hours of lecture, discussion and exercises per week, and an independent project. An introduction to the physiology of adaptation to the physical and biotic environments, including animal energetics, biology of body size, and physiological constraints on animal life history. Fall and Spring.

Note: Credit will not be granted for both EFB 462 and EFB 662.

**EFB 681 Aquatic Ecosystem Restoration and Enhancement (2)**

One and three-quarter hours of lecture and discussion per week and three field experiences. Guiding principles for ecological restoration of freshwater aquatic ecosystems focusing on effects of nutrient loading, sedimentation, flow alteration, and habitat loss. Factors leading to loss of aquatic resources and effectiveness of techniques to restore habitat and fauna are analyzed. Student presentation of a relevant topic and field excursions to perturbed areas and recent restoration projects are required. Fall, odd years.

Prerequisites: none. Directed toward graduate students in areas involving aquatic sciences and management.

**EFB 684 Mammalian Winter Ecology (3)**

Ten-day field course conducted during one weekend in February and during March break in the Adirondack Mountains of New York. The

course explores ecological adaptations of mammals for surviving the winter in northern latitudes. Students are in the field daily. There is a course fee. Spring.

**EFB 685 Ecology of Mammals of the Adirondack Mountains (2)**

One week, field-based course with 15 hours of lecture and 45 hours of field/laboratory work. Focus on Adirondack mammals, their life histories, adaptations and habitat requirements. Emphasis on experiential learning where participants live trap, mark, and release small mammals, mist net bats, and employ radio telemetry techniques to understand the habits of mammals. Course is designed for college teachers and graduate students with teaching responsibilities. Fall (late summer).

**EFB 687 Fisheries Science and Management (3)**

Three hours of lecture per week. Introduction to the biology, ecology, quantitative assessments, conservation, and management of fish species targeted in fisheries. Includes models and empirical studies of population dynamics, life history theory, population growth, mortality, production, exploitation, and management. Critical synthesis project required. Fall.

Prerequisites: Calculus and either Limnology or Ichthyology or permission of instructor. Note: Credit will not be granted for both EFB 487 and EFB 687.

**EFB 692 Ecology and Management of Waterfowl (3)**

Three hours of lecture per week. A detailed examination of waterfowl ecology and management. The course is structured around the annual cycle, focusing on strategies of survival and reproduction; management aspects are treated throughout the course. Fall and Spring.

Prerequisite: EFB 483.

**EFB 693 Wildlife Habitats and Populations (4)**

Three hours of lecture/discussion and one three-hour laboratory per week; one Saturday field trip required. Application of ecological concepts including succession and population biology to wildlife management planning and program assessment. Students are exposed to U.S. Fish and Wildlife Service habitat evaluation procedures and fundamentals of population modeling. Fall.

Note: Credit will not be granted for both EFB 493 and EFB 693.

**EFB 733 Techniques in Plant Physiology (2 - 4)**

One hour of lecture and variable lengths of laboratory (three to nine hours) per week. Comprehensive study of techniques essential for research in plant physiology. Students may choose the instructors they wish to work with, and should consult the instructors for further details. May be repeated for credit in different specialties. Fall.

Prerequisites: EFB 531 and biochemistry with laboratory.

**EFB 796 Topics in Environmental and Forest Biology (1 - 3)**

Special instruction, conference, advanced study, and research in selected subject areas. A written report required. Check Schedule of Courses for details. Fall and Spring.

**EFB 797 Seminar in Environmental and Forest Biology (1)**

Seminar discussions of subjects of interest and importance in environmental and forest biology. Seminar offerings are available in most subdisciplinary areas. Check Schedule of Courses for details. Fall and Spring.

**EFB 798 Research Problems in Environmental and Forest Biology (1 - 12)**

Individual advanced study of selected special problems in environmental and forest biology. Offered by arrangement with individual faculty. A written report required. Fall and Spring.

**EFB 898 Professional Experience (1 - 12)**

Professional experience which applies, enriches and/or complements formal coursework. Graded on an "S/U" basis. Fall, Spring and Summer.

**EFB 899 Master's Thesis or Project Research (1 - 12)**

Investigation leading to the completion of a research-oriented thesis or to an application-oriented project. Graded on an "S/U" basis. Fall, Spring and Summer.

**EFB 999 Doctoral Thesis Research (1 - 12)**

Investigation leading to the completion of the doctoral thesis. Graded on an "S/U" basis. Fall, Spring and Summer.

**ENS - Environmental Science (Graduate)**

**ENS 519 Spatial Ecology (3)**

Two hours of classroom instruction and three hours of laboratory, field trip, workshop, or group studio per week. Geographical modeling is the simulation of natural systems in a spatial context, interfacing the traditional tools of ecological modeling with those of Geographic Information Systems. Students in this course learn the fundamentals of ecological modeling and develop a spatial model using GIS tools to address their own research questions. Spring.

Prerequisites: EFB 518 or computer programming course; GIS course. Co-requisite: GIS course (if not already completed).

**ENS 596 Special Topics in Environmental Science (1 - 3)**

Experimental or special coursework in Environmental Science for beginning graduate students, fifth year, and seniors with appropriate academic background. Subject matter and methods will vary. Fall or Spring.

**ENS 601 Water Resources Management (3)**

Three hours of lecture and discussion per week. This course provides an introduction to interdisciplinary water management. It draws upon subject matters from many areas, including water policy, planning, economics, hydrology, law, engineering and water quality. Fall.

**ENS 607 Wetland Practicum (2 - 3)**

Two hours of lecture and three hours of group learning per week. Provides students with a working knowledge of wetland management, emphasizing wetland delineation, functional assessment and mitigation with module problems with reports required for each module. Two credits for completion of two modules; three credits for completion of three modules. Fall.

**ENS 696 Special Topics in Environmental Science and Policy (1 - 3)**

Experimental and developmental courses in new areas of interest to environmental studies faculty and graduate students not covered in regularly scheduled courses. Fall and Spring.

**ENS 796 Advanced Topics in Environmental Science and Policy (1 - 3)**

Lectures and discussions, seminars, conferences and group research on advanced topics of special or current interest, in fields of interest to environmental studies faculty and graduate students. Fall and Spring.

**ENS 797 Environmental Science Seminar (1 - 3)**

Discussion of current topics and research related to environmental science. Fall and Spring.

**ENS 798 Problems in Environmental Science and Policy (1 - 12)**

Individualized, special study of environmental science and policy subjects and issues. Comprehensive oral or written report required for some problems. Fall, Spring and Summer.

**ENS 898 Professional Experience (1 - 12)**

Professional experience which applies, enriches and/or complements formal coursework. Graded on an "S/U" basis. Fall, Spring and Summer.

**ENS 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

**ENS 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

**ERE - Engineering (Environmental and Resource Engineering)****ERE 132 Orientation Seminar: Environmental Resources Engineering (1)**

One hour of lecture, discussion and/or exercises per week. Introduction to department and campus resources available to ensure academic success for Environmental Resources Engineering majors. Introduction to engineering as a design profession. Fall.

**ERE 133 Introduction to Engineering Design (3)**

Two hours of lecture and three hours of group instruction per week. An introduction to the engineering profession, including design, communication, ethical and professional behavior, teamwork and data analysis. Learning is reinforced through study, conduct and critique of design exercises related to environmental resources engineering. Spring.

**ERE 221 Engineering Mechanics Statics (3)**

Three hours of lecture per week. Forces and vectors, moments, equivalent force systems, free bodies, structures, section properties. Fall.  
Prerequisites: Integral calculus and general physics.

**ERE 222 Engineering Mechanic Dynamics (2 - 3)**

Two hours of lecture per week. Kinematics and kinetics of particles and rigid bodies; rectangular, normal and tangential, radial and transverse components; translation and rotation; force and acceleration; impulse; momentum; work and energy; impact. Spring.  
Prerequisites: Statics and Calculus II.

**ERE 223 Statics and Dynamics (4)**

Four hours of lecture per week. This course provides fundamental principles, methods and applications of engineering mechanics. Development and discussion of analytic models for rigid-body mechanics are used to apply theories. Rigid bodies of a practical nature and at rest or in motion are covered. Fall.  
Prerequisites: Algebra, derivative and integral calculus.

**ERE 275 Ecological Engineering I (3)**

Two hours of lecture and three hours of group instruction per week. Overview of ecological engineering theory and practice. Key concepts, empirical models, and case studies of ecological engineering. Living machines, treatment wetlands, bioremediation, municipal composting, agroforestry, traditional ecological knowledge, energy analysis, and ecosystem restoration. Spring.  
Prerequisites: one semester each of calculus, biology, chemistry, and ecology. Forest Engineering students only or by permission of instructor.

**ERE 296 Special Topics in Engineering (1 - 3)**

Provides experimental, interdisciplinary, or special coursework at the freshman and sophomore levels within the field of environmental resources engineering. Subject matter and course format vary from semester to semester and section to section. Fall and Spring.

**ERE 311 Ecological Engineering in the Tropics (3)**

One hour of discussion per week with intensive spring break field study in a Caribbean country. Principles of ecological engineering for ecosystem restoration and pollution control. Field trips to pristine and degraded ecosystems including: humid tropical cloud forests, coastal mangrove, dry mountain forests, and coral reefs to identify target functions for nature and society, observe degradations, and develop sustainable restoration designs. Spring.  
Prerequisite(s): one course in calculus, biology, and chemistry. Note: Credit will not be granted for both ERE 311 and ERE 511.

**ERE 335 Numerical and Computing Methods (3)**

Three hours of lecture/discussion per week. Introduction to numerical and computing methods for engineers. Writing computer code to analyze and solve engineering problems using state-of-the-art software packages. Fall.  
Prerequisite: MAT 485.

**ERE 340 Engineering Hydrology and Hydraulics (4)**

Three hours of lecture and three hours of laboratory and discussion per week. Introduction to water resources engineering. Hydraulics processes include pipe flow, open-channel flow, flows within control structures, and flow through porous media. Hydrologic processes include watershed storage and flux, rainfall-runoff models, flood routing, and stormwater design. Spring.  
Prerequisites: ERE 133, MAE 341, ERE 335, ERE 371. Co-requisite: APM 395. Note: Credit will not be granted for both ERE 340 and ERE 540.

**ERE 351 Basic Engineering Thermodynamics (3)**

Three hours of lecture per week. Principles of energy conservation and conversion: first and second laws. Relation to PVT behavior, property

functions, equilibria and heat and mass transfer, and applications to energy and power systems. Introduction to engineering problem analysis and computer methods. Spring.

Prerequisite(s): Physics, general chemistry, and calculus.

**ERE 362 Mechanics of Materials (3)**

Three hours of lecture per week. Theories of stress, deformation and stability of common structural materials subjected to various force systems. Spring.

Prerequisites: Integral calculus and statics.

**ERE 365 Principles of Remote Sensing (4)**

Three hours of lecture and three hours of laboratory and discussion per week. A qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data. Introductory concepts and methods in digital image processing and photogrammetry. Spring.

Prerequisite: ERE 371 Surveying for Engineers. Note: Credit will not be granted for both ERE 365 and ERE 565.

**ERE 371 Surveying for Engineers (4)**

Three hours of lecture and three hours of laboratory per week. The principles of plane surveying and position determination for engineers. Subject matter areas include introduction to the theory of measurement and errors, reference surfaces, coordinate systems and datums, horizontal and vertical measurements, traversing and computations, construction surveying including circular and parabolic curves, property and public land surveys, the analysis and treatment of systematic and random errors, foundations and applications of global positioning systems. Laboratory fieldwork and computations culminate in a topographic map. Fall.

Prerequisite: Calculus.

**ERE 385 Mechanical Design (3)**

Three hours of lecture per week. The principles of operation and design of mechanical systems common in engineering. Solution of equipment design using such components as springs, gears, motors and transmissions. Strength, reliability and economy are considered. Design projects are oriented to current concerns in construction, environment, and manufacturing. Spring.

Prerequisite: ERE 221; Co-requisites: ERE 222, ERE 362.

**ERE 412 River Form and Process (3)**

Three hours of lecture per week including river field sites. Field-based data collection methods for river classification. Bankfull flow estimates. Classified river form, suggested evolution sequences and governing fluvial processes. Computational river hydraulics, sediment transport, and issues of channel stability and restoration. Fall.

Prerequisites: ERE340, ERE371, APM395. Note: Credit will not be granted for both ERE 412 and ERE 612.

**ERE 430 Engineering Decision Analysis (3)**

Three hours of lecture per week. Classical engineering economics: time value of money, nominal and effective interest, and present worth, annual worth, rate of return, and benefit-cost ratio comparison techniques. Identification and evaluation of alternative investment and borrowing decisions, including the role of inflation, depreciation, taxes and uncertainty. Investment theory including the potential risks and rewards associated with investments options. Simulation and optimization techniques to aid in management decisions. Fall.

**ERE 440 Water Pollution Engineering (3)**

Three hours of lecture per week. Two laboratory exercises and one field trip. Introduction to physical, chemical and biological parameters of water and wastewater quality as well as principles of unit operations and processes for wastewater treatment and reuse. Study of design parameters and design procedures for wastewater treatment and reuse. Spring.

Prerequisites: FCH 152 General Chemistry II; EFB 101 General Biology I. Co-requisite: APM 485 Differential Equations.

**ERE 444 Hydro-Meteorology (3)**

Three hours of lecture per week. Atmospheric physics, moisture dynamics, and thermodynamics emphasizing feedback loops with precipitation. Quantitative descriptions of stability and dynamics and the development of fronts, cyclones, and thunderstorms. Weather station sensors and data-logger programming. Testing of analysis products, numerical weather models, quantitative precipitation forecasts, and radar precipitation data. Spring.

Prerequisites: Physics 1, Calculus II, permission of instructor.

**ERE 445 Hydrologic Modeling (3)**

Three hours of lecture per week. An exploration of deterministic and stochastic hydrologic models, model development, and the use of computer programming to construct, calibrate, manipulate, and interpret hydrologic models. Theoretical and analytical approaches to describing hydrologic processes, including precipitation, evapotranspiration, infiltration, surface runoff, percolation, and groundwater discharge. Stochastic techniques include frequency, trend, and regression analyses. Fall.

Prerequisite(s): Introductory computer programming, Probability and Statistics, one year of Calculus. Note: Credit will not be granted for both ERE 445 and ERE 645.

**ERE 448 Open Channel Hydraulics (3)**

Three hours of lecture per week. Advanced concepts in open channel hydraulics, including the energy and momentum principles, critical flow, uniform flow, flow profiles, and unsteady flow used suitable for engineering practice. Spring.

Prerequisite: FEG 340 or equivalent or consent of instructor. Note: Credit will not be granted for both ERE 448 and ERE 548.

**ERE 450 Environmental Hydraulics (3)**

Three hours of lecture per week. Theories of open channel flows and dynamics. Hydraulic physical and computational models. Turbulent processes, advection and dispersion components of mixing. Physical and numerical analysis of unsteady flows. Interactions of channel hydraulics with sediment and air interfaces regulating ecosystem functions. Spring.

Prerequisites: FEG133, MAE341, FEG335, FEG340, ERE371, APM 395.

**ERE 468 Solid Waste Management (3)**

Three hours of lecture and discussion per week. Introduction to solid waste regulations, social economic, environmental and technical factors. Design of solid waste management systems, including collection, recycling, composting, energy recovery, land disposal, leachate treatment, and stormwater control. Field trips. Fall.

Prerequisites: chemistry, biology, soil science, engineering hydrology.

**ERE 475 Ecological Engineering II (3)**

Three hours of lecture/seminar/discussion per week. Two field trips. Hands-on construction, operation and monitoring of ecological treatment systems. Emphasizing constructed wetlands and ponds for wastewater treatment and reuse, with minor topics selected by students. Design exercises for treatment of sewage, stormwater runoff, landfill leachate, or agricultural wastewater. Fall.  
Prerequisite: ERE 440 or equivalent.

**ERE 485 Fundamentals of Engineering Preparation (1)**

Discussion of content and administration of the Fundamentals of Engineering (FE) Exam, a comprehensive review of FE-type problems, and a targeted review of specific topics on the FE Exam. Spring.  
Prerequisite(s): Senior standing or consent of instructor.

**ERE 489 Environmental Resources Engineering Planning and Design (3)**

Two hours of lecture and three hours of laboratory per week. A capstone course to integrate engineering coursework with the engineering design process to solve interdisciplinary environmental problems. Semester-long project provides experience in problem analysis, teamwork, project management, engineering ethics, professional communication and related aspects. Spring.  
Prerequisite(s): Senior standing in Forest Engineering, ERE 340, ERE 365.

**ERE 496 Special Topics (1 - 3)**

Lectures, readings, problems and discussions. Topics in environmental or resource engineering as announced. Fall and/or Spring.

**ERE 498 Research Problem in Environmental Resources Engineering (1 - 3)**

Independent research in topics in environmental resources engineering for the highly motivated undergraduate student. Selection of subject area determined by the student in conference with appropriate faculty member. Tutorial conferences, discussions and critiques scheduled as necessary. Fall, Spring.  
Prerequisite: Permission of instructor.

**ERE 506 Hazardous Waste Management (3)**

Three hours of lecture and discussion per week. Systematic control of generation, storage, transport, treatment and disposal of hazardous waste. Applicable hazardous waste regulations. Pollutant transport mechanisms. Technology design to investigate, control emissions and remediate sites. Urban economic redevelopment impacts. Fall.  
Pre- or co-requisite(s): Chemistry and biology. Permission of instructor for seniors in good standing.

**ERE 511 Ecological Engineering in the Tropics (3)**

One hour of discussion per week with intensive spring break field study in a Caribbean country. Principles of ecological engineering for ecosystem restoration and pollution control. Field trips to pristine and degraded ecosystems including: humid tropical cloud forests, coastal mangrove, dry mountain forests, and coral reefs to identify target functions for nature and society, observe degradations, and develop sustainable restoration designs. ERE 511 students will perform the additional work of writing a 15-page research paper. Spring.  
Prerequisites: 1 course in calculus, biology, and chemistry. Note: Credit will not be granted for both FEG 311 and ERE 511.

**ERE 519 Green Entrepreneurship (3)**

Three hours of lecture/discussion per week. Explore challenges and goals of creating a start-up venture in environmental science or technology. Recognize trends in the marketplace, and where commercial opportunities can be created. Analyze feasibility and potential to create a sustainable venture. Other topic areas include critical success factors and key start-up issues unique to science and technology firms. Spring.  
Pre- or Co-requisites: FOR 207 Introduction to Economics or equivalent; or permission of instructor.

**ERE 527 Stormwater Management (3)**

Three hours of lecture per week. One Saturday field trip. Techniques for urban stormwater and erosion control and analysis of associated water quality impacts. Review of applicable regulations and design standards. Students will engage in individual and team-oriented activities such as lecture, discussion, observation, computation, reading and writing. In addition, students are required to participate in a Saturday field trip where examples of stormwater management facilities will be reviewed. Students will, in small teams, generate a design for a stormwater management alternative at a local site. Fall.  
Prerequisite: FEG 340 or equivalent as determined by instructor.

**ERE 530 Numerical and Computing Methods (3)**

Three hours of lecture/discussion per week. Programming skills and computing techniques using state-of-the-art software packages. Applications of programming and computing methods for solving geospatial, ecological, and/or water resource engineering problems. Fall.  
Prerequisite(s): Differential Equations.

**ERE 534 Transport Phenomena (3)**

Three hours of lecture per week. Principles of heat and mass transfer as applied to the bioprocess industries. Topics include conduction, convective heat and mass transfer, diffusion of both steady-state and transient situations, analogies for heat and mass transfer, boundary layers, porous media transport, heat and mass transfer analysis. Discussion of specific bioprocess examples. Spring.  
Note: Credit will not be granted for both BPE 335 and ERE 534.

**ERE 540 Engineering Hydrology and Hydraulics (3)**

Three hours of lecture and discussion per week. Introduction to water resources engineering. Hydraulics processes include pipe flow, open-channel flow, flows within control structures, and flow through porous media. Hydrologic processes include watershed storage and flux, rainfall-runoff models, flood routing, and stormwater design. Spring.  
Prerequisites: FEG 133, MAE 341, FEG 335, ERE 371, or equivalent. Co-requisite: APM 395 or equivalent. Note: Credit will not be granted for both ERE540 and FEG340.

**ERE 548 Open Channel Hydraulics (3)**

Three hours of lecture per week. Advanced concepts in open channel hydraulics, including the energy and momentum principles, critical flow, uniform flow, flow profiles, and unsteady flow used suitable for engineering practice. Spring.  
Pre-requisites: ERE 340 or permission of instructor. Note: Credit will not be granted for both ERE 448 and ERE 548.

**ERE 551 GIS for Engineers (3)**

Two hours of lecture and three hours of laboratory per week. Introduction to fundamental concepts in geographic information systems (GISs) with a focus on engineering applications. Fundamental concepts and development of geographic information systems including models and georeferencing systems used to represent and characterize spatial data. Data processing including collection and preprocessing, data management, spatial analysis and manipulation, and data output. Necessity and utility of spatial data in engineering design analysis. Fall. Prerequisite: Calculus. Co-requisite: ERE 371 or equivalent.

**ERE 553 Introduction to Spatial Information (1)**

Three hours of lecture per week for the first third of the semester. An introduction to spatial terminology and methods for determining and expressing position. Examination of accuracy and precision in the context of horizontal measurements. Issues with subsequent use of measurements for producing maps and performing analysis. Fall.

**ERE 561 Engineering Thermodynamics (3)**

Three hours of lecture per week. Principles of classical thermo-dynamics applied to engineering practice. First and second laws; heat effects; property functions and their correlation; physical and chemical equilibrium; solutions and mixtures; equations of state. Compressible flow. Electrolyte solutions. Thermodynamic analysis of processes and systems via case studies and computer simulation. Compressible flow and/or thermodynamics of electrolyte solutions. Spring.

Prerequisites: Physics and Calculus. Note: Credit will not be granted for both PSE 361 and ERE 561.

**ERE 565 Principles of Remote Sensing (4)**

Three hours of lecture and three hours of laboratory and discussion per week. A qualitative and quantitative introduction to the fundamentals of acquiring, analyzing and utilizing remote sensing data. Introductory concepts and methods in digital image processing and photogrammetry. Spring.

Prerequisite: ERE 371 Surveying for Engineers or permission of instructor. Note: Credit will not be granted for both FEG 365 and ERE 565.

**ERE 566 Introduction to Global Positioning Systems (1)**

Three hours of lecture per week for the last third of the semester. An introduction to the theory and practice of performing global positioning system (GPS) measurements. Comparison of accuracy potential for different GPS equipment and techniques. Exploration of error sources that reduce the accuracy of GPS measurements. Collection of GPS data. Fall.

**ERE 596 Special Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Topics in environmental and resource engineering not covered in established courses. Designed for the beginning graduate student or selected upper-division undergraduate. Fall and/or Spring.

**ERE 612 River Form and Process (3)**

Three hours of lecture per week including river field sites. Field-based data collection methods for river classification. Bankfull flow estimates. Classified river form, suggested evolution sequences and governing fluvial processes. Computational river hydraulics, sediment transport, and issues of channel stability and restoration. Fall.

Prerequisites: Engineering Hydrology and Hydraulics, Engineering Probability and Statistics. Note: Credit will not be granted for both FEG 412 and ERE 612.

**ERE 621 Spatial Analysis (3)**

Three hours of lecture and discussion per week. Spatial statistics and modeling as applied to various data formats: single point data, continuous data and area data. First and second order effects, complete spatial randomness, tessellation, kernel, covariograms and variograms, kriging, distance measures, correlation/correlogram. Spring.

Prerequisite(s): APM391, FEG335 or permission of instructor.

**ERE 622 Digital Image Analysis (3)**

Three hours of lecture and discussion per week. Elements of digital image processing and analysis systems: Digital image representation, visual perception, sampling and quantization, pixel connectivity, Fourier transforms, image enhancement, filtering, image segmentation, edge detection, thresholding, representation schemes, descriptors, morphology, recognition and interpretation. Spring.

Prerequisite(s): APM391, FEG335 or permission of instructor.

**ERE 641 Biomass Energy (3)**

Three hours of lecture per week. Historical, current and future uses of biomass as a source of renewable energy for the production of bioenergy, biofuels and bioproducts. Characteristics of biomass, their conversion to different forms of energy and end products and an assessment of their sustainability. Spring.

Prerequisite: ESC 525, ESC 535 or permission of instructor; one semester of freshman chemistry or permission of instructor. Note: Credit will not be granted for both BPE 441 and ERE 641.

**ERE 643 Water Pollution Engineering (3)**

Three hours of lecture per week. Two laboratory exercises, one field trip and group project. Introduction to physical, chemical and biological parameters of water and wastewater quality as well as principles of unit operations and processes for wastewater treatment and reuse. Study of the design parameters and design procedures for wastewater treatment and reuse. Spring.

Prerequisite(s): General Chemistry, microbiology. Co-requisite: Differential equations. Note: Credit will not be granted for both ERE 440 and ERE 643.

**ERE 644 Hydro-Meteorology (3)**

Three hours of lecture per week. Atmospheric physics, moisture dynamics, and thermodynamics emphasizing feedback loops with precipitation. Quantitative descriptions of stability and dynamics and the development of fronts, cyclones, and thunderstorms. Weather station sensors and data-logger programming. Testing of analysis products, numerical weather models, quantitative precipitation forecasts, and radar precipitation data. Spring. Prerequisites: Physics, Calculus II, permission of instructor

Prerequisites: Physics, Calculus II, permission of instructor.

**ERE 645 Hydrologic Modeling (3)**

Three hours of lecture per week. An exploration of deterministic and stochastic hydrologic models, model development, and the use of computer programming to construct, calibrate, manipulate, and interpret hydrologic models. Theoretical and analytical approaches to describing hydrologic processes, including precipitation, evapotranspiration, infiltration, surface runoff, percolation, and groundwater

discharge. Stochastic techniques include frequency, trend, and regression analyses. Fall.

Prerequisite(s): Introductory computer programming, Probability and Statistics, 1 year of Calculus. Note: Credit will not be granted for both ERE 445 and ERE 645.

**ERE 650 Environmental Hydraulics (3)**

Three hours of lecture per week. Theories of open channel flows and dynamics. Hydraulic physical and computational models. Turbulent processes, advection and dispersion components of mixing. Physical and numerical analysis of unsteady flows. Interactions of channel hydraulics with sediment and air interfaces regulating ecosystem functions. Spring.

Prerequisites: FEG133, MAE341, FEG335, FEG340, ERE371, APM 395, or equivalent.

**ERE 667 Process Control (3)**

Three hours of lecture per week. Presents an introduction to the principles of process control. Linear analysis, Laplace transforms, and nonlinear simulation are presented and applied to feedback, and feedforward control. Examples of process simulation, accuracy and stability of control are drawn from paper industry processes. Process identification using numerical techniques and MATLAB. Fall.

Prerequisite: Differential Equations. Note: Credit will not be granted for both PSE 477 and ERE 667.

**ERE 674 Methods in Ecological Treatment Analysis (3)**

Two hours of lecture/seminar/discussion and three hours of lab per week. Introduction to the components and design principles of engineered ecosystems for water quality improvement. Common lab exercises for a comprehensive analysis of an engineered ecosystem, including water quality, reaction kinetics, hydraulic characteristics, vegetation, soil and gravel, and microbial community. Discussion on experimental procedures and data analysis. Spring.

**ERE 675 Ecological Engineering for Waste Management (3)**

Three hours of lecture/seminar/discussion per week. Hands-on construction, operation and monitoring of engineered ecosystems for waste management. Emphasizing constructed wetlands and ponds for wastewater treatment and reuse, with minor topics selected by students.

Design exercises for treatment of sewage, stormwater runoff, landfill leachate, or agricultural wastewater. Fall.

Prerequisite(s): ERE 440/643 or equivalent.

**ERE 692 Remote Sensing of the Environment (3)**

Three hours of lecture/discussion per week. Understanding of various remote sensing systems, their applications, and advanced digital image processing techniques. Analysis of satellite and airborne-acquired remote sensing data. Spring.

Prerequisite(s): FEG 365 or equivalent introduction to remote sensing.

**ERE 693 GIS-Based Modeling (3)**

Three hours of lecture/discussion per week. Geographical, temporal, environmental modeling concepts using GIS-based modeling languages and techniques. Various modeling concepts and techniques including spatial interpolation, suitability/capability modeling, hydrologic modeling, diffusion modeling, calibration, optimization, accessibility modeling, and rainfall-runoff modeling. Fall.

Prerequisite(s): ERE 551 or equivalent.

**ERE 796 Advanced Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Advanced topics in forest engineering, paper science and engineering, and wood products engineering. Fall and/or Spring.

Prerequisite: Permission of instructor.

**ERE 797 Research Methods in Environmental Resources Engineering (1 - 3)**

One to three hours of discussion/seminar per week. Introduction to research facilities, opportunities, and responsibilities of graduate scholarship. Discussion of ERE research topics, including journal reading, proposal formulation, funding, and engineering tools. Use of scholarly resources including e-journals, web, proposal development, and presentations. Fall and Spring.

**ERE 798 Research in Environmental and Resource Engineering (1 - 12)**

Independent research topics in Environmental Resources Engineering. Fall, Spring or Summer.

Credit hours to be arranged.

**ERE 898 Professional Experience/Synthesis (1 - 6)**

A supervised, documented professional work experience in the Master of Professional Studies degree program. Fall, Spring or Summer.

Prerequisite: Approval of proposed study plan by advisor, Department, and any sponsoring organization.

**ERE 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

**ERE 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

**ESC - Environmental Science**

**ESC 132 Orientation Seminar (1)**

One hour of lecture or discussion each week. Introduction to campus facilities, personnel, lower-division curriculum and upper-division study options within the Environmental Science program. Fall.

**ESC 200 Climate Change Science and Sustainability (1)**

Climate Change Science and Sustainability is an introduction to climate science, the evidence of modern climate change, and an evaluation of some of the proposed solutions. The course integrates NASA and other web-based climate change media and products with outside readings. NASA's spatial and temporal climate change resources are the basis for most learning activities, which will enable students to continue their exploration of personal and societal climate change solutions.

**ESC 296 Special Topics in Environmental Science (1 - 3)**

One to three hours of class meetings per week. Special topics of current interest to lower-division undergraduate students in environmental science. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring.

Prerequisite: Permission of instructor.



**ESC 325 Energy Systems (3)**

Three hours of lecture per week. An interdisciplinary overview of human-dominated energy systems. Topics include traditional extractive approaches, sustainable energy systems, energy return on investment, thermodynamics, energy flow analysis, resource supply, utilization rates, and environmental issues. Students are introduced to the multiple disciplines required to evolve more sustainable systems. A full-day field trip. Fall.

Prerequisites: EFB 120, FCH 150, and PHY 211. Note: Credit will not be granted for both ESC 325 and ESC 525.

**ESC 335 Renewable Energy (3)**

Three hours of lecture/discussion per week providing an overview of the role of renewable energy in the context of energy supply. Sustainable sources of heat, power and fuels will be covered and compared in terms of economic and environmental impacts. A one-day field trip of renewable projects is required. Spring.

Prerequisite: ESC 325. Note: Credit will not be granted for both ESC 335 and ESC 535.

**ESC 422 Energy Markets and Regulation (3)**

Three hours of lecture/discussion per week concerning markets and regulation of energy. Topics include: the economics of energy markets, industry restructuring, and the development of markets for energy efficiency and renewable power. The role and impacts of energy regulation on markets will also be examined. Fall.

Prerequisite: ESC 325. Note: Credit will not be granted for both ESC 422 and ESC 622.

**ESC 450 Renewable Energy Capstone Planning (1)**

One-hour group meeting every two weeks. This course will afford the student an opportunity to select a topic, in conjunction with the instructor, for detailed investigation in Capstone II. Each student will work individually with the instructor to arrive at a feasible project. Fall.

Prerequisites: ESC 325 and ESC 335. Co-requisite: ESC 422.

**ESC 460 Renewable Energy Capstone Planning (2)**

One half-hour meeting per week. Students will synthesize information from courses in the Renewable Energy minor by performing research and preparing a scientific report on topics related to renewable energy and energy. The research will consist of literature review/analysis, modeling, fieldwork or laboratory research. Spring.

Prerequisite: ESC 450.

**ESC 494 Capstone Seminar (1)**

One hour of lecture/discussion per week. Support and instruction for completion and presentation of the senior synthesis project for Environmental Science. Topics include research skills and literature review, data analysis, scientific writing including editing, and oral presentation. Research or internship must be nearly or fully completed.

**ESC 498 Research Problems in Environmental Science (1 - 5)**

Independent research in topics in environmental science for undergraduate students. Selection of subject area determined by the student in conjunction with an appropriate faculty member. Tutorial conferences, discussions and critiques scheduled as necessary. Final written report required for departmental record. Fall, Spring and/or Summer.

Prerequisite(s): Consent of instructor.

**ESC 525 Energy Systems (3)**

Three hours of lecture per week. An interdisciplinary overview of human-dominated energy systems. Topics include traditional extractive approaches, sustainable energy systems, energy return on investment, thermodynamics, energy flow analysis, resource supply, utilization rates, and environmental issues. Students are introduced to the multiple disciplines to evolve more sustainable systems. A full-day field trip. Fall.

Prerequisites: EFB 120, FCH 150, PHY 211 or equivalent or permission of instructor. Note: Credit will not be granted for both ESC 325 and ESC 525.

**ESC 535 Renewable Energy (3)**

Three hours of lecture/discussion per week providing an overview of the role of renewable energy in the context of energy supply. Sustainable sources of heat, power and fuels will be covered and compared in terms of economic and environmental impacts. A one-day field trip of renewable projects is required. Spring.

Prerequisite: ESC 325 or equivalent. Note: Credit will not be granted for both ESC 335 and ESC 535.

**ESC 622 Energy Markets and Regulation (3)**

Three hours of lecture/discussion per week concerning markets and regulation of energy. Topics include: the economics of energy markets, industry restructuring, and the development of markets for energy efficiency and renewable power. The role and impacts of energy regulation on markets will also be examined. Fall.

Prerequisites: ESC 325 or equivalent or permission of instructor. Note: Credit will not be granted for both ESC 422 and ESC 622.

**ESF - College-Wide****ESF 109 Honors Seminar in Environmental Science and Forestry (1)**

One hour of lecture/discussion per week. Sequential presentations by ESF faculty and staff members. Exploration of science, engineering, design, management and social science applied to regional, national and global issues. A written report and presentation is required. Fall.

Prerequisite: Admission to the lower division Honors Program.

**ESF 200 Information Literacy (1)**

Three hours of lecture/discussion per week for five weeks. Introductory course for students of all levels and all curricula to the basic research process for information retrieval and management. Emphasis on electronic bibliographic and Internet research tools. Fall and Spring.

**ESF 209 Honors Seminar in Environmental Science and Forestry (1)**

One hour of presentation and discussion per week. Sequential presentations by students, or faculty, or both. Exploration of science, engineering, design, management and/or social science applied to regional, national and global environmental issues. A presentation and/or a written report may be required. Fall.

Prerequisite: Admission to the lower division Honors Program.

**ESF 300 Introduction to Geospatial Information Technologies (3)**

Two hours of lecture and three hours of laboratory per week. A theoretical and practical course providing an introduction to the uses and limitations of geospatial information technologies, including geographic information systems (GIS), global positioning systems (GPS) and remote sensing, for environmental science and natural resources management applications. Fall and Spring.

**ESF 309 Honors Exploration Seminar (1)**

One hour of group discussion or seminar per week for seven weeks and two additional, individual meetings. Selection and refinement of honors thesis project topic, development of project plan and start of research. Fall and Spring.

Prerequisite: Admission to the ESF Upper Division Honors Program.

**ESF 332 Seminar for New Transfer Students (0)**

One hour of weekly lectures and discussions per week designed to introduce the transfer student to the College and its academic and social environs. Fall and Spring.

**ESF 499 Honors Thesis/Project (1 - 5)**

Guided independent study in a topic related to the student's undergraduate major, resulting in a thesis/project. Students will give an honors presentation of their work. Fall and Spring.

**ESF 503 Seminar on University Outreach and Public Service (1 - 3)**

One- to three-credit seminar examines processes and strategies designed to enhance the scholarship and practice of university-based outreach and public service with an emphasis on relationships with K-12 schools and community organizations. Spring.

**ESF 797 Graduate Seminar on Information Resources (1)**

One hour of lecture/discussion per week. Searching for and evaluating information resources. Using citation management software. Preparing to write the research proposal and write and defend subsequent thesis/dissertation. Student presentations on information tools, thesis/dissertation research topics, formation of problem statement. Spring.

**EST - Environmental Studies****EST 132 Introduction to Environmental Studies (3)**

Three hours of lecture, discussion and analytical activities per week. Gateway course for EST majors. Introduction to the study of environmental problems in the social sciences and humanities. Topics: pollution, conservation, preservation, human health, ecosystem health, limits to growth, sustainability, ecosystems, population, energy, risk and traditional knowledge. Fall.

**EST 140 Introduction to Native Peoples, Lands & Cultures (3)**

Three hours of lecture/discussion per week. Introductory survey of the history, geography, economy, and culture of Native Americans from prehistory to present, with special attention to the Great Lakes region/upstate New York and environmental topics. Draws on texts, films, guest speakers, and other resources. Spring.

**EST 200 Cultural Ecology (3)**

Three hours of lecture/discussion/oral presentations per week. Students develop skills and fluency in preparing, delivering and evaluating multicultural and traditional environmental management and decision-making. Emphasis is on situations encountered in the environmental professions. Case studies pose ethical questions, which challenge students to apply theory and analysis to each case. Topics also include interactions of culture and environment, relationship between traditional and scientific knowledge and co-management as multicultural decision making. Self-evaluation and peer evaluations are emphasized. Fall or Spring.

**EST 201 US History Reconstruction to the Present (3)**

Three hours of lecture/discussion per week. History of changes occurring in America post 1865 including land use, government, economic and international relations. Spring.

**EST 220 Urban Ecology (3)**

Two hours lecture/discussion, three hours of outdoor laboratory per week. Explores the city from an ecosystems perspective. Addresses the role and importance of science, engineering, the design professions, and community participation in creating livable communities. Environmental equity and justice are addressed. Fall.

**EST 221 Introduction to American Government (3)**

Three contact hours per week. Describes American political system and its roles and functions in society. Examines how political processes change over time, including the role of rhetoric and argumentation in policy development. Explores critical analysis of political phenomena. Fall.

**EST 230 China Experience (3)**

Forty five hours (equivalent) of lecture and field studies. General survey of the history of China from ancient societies through the current time, with attention to cultural, ecological and natural resource issues focused on selected localities of China. The locality and/or hot spots will be selected from: the invention of paper; printing technology; renewable energy; anaerobic digestion of manual / plant biomass; wastewater treatment; Great Walls; Forbidden City; Three Gorges area; Canals; Chinese gardens; Sichuan; Dujiangyang Irrigation Dam/Channels; Panda preservation; Hakka culture; Tibetan culture; plants and vegetation, etc. Analysis of the evolution of the Chinese culture. Historical and contemporary influences of China. Spring, Fall or Summer.

**EST 231 Environmental Geology (3)**

Three hours of lecture and discussion per week. Environmental Geology is an applied field of study that uses geological information to assist in resolving human conflicts related to land use issues, environmental damage, and resource use. Topics include natural resources, energy, environmental pollution, waste disposal, geological hazards and climate change. Spring.

**EST 245 Nature and Popular Culture (3)**

Three hours of lecture and discussion per week. An interdisciplinary exploration of the meanings of nature expressed in North American popular culture and of the implications of those meanings for environmental affairs. The expression of dominant 20th century Western ideologies of humanism and consumerism through such phenomena as advertising, nature shows, tourism, theme parks, zoos, rodeos, feature films, weather reports, lawns and the World Wide Web are identified using a mix of cultural studies and philosophy. Fall.

**EST 296 Special Topics in Environmental Studies (1 - 3)**

Experimental, interdisciplinary or special coursework at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall or Spring.

**EST 301 Leadership through Mentoring (1)**

Biweekly meetings with instructors and with first-year student groups. Advanced leadership training for students in the ESF Peer Mentoring Program. Use of online resources to augment person-to-person interactions and group meetings. Fall.

Prerequisites: Upper division class standing, participation in the Peer Review Mentoring Program, and successful completion of Orientation Leader training.

**EST 321 Government and the Environment (3)**

Three contact hours per week. Examines the relationship between government and the environment, primarily in the U.S. Introduces environmental policy, including the policy making process. Reviews legal framework and current issues in several thematic areas (e.g., air, water, hazardous waste, and endangered species protection). Spring

**EST 353 Environmental Psychology (3)**

Three hours of lecture per week. Overview of theory, research, and methods in environmental psychology and sustainable behavior. Explores the role of human behavior as a root cause of environmental degradation and examines the contribution of individual and societal processes. The cognitive-behavioral perspective is emphasized in understanding these issues. Fall, odd years.

Prerequisites: Introductory psychology; junior status or permission of instructor.

**EST 361 History of the American Environmental Movement (3)**

Three hours of lecture and discussion per week. The historic and cultural origins and evolution of this complex, multifaceted social phenomenon called the environmental movement and its influence on public policies, values and lifestyles. The events, personages, philosophies and historical/cultural processes that marked and continue to drive various, competing attitudes toward nature, even within the United States environmental movement. Fall.

**EST 366 Attitudes, Values and the Environment (3)**

Three hours of lecture per week. Historical roots of environmental attitudes, values, and ethics with special emphasis on how individual attitudes impact environmental issues. Perspectives on man's relationship and responsibility to nature. Value implications of ecological principles and concepts. Examples of current environmental issues are examined in this context. Fall, even years.

Prerequisites: Junior status or permission of instructor.

**EST 388 Psychological Principles of Risk Communication (3)**

Three hours of lecture and discussion per week. Presents socio-psychological principles and theoretical underpinnings guiding the applied social science approach to environmental risk communication issues. Three overlapping themes will be considered and linked: how communities cope with environmental hazards, how risk information is cognitively processed and evaluated and how risk communication influences perception, evaluation and behavior. Spring, even years.

Prerequisite: Upper-division status.

**EST 390 Social Processes and the Environment (3)**

Three hours of lecture/discussion per week. Explores alternative ways of explaining the relationship between social processes and environmental conditions. Analyzes classical and modern social theories and applies their insights to questions of human-environment interaction. Introduces qualitative social science research methods and the social construction of environmental meaning. Fall or Spring.

**EST 393 Environmental Discourse and Communication (3)**

Three hours of lecture and discussion per week. Considers the role of communication and political discourse in shaping perceptions of nature and environmental issues/problems. Explores a variety of interpersonal, group, organizational and mass communication theories and a wide range of environmental discourses using examples of written, visual, broadcast, and electronic communication. Spring.

Prerequisite: Junior standing, and either EST 245 or permission of instructor.

**EST 400 Senior Paper (3)**

Individual study of an environmental topic resulting in a formal report that meets the requirements for an environmental studies synthesis experience. These requirements are identified in course meetings. Enrollment is restricted to environmental studies seniors. Fall and Spring.

**EST 426 Community Planning and Sustainability (3)**

Three hours of lecture and demonstration per week. Presents ecological planning and development concepts and theory guiding local and global initiatives for sustainable development. Overlapping themes are considered and linked: the relationship between landscape patterns reflecting wealth, poverty and environmental quality; the role of efficiency in reducing environmental impacts; and the questions of environmental equality, and the quality of development. Fall.

**EST 427 Environmental and Energy Auditing (3)**

Three hours of lecture, demonstration, and discussion per week. Presents environmental and energy auditing concepts and theory guiding local and regional initiatives for greenhouse gas production and energy use reduction. This course utilizes a practicum approach through use of inventory and analysis tools by student teams for project application. Spring.

Note: Credit will not be granted for both EST 427 and EST 627.

**EST 450 Sustainable Enterprise (3)**

Three hours of classroom/presentation per week. Economic, social, and environmental dimensions of sustainability and their interdependence. Influences on organizations to adopt sustainable approaches to operations and activities. Tools to validate organizational sustainability. Transdisciplinary emphasis. Fall.

Note: This course is cross-listed at SU School of Management as LPP/SHR 450.

**EST 460 Land Use Law (3)**

Three hours of lecture and discussion per week. This course provides an understanding of U.S., state and local laws affecting land use in New York in the context of current environmental policy debates. Students learn to recognize and analyze legal issues involving land use in varying contexts. Spring.

Prerequisites: EST 221 or permission of the instructor. Note: Credit will not be granted for both EST 460 and EST 660.

**EST 494 Senior Seminar in Environmental Studies (1)**

Two-hour seminar every two weeks. For all seniors in Environmental Studies. Students will prepare portfolios and give capstone presentations on their senior synthesis project and develop career goals and plans. Spring.

Prerequisites: Limited to graduating seniors in the Department of Environmental Studies.

**EST 495 Selected Readings in Environmental Studies (1 - 3)**

An in-depth and independent exploration of selected readings from the environmentally related literature. Emphasis is placed on gaining insights and understanding from the readings, rather than producing an extensive bibliography. Fall, Spring and Summer.

Prerequisite: Approval of study plan by instructor.

**EST 496 Special Topics in Environmental Studies (1 - 3)**

Special topics of current interest to undergraduate students in environmental studies and related fields. A detailed course subject description will be presented as the topic area is identified and developed. Fall, Spring and Summer.

Prerequisite: Permission of instructor.

**EST 498 Introductory Research Problems (1 - 3)**

Guided individual study of an environmental topic. Emphasis is on the study procedure and the methods employed. Enrollment is possible at various times during the semester. Fall, Spring and Summer.

Prerequisite: Approval of study plan by instructor.

**EST 499 Environmental Studies Internship (1 - 12)**

Internships provide students with a supervised field experience to apply and extend their academic abilities in a professional working environment. Enrollment is possible at various times during the semester. Fall, Spring and Summer.

Prerequisites: Environmental Studies senior status and written approval of an internship contract by major professor, curriculum director and field supervisor.

**EST 550 Environmental Impact Analysis (3)**

Three hours of lecture per week. The law, administration and natural/social science basis of the environmental impact assessment process in the federal government and New York state. Spring.

Prerequisite: Graduate matriculation or permission of instructor.

**EST 600 Foundations of Environmental Studies (3)**

Three hours of lecture/discussion per week. Examines frameworks for understanding and solving environmental problems. Familiarizes students with the epistemological foundations of environment-society relations. Considers multiple methodological and analytical strategies. Uses a case study method to exemplify key principles. Fall.

Prerequisites: Undergraduate courses in general ecology, environmental science and policy or communication theory.

**EST 603 Research Methods and Design (3)**

Three hours of lecture/discussion per week. Comprehensive survey of research methods and design for Environmental Studies. Topics covered include the scientific method; research design; quantitative, qualitative, and mixed research methods; sampling; data collection techniques; data analysis and interpretation; research ethics; and research proposal development. Fall.

**EST 604 Social Survey Research Methods for Environmental Issues (3)**

Three hours of lecture and discussion per week. Provides a critical overview of survey methods used to study human dimension of environmental problems. Explores fundamental theories, techniques, and applications of environmentally related social survey research processes. Design of original survey research and critical assessment of existing research. Spring, odd years.

Prerequisite: Undergraduate basic statistics course.

**EST 605 Qualitative Methods (3)**

Three hours of lecture and discussion per week. Survey of the generally recognized paradigms and methods that qualitative researchers use to better understand, evaluate, and perhaps influence complex social phenomenon. Research proposal, pilot study, final report and oral presentation required. Spring, even years.

**EST 606 Environmental Risk Perception: Implications for Communication and Policy (3)**

Three hours of lecture and discussion per week. Concepts, problems and research related to the assessment and management of environmental hazards in our society. Current psychological, sociological and cultural theories in risk perception, communication, and policy. Emphasis on the interplay between science, politics, law, values and public opinion. Fall.

Prerequisites: Coursework in psychology, sociology or policy recommended.

**EST 608 Environmental Advocacy Campaigns and Conflict Resolution (3)**

Three hours of lecture and discussion per week. Addresses complex dynamics, strategies, and tactics of 1) organized campaigns by grassroots to international organizations to advocate for particular environmental policy and 2) processes that seek to resolve, manage, or prevent environmental conflicts when appropriate. Readings, simulations, projects, and case study analysis. Fall.

**EST 609 Collaborative Governance Processes for Environmental and Natural Resource Management (3)**

Three hours of lecture and discussion per week. Introduces the evolution of innovative multistakeholder processes that characterize collaborative governance (CG). Distinguishes CG from traditional public involvement and dispute resolution approaches, and explores its challenges and opportunities. Provides knowledge and introductory tools to design and be more productive participants in collaborative processes. Spring, odd years.

**EST 612 Environmental Policy and Governance (3)**

Three hours of lecture and discussion per week. Examination of the dynamic relationships present in the creation and implementation of environmental policies. Considers the roles of the state, the private sector, and nongovernmental organizations. Explores background and implications of recent trends in environmental management. Spring.

**EST 625 Wetland Management Policy (3)**

Three hours of lecture and discussion per week. International, national, and local wetland management and conservation issues. Application of methods of policy research, critical evaluation and design of wetland management issues including delineation, functional evaluation, wetland

banking, and property rights issues. Research paper required. Fall, odd years.  
Prerequisite: EFB 542 or equivalent.

**EST 626 Concepts and Principles of Sustainable Development (3)**

Three hours of lecture and discussion per week. Presents ecological and development concepts and theory guiding local and global initiatives for sustainable development. Four overlapping themes are considered and linked: the relationship between patterns of wealth, poverty and environmental quality; the role of efficiency in reducing environmental impacts; the theme of frugality and sufficiency in advancing development; the questions of environmental equality, and the quality of development. Fall or Spring.

**EST 627 Environmental and Energy Auditing (3)**

Three hours of lecture, demonstration, and discussion per week. Presents environmental and energy auditing concepts and theory guiding local and regional initiatives for greenhouse gas production and energy use reduction. This course utilizes a practicum approach through use of inventory and analysis tools by student teams for project application. Spring.

Note: Credit will not be granted for both EST 427 and EST 627.

**EST 628 Great Lakes Policy and Management (3)**

Three hours of lecture and discussion per week. Provides a comprehensive understanding of environmental policy and management in the Great Lakes. Emphasizes how scientific knowledge of conditions in the Great Lakes is used by policy makers in the Canadian and U.S. federal governments and the states and provinces. Intended both for policy- and science-oriented students. Spring, even years.

**EST 635 Public Participation and Decision Making: Theory and Application (3)**

Three hours of discussion, presentation and exercises per week. Provides a student with fundamental theories and techniques for developing and applying citizen participation strategies and conflict resolution as they relate to environmental science and planning decision making. Spring.

**EST 640 Environmental Thought and Ethics (3)**

Three hours of discussion per week. Critical interdisciplinary introduction to philosophical, religious, cultural and historical dimensions of environmental affairs. How ecologically significant cultural assumptions, ideologies, representations, and institutionalized practices contribute to human meanings and relationships to other-than-human-nature. Special attention to the role of language and questions of environmental ethics and ontology. Spring.

**EST 645 Mass Media and Environmental Affairs (3)**

Three hours of discussion per week. Introduces the mass media's role in environmental affairs. Relationships between media organizations, technology, content, and audiences frame examination of how nature and environmental issues and problems are engaged by the media and with what consequences. News and current affairs, advertising and entertainment genres are considered. Fall.

**EST 650 Environmental Perception and Human Behavior (3)**

Three hours of lecture and discussion per week. Application of environmental perception and human behavior paradigms and theories in understanding the causes and potential solution strategies to environmental issues. Interdisciplinary approach utilizes concepts, theories and research from disciplines including environmental psychology, sociology, anthropology, and risk perception to understand the myriad influences on human behavior as it relates to environmental impacts. Spring.

**EST 660 Land Use Law (3)**

Three hours of lecture and discussion per week. This course provides an understanding of U.S., state and local laws affecting land use in New York, in the context of current environmental policy debates. Students learn to recognize and analyze legal issues involving land use in varying contexts. Spring.

**EST 695 Environmental Journalism (3)**

Three hours of lecture per week. This course covers a range of topics related to journalism: interviewing, writing the lead, style, writing and organizing the story, layout, editing and revising, writing features and follow-up stories, covering speeches, etc. In addition, students explore how the media covers scientific and environmental issues. Students work on writing skills--from basic editing techniques to more sophisticated areas of style. Spring.

**EST 696 Special Topics in Environmental Studies (1 - 3)**

One to three hours of lecture and discussion per week. Experimental and developmental courses in new areas of interest to environmental studies faculty and graduate students not covered in regularly scheduled courses. Fall and Spring.

**EST 702 Environmental and Natural Resource Program Evaluation (3)**

Three hours of lecture and discussion per week. The systematic analysis of public environmental programs with an emphasis on the evaluation of resultant environmental outcomes. Topics include evaluation contexts, objective setting, environmental monitoring, and analysis of agency organization and procedures. Spring.

**EST 796 Advanced Topics in Environmental Studies (1 - 3)**

One to three hours of classroom instruction per week. Lectures and discussions, seminars, conferences and group research on advanced topics of special or current interest to environmental studies faculty and graduate students. Fall and Spring.

**EST 797 Environmental Studies Seminar (1 - 3)**

One to three hours of classroom instruction/discussion per week. Discussion of current topics and research related to environmental studies. Fall and Spring.

**EST 798 Problems in Environmental Studies (1 - 3)**

One to three hours of supervised individual activity per week. Individualized, special study of environmental studies subjects and issues. Comprehensive oral or written report required for some problems. Fall, Spring and Summer.

**EST 898 Professional Experience (1 - 12)**

Variable number of hours of professional experience per week. Professional experience which applies, enriches and/or complements formal coursework. Graded on an "S/U" basis. Fall, Spring, and Summer.

**EST 899 Master's Thesis Research (1 - 12)**

One to 12 hours of supervised individual activity per week. Research and independent study for the master's degree and thesis. Fall, Spring, and Summer.

**EWP - Environmental Writing Program****EWP 190 Writing and the Environment (3)**

Three hours of lecture, discussion, and workshops per week. Introduction to academic writing, reading, and research, reflecting college-level literacy skills of analysis, argument, and critical thinking. The course includes frequent informal writing assignments and three formal writing projects requiring revision. An oral presentation is required. Fall.

**EWP 220 Public Presentation Skills (3)**

Three hours of lecture per week. Development of skills and fluency needed by environmental professionals in preparing, delivering and evaluating effectiveness of expository and persuasive oral presentations. Communication theory, rhetorical analysis, and visualizations of complex and technical data, self and peer evaluation, listening skills. Fall and Spring.

**EWP 290 Writing, Humanities, and the Environment (3)**

Three hours of lecture, discussion, and workshops per week. Students will critically examine the rhetoric of nature and the environment and the literary expectations of their disciplines. Students will engage in a sustained research project involving writing and graphics. Frequent informal and formal writing assignments, research and documentation, and an oral presentation are required. Spring.

**EWP 291 Writing, Humanities, and the Environment (Honors) (3)**

Three hours of discussion and lecture per week. Focusing on food politics, this course builds on critical reading and writing skills developed in EWP 190. Students complete a 20-hour service project with a community food organization, while researching and writing about food politics and their community service experience. Spring.

Prerequisite(s): EWP 190 or equivalent.

**EWP 296 Special Topics in Writing, Literature, and Public Presentation Skills (1 - 3)**

Experimental, interdisciplinary or special course work at the freshman or sophomore levels. Subject matter and course format vary from semester to semester or offering on the basis of needs and objectives of the course. Fall or Spring.

**EWP 300 Survey of Environmental Writing (3)**

Three hours of classroom instruction per week. Students will explore forms of environmental writing including but not limited to journalism, poetry, memoir, field notes, historical research, natural histories and polemics. Students will analyze these writings rhetorically and create a range of texts including creative pieces, factually-based reporting, nature writing, and writing about science. Fall.

Prerequisites: EWP 190 and EWP 290.

**EWP 311 Urban Environmental Literature (3)**

Three hours of discussion and lecture per week. Development of reading, writing, and critical thinking skills that illustrate the flora, fauna, geology, and climate that shape urban life. Evaluation and discussion of poetry and prose by contemporary authors who use urban nature as their subjects. Spring.

Prerequisite: Upper division status or permission of instructor.

**EWP 390 Literature of Nature (3)**

Three hours of discussion and lecture per week. Examination of views of nature and the environment as seen through works of 19th and 20th century writers, poets, and essayists. Readings, discussions, and written assignments explore aesthetics, socio-political climate, and prevailing attitudes toward the environment that formed the backdrop for readings. Fall and Spring.

**EWP 405 Writing for Science Professionals (3)**

Three hours of lecture, discussion, and workshops per week. Principles and practice of writing skills required of science professionals. Develop proficiency in determining the purpose of a document; analyzing audience; selecting, developing and organizing information in an appropriate design; and writing clearly, precisely and effectively. Writing assignments done weekly; rewriting is routinely required. Fall and Spring.

Prerequisite: EWP 290 and junior or senior status, or permission of instructor.

**EWP 410 Writing for Environmental Professionals (3)**

Three hours of lecture, discussion, and workshops per week. Includes principles and practices of writing and communication skills relevant to environmental professionals. Emphasizes proficiency in analyzing audience and purpose; selecting, developing and organizing information in an appropriate design; and writing clearly, precisely and effectively. Fall and Spring.

Prerequisite: EWP 290 and junior or senior status, or permission of instructor.

**EWP 420 Advanced Public Presentation Skills (3)**

Three hours of lecture/discussion/student presentations per week. Emphasizes both theory and practice in effectively delivering, interpreting, and responding to public presentations. Social, cultural, and political dimensions of public addresses are examined. Issues of diversity and power are discussed. Small group communication is viewed as a site for creative problem solving. Audience analysis, adaptation, strategic arrangement, and concept development are explored. Fall and Spring.

Prerequisite: Junior or senior status, or permission of instructor.

**EWP 490 Contemporary Literature of Nature (3)**

Three hours of discussion and lecture per week. This writing-intensive literature course takes an ecocritical approach to nature literature, both poetry and prose, written by contemporary authors. Coverage includes ecofeminism, science literature, and native American literature. Spring.

**EWP 494 Creative Non-fiction in the Sciences (3)**

Three hours of classroom instruction per week. Students in the course will read and write creative nonfiction, a genre that reflects a harmonious movement among subjective experience, factual research, and public interest in science and the environment. The course focuses on the writing processes and techniques used to write ideas, theories, and experiences to a lay audience. Spring.

Prerequisite: EWP 190. Note: Credit will not be granted for both EWP 494 and EWP 694.

**EWP 495 Environmental Journalism (3)**

Three hours of lecture per week. This course covers a range of topics related to journalism: interviewing, writing the lead, style, writing and organizing the story, layout, editing and revising, writing features and follow-up stories, covering speeches, etc. In addition, students explore how the media covers scientific and environmental issues. Students work on writing skills--from basic editing techniques to more sophisticated areas of style. Spring.

**EWP 496 Special Topics in Writing, Literature, and Public Presentation Skills (1 - 3)**

Special topics of current interest to undergraduate students in writing, literature, and public presentation skills. A detailed course description will be presented as the topics area is identified and developed. Fall and Spring.

**EWP 498 Independent Study in Writing, Literature and Public Presentation Skills (1 - 3)**

Guided individual study of a topic in composition, literature and public presentation skills. Enrollment is possible at various times during the semester. Fall and Spring.

**EWP 620 Public Presentation Skills for Environmental Professionals (3)**

Three hours of lecture per week. Development of skills and fluency needed by environmental professionals in preparing, delivering and evaluating effectiveness of expository and persuasive oral presentations. Communication theory, rhetorical analysis, and visualizations of complex and technical data, self and peer evaluation, listening skills. Fall/Spring.

**EWP 694 Creative Non-fiction in the Sciences (3)**

Three hours of classroom instruction per week. Students in the course will read and write creative nonfiction, a genre that reflects a harmonious movement among subjective experience, factual research, and public interest in science and the environment. The course focuses on the writing processes and techniques used to write ideas, theories, and experiences to a lay audience. Spring.

Note: Credit will not be granted for both EWP 494 and EWP 694.

**FCH - Chemistry****FCH 132 Orientation Seminar: Chemistry (1)**

One hour of lecture and discussion per week. Introduction to campus resources available to ensure academic success. Introduction to chemistry as a field of inquiry. Introduction to laboratory safety. Fall.

**FCH 150 General Chemistry I (3)**

Three hours of lecture per week. This first semester general chemistry course is organized around the physical and chemical properties of matter. It introduces the atomic structure of elements, the kinds of bonds in chemical compounds, how atomic ratios in molecules from the basis for the stoichiometry of reactions, begins a treatment of thermodynamics and discusses the principles of chemical reactivity. Fall. Prerequisite(s): APM 104 (may be taken concurrently) or equivalent (ex. Precalculus).

**FCH 151 General Chemistry Laboratory I (1)**

Three hours of laboratory per week. Basic laboratory techniques will be emphasized through experiments dealing with the density of solids and liquids, atomic ratios and mass combining ratios, atomic structure and the periodic table, calorimetry, chemical reactivity, geometric structure of molecules, formation of coordination compounds, and paper chromatography. Fall. Prerequisite: FCH 150.

**FCH 152 General Chemistry II (3)**

Three hours of lecture. The second course in general chemistry continues the development of chemical reactivity by focusing on chemical kinetics and chemical equilibrium. Aqueous phase processes are emphasized and are applied to precipitation and solubility equilibria, acid/base dissociation phenomena, and fundamental electrochemical reactions. Spring. Prerequisite: FCH 150 and APM 104 (or equivalent (minimum Precalculus)).

**FCH 153 General Chemistry Laboratory II (1)**

Three hours of laboratory per week. Concepts of chemical kinetics and equilibrium processes will be reinforced through experiments in titrimetric analyses, determinations of  $K_a$  and  $K_{sp}$  values, investigation of rate constants and reaction orders, buffer preparations, oxidation/reduction reactions and qualitative analyses. Spring. Prerequisites: FCH 150, FCH 151. Co-requisite: FCH 152.

**FCH 210 Elements of Organic Chemistry (4)**

Three hours of lecture and four hours of laboratory per week including pre-laboratory instruction. Nomenclature, preparation, and important reactions of functional groups and classes of organic compounds including examples relevant to biology. Isomerism and stereochemistry topics of biomolecules. Quantitative study of weak acids and weak bases. Lab techniques include compound manipulations, extractions, distillations, chromatography, synthesis, and calculation of yields. Spring. Prerequisite: One year of General Chemistry.

**FCH 221 Organic Chemistry I\* (3)**

Three hours of lecture per week. The structure, properties and fundamental reactivity of organic compounds will be studied with emphasis on the reaction mechanisms and stereochemistry. In combination with FCH 223, this course provides a full survey of common classes of carbon compounds. Fall. Prerequisite: FCH 150, FCH 151, FCH 152, FCH 153. \*This course description was added to the on-line catalog on October 21, 2009.

**FCH 222 Organic Chemistry Laboratory I (1)**

Four hours of laboratory including pre-laboratory instruction per week. Laboratory safety. Melting and boiling points, distillation, recrystallization, thin-layer and column chromatography, isolation of natural products, organic synthesis and spectroscopy. Fall. Co-requisite: FCH 221.

**FCH 223 Organic Chemistry II (3)**

Three hours of lecture per week. The structure, properties and fundamental reactivity of organic compounds will be studied with emphasis on the reaction mechanisms and stereochemistry. In combination with FCH 221, this course provides a full survey of common classes of carbon

compounds. Spring.  
Prerequisite: FCH 221.

#### **FCH 224 Organic Chemistry Laboratory II (1)**

Four hours of laboratory including pre-laboratory instruction per week. Continuation of FCH 222. Simple physical and instrumental techniques applied to organic chemistry. Gas chromatography, polarimetry, spectroscopy. Introduction to classical literature synthesis. Topics from natural products chemistry including chemical ecology, biomimetic synthesis, and the synthesis of an anticancer drug from birch bark. Spring.  
Prerequisite: FCH 222. Co-requisite: FCH 223.

#### **FCH 290 Chemistry Teaching Assistant Experience for Undergraduates (1 - 3)**

Undergraduate students will gain experience with the management, evaluation and assessment of undergraduate courses in chemistry. Assistants will assist the instructor with course activities and mentor students on how to succeed in the respective course. Teaching Assistant responsibilities vary by section and instructor. Fall and Spring.  
Prerequisite(s): Consent of Instructor.

#### **FCH 325 Organic Chemistry III (4)**

Two hours of lecture, one six-hour laboratory per week. Classical and recent literature synthesis of organic compounds, employing advanced techniques. Fall.  
Prerequisite: Two semesters of elementary organic chemistry.

#### **FCH 360 Physical Chemistry I (3)**

Three hours of lecture per week. An introduction to the properties of gases and liquids, the laws of thermodynamics, phase, phase transitions, solutions and colligative properties, and reaction equilibria. Fall.  
Prerequisite(s): MAT 295 and 296, and PHY 211 and 212, or their equivalents.

#### **FCH 361 Physical Chemistry II (3)**

Three hours of lecture per week. Includes discussion on electrochemistry, principles of quantum mechanics, statistical mechanics, chemical kinetics, and basic spectroscopy. Spring.  
Prerequisite: FCH 360.

#### **FCH 380 Analytical Chemistry I: Gravimetric, Titrimetric and Potentiometric Analysis (3)**

Two hours of lecture and one three-hour laboratory per week. Equilibrium concepts and practical implementations of precipitation, complexation, acid-base and oxidation-reduction processes in quantitative chemical analysis. Fall.  
Prerequisites: Two years of undergraduate chemistry and FCH 360 taken concurrently or permission of instructor.

#### **FCH 381 Analytical Chemistry II: Spectroscopic, Chromatographic and Electroanalytical Instrumental Technique (3)**

Two hours of lecture and one three-hour laboratory per week. Theory and practice of technology applications to UV/VIS, AAS, AES, XES, ASV, GLC and HPLC. Spring.  
Prerequisites: Two years of undergraduate chemistry and FCH 361, FCH 380 taken concurrently or permission of instructor.

#### **FCH 384 Spectrometric Identification of Organic Compounds (1 - 2)**

Two hours of lecture and discussion per week. The first-half semester (1 credit) will deal with common classes of organic compounds; the second-half semester (1 credit) will deal with more complex structures. The use of complementary information from mass, infrared, nuclear magnetic resonance and ultraviolet spectrometry will be applied to identification of organic natural products. Spring.  
Prerequisites: Organic chemistry; one semester of advanced organic chemistry for second credit.

#### **FCH 390 Drugs from the Wild (3)**

Three hours of lecture and discussion per week. This course is designed to give students a comprehensive understanding of the variety of medicinal agents available from natural sources. Economic and societal aspects will be explored as well as scientific ones. In addition to curative agents, discussions will include toxic substances, folk medicinal (including herbal) preparations, and the so-called "recreational drugs." Fall, odd years.  
Prerequisites: Introductory courses in chemistry and biology.

#### **FCH 399 Introduction to Atmospheric Sciences (3)**

Three hours of lecture and discussions per week. Atmospheric composition, mass and structure; solar radiation and the global energy budget; atmospheric moisture budget, cloud and precipitation; photolysis, gas-phase oxidation, aqueous chemistry, and gas-to-particle conversion; physical and chemical mechanisms driving environment phenomena such as acid rain, the greenhouse effect, the ozone hole, remote and urban air pollution, and haze.  
Prerequisite(s): General physics I, 1 year each of general chemistry and calculus. Co-requisite(s): General physics II.

#### **FCH 410 Inorganic Chemistry (3)**

Three hours of lecture per week. An introduction to the bonding, structure and reactivity of transition metals and main group elements. Topics will include but are not limited to covalent molecular structures, coordination chemistry, organometallic chemistry, catalysis, bioinorganic chemistry and solid state materials. Spring, even years.  
Prerequisite: One year of general chemistry, one year of organic chemistry.

#### **FCH 440 Introduction to Chemical Ecology (3)**

Three hours of lecture with discussion per week. Centers on chemical signals among organisms from microbes to man as they affect ecology, physiology and behavior; and as they can be utilized for agriculture, pest management and animal husbandry. Spring.  
Prerequisites: Biology (one year), and organic chemistry (one year). Note: Credit will not be granted for both FCH 440 and EFB 412.

#### **FCH 495 Introduction to Professional Chemistry (1)**

The professional chemist's relationship with industry, government and universities. Employment opportunities for the chemist, professional organizations and unions will be discussed. The selection of a senior research topic and a literature survey will be required. Fall.  
Prerequisite: Senior status.

#### **FCH 496 Special Problems in Chemistry (1 - 3)**

An opportunity for a special problem, technique development, independent or unstructured study in an area related to the chemical profession. The work may be technical, professional, or interdisciplinary. Advisors outside this department may be solicited. A brief proposal must be



presented for approval with specific arrangements outlined including faculty advisor and objectives of the study. A written report will be expected. Fall and Spring.

Prerequisite: Upper-division status.

**FCH 497 Undergraduate Seminar (1)**

One hour per week. Literature surveys and seminars on topics of current research interest and recent advances in chemistry. Spring.

**FCH 498 Introduction to Research (5)**

Eighteen hours of laboratory, library search and report writing. Solution of a selected research problem using special laboratory techniques. A written report on data, procedures, results and conclusions. Fall and Spring.

**FCH 510 Environmental Chemistry I (3)**

Three hours of lecture per week. Introduction to the processes that control chemical behavior in aquatic environments, including precipitation, gas exchange, acid-base, redox, complexation and adsorption reactions. Emphasis will be on explanation and prediction of chemical behavior, using computer models where appropriate. Examples will be from the areas of water and wastewater treatment, pollutant fates and geo-chemistry. Spring.

Prerequisites: An introductory course in physical chemistry is required and a short course in computer programming is recommended.

**FCH 511 Environmental Chemistry II (3)**

Three hours of lecture per week. Includes a detailed chemical explanation of current topics of concern in environmental chemistry and the chemistry of pollution. Lectures will cover topics relating to air, soil and biota pollutional impact. Fall.

Prerequisite: Chemistry through physical chemistry or permission of instructor.

**FCH 515 Methods of Environmental Chemical Analysis (3)**

One hour of lecture and six hours of laboratory per week. An introduction to sampling, analytical and quality control procedures necessary to obtain reliable water quality data. All analyses will be performed on a single aquatic system with the purpose of developing a final report characterizing the water quality of that system. Fall.

Prerequisite: A course in quantitative chemical analysis.

**FCH 524 Topics in Natural Products Chemistry (3)**

Three hours of lecture and discussion per week. A course intended to introduce the student to various types of secondary metabolites including several of past and current interest because of their pronounced biological activities. Modes of chemical reactivity and means of structure determination and syntheses are covered. Spring.

**FCH 530 Biochemistry I (3)**

Three hours of lecture per week. General biochemistry with emphasis on cellular constituents and metabolic reactions. The chemical, physical and biological properties of amino acids, proteins, carbohydrates and their intermediary metabolism will be discussed. The chemistry of enzymes, energy transfers and biological oxidations will also be covered. Fall.

Prerequisite: One year of organic chemistry.

**FCH 531 Biochemistry Laboratory (3)**

One hour lecture and six hours of laboratory per week on the basic techniques used in biochemical research with an emphasis on proteins and enzymes. Techniques include spectrometry, chromatography, electrophoresis, amino acid analysis, coupled assays, and the isolation and characterization of enzymes. Fall.

Prerequisite: One semester of quantitative analysis with laboratory. Co-requisite: FCH 530 with permission of instructor.

**FCH 532 Biochemistry II (3)**

Three hours of lecture per week. Topics discussed are biosynthesis and degradation of amino acids and nucleic acids, protein biosynthesis, and an introduction to molecular biology. Spring.

Prerequisites: FCH 530 and its pre- and co-requisites.

**FCH 540 Carbohydrates I: Structure, Reactions and Analysis (2)**

Two hours of lecture/discussion per week on the structure, reactions, and analysis of carbohydrates and polysaccharides. Introduction to carbohydrate structure and nomenclature. Overview of important oligosaccharides and major classes of polysaccharides. Reactions of carbohydrates-derivatization, polymerization, degradation. Analysis of carbohydrate molecules' sequence and linkages size, shape, distribution of functional groups. Fall.

Prerequisite: One year of introductory organic chemistry, or permission of instructor.

**FCH 550 Polymer Science: Synthesis and Mechanisms (3)**

Three hours of lecture per week. Introduction to the synthesis of polymers and the mechanism of polymerization processes. Addition homopolymerization and copolymerization by radical, ionic, and coordination type catalysts. Synthesis of block and graft copolymers. Stepwise polymerization, network formation and gelation. Structure of polymers and stereoregular polymerization. Degradation of polymers, reactions on polymers, polyelectrolytes. Three hours of lecture. Spring.

Prerequisites: One year of organic chemistry and one year of physical chemistry.

**FCH 551 Polymer Techniques (3)**

Two hours of lecture/discussion and four hours of laboratory per week; laboratory reports, final exam. Twelve experiments covering the main topics of polymer synthesis (four weeks), molecular weight determination (four weeks), and characterization (four weeks) are selected from areas such as the following: free-radical solution, bulk and emulsion polymerizations; ionic and condensation polymerizations, copolymerization and reactivity ratio determination; osmometry, viscometry, light scattering, gel permeation chromatography, polarized light microscopy, X-ray diffraction, differential scanning calorimetry, thermogravimetric analysis, dynamic mechanical analysis, stress-strain analysis; nuclear magnetic resonance spectroscopy, Fourier transform infrared spectroscopy, ultraviolet/visible spectroscopy. The lecture component will include discussions of the laboratory activities as well as related topics such as the preparation of monomers, safe handling methods for monomers, polymers, solvents, catalysts, etc. Fall.

Prerequisites: One year of organic and one year of physical chemistry, or permission of instructor. Co-registration in FCH 552 is recommended.

**FCH 552 Polymer Science: Properties and Technology (3)**

Three hours of lecture per week. Introduction to physical chemistry, physics, processing and technology of synthetic polymers. Polymer

solutions, including molecular weight determinations and chain statistics. Polymer solid states, including rubber elasticity, visco-elasticity, the glassy state and the crystalline state. Properties, processing, and technology of films, fibers, elastomers, and foams. Fall.  
Prerequisites: One year of organic chemistry and one year of physical chemistry.

#### **FCH 560 Chromatography and Related Separation Sciences (3)**

Three hours of lecture and discussion per week. A course designed to give the student a thorough understanding of analytical and isolation chemistry by modern chromatographic, distributive and molecular sieving techniques. The chemistry of the systems discussed will be stressed as well as the important physical aspects. Spring.

Prerequisites: Two semesters each of organic and general chemistry.

#### **FCH 571 Wood Chemistry I: General Wood Chemistry (2)**

Two hours of lecture per week. Introduction to carbohydrate chemistry. Chemistry of cellulose, hemicelluloses, and lignin. Cellulose derivatives. Distribution of polysaccharides and lignin in wood. Wood extractives. Chemistry of bark. Formation of heartwood. Wood as a chemical raw material. Fall.

Prerequisite: One or two semesters of a three-credit undergraduate course in organic chemistry.

#### **FCH 630 Plant Biochemistry (3)**

Three hours of lecture and discussion per week. Includes the biochemistry of photosynthetic electron transport and phosphorylation, photosynthetic carbon fixation, photorespiration, nitrogen fixation, nitrate reduction, photochrome, and plant hormones. The economic, ecological and environmental aspects of plant biochemistry will also be discussed. Spring.

Prerequisites: FCH 530, FCH 532.

#### **FCH 650 Statistical Physics and Chemistry of Macromolecules (3)**

Three hours of lecture per week. Topics to be discussed are chain statistics, polymer thermodynamics, scaling theory, colloidal particles, viscoelasticity and the glass transition. Spring, even years.

Prerequisites: FCH 360 and FCH 552 or equivalent; consent of instructor.

#### **FCH 796 Special Topics in Chemistry (1 - 3)**

Lectures, conferences and discussion. Advanced topics in physical chemistry, organic chemistry or biochemistry. Fall and Spring.

#### **FCH 797 Graduate Seminar (1)**

Presentation and discussion of a selected topic in chemistry. Topics to be selected by participating faculty each semester. Fall and Spring.

#### **FCH 798 Research in Chemistry (1 - 12)**

Independent research in physical and organic chemistry of synthetic polymers, physical and organic chemistry of natural polymers, organic chemistry of natural products, ecological chemistry and biochemistry. One written report required. Fall, Spring and Summer.

#### **FCH 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's degree and thesis. Fall, Spring and Summer.

#### **FCH 997 Seminar (1)**

Seminars scheduled weekly; an average of 20 to 30 seminars are given annually. Discussion of recent advances in chemistry. Credit is given only once to a student. Fall and Spring.

#### **FCH 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral degree and dissertation. Fall, Spring and Summer.

### **FOR - Forestry (Resource Management)**

#### **FOR 106 Introduction to Green Entrepreneurship (3)**

One-week short-course. An introduction to the challenges and goals of creating a start-up venture in environmental science or technology. Recognize marketplace trends and creating commercial opportunities. Analyze feasibility and potential to create a sustainable venture. Topics include critical success factors and key start-up issues unique to science and technology. Summer.

Prerequisite(s): Completed 11th grade.

#### **FOR 132 Orientation Seminar: F&NRM (1)**

Thirteen hours of lecture and six hours of field time. An introduction to forest and natural resource management and related career paths. Indoor and outdoor lectures expand student awareness of ESF's educational opportunities, properties, and faculty in FNRM. Fall.

#### **FOR 201 Introduction to Watershed Hydrology (2)**

One hour of online lecture per week. Introductory survey of the distribution of water throughout the atmosphere, biosphere, and the physical earth. Topics include major storages and flows of water including precipitation, evaporation, runoff, urban stormwater, and soil storage, as well as water budgets and watershed management. Spring, fall, summer.

#### **FOR 202 Introduction to Sociology (3)**

Three hours of lecture per week. General introductory principles and methods of sociology including group dynamics and development, different structural arrangement of social groups, community development and adjustment processes, relationships with the natural environment. Fall and Spring.

#### **FOR 203 Western Civilization and the Environment (3)**

Three hours of lecture per week. General survey of the history of Western civilization from ancient societies through the seventeenth century, with attention to environmental and natural resource issues and perspectives. Analysis of the rise of the West. Historic and contemporary influences of the Western tradition. Fall and Spring.

#### **FOR 204 Natural Resources in American History (3)**

Three hours of lecture/discussion per week. Introductory survey of American history from colonization through the twentieth century, with attention to natural resources use, allocation, and management. Environmental history and introduction to historiography. Fall and Spring.

#### **FOR 207 Introduction to Economics (3)**

Three hours of lecture per week. Coverage of basic theory in microeconomics and macroeconomics. Application of theory and economic models

to problems at the firm and national policy levels. Exploration of topics in money and banking, globalization and economic development. Fall and Spring.

**FOR 232 Natural Resources Ecology (3)**

Two hours of lecture/discussion and three hours of laboratory per week. Introduction to basic principles of ecology as they relate to terrestrial ecosystems and natural resources. The physical environment, genetics and adaptation, ecosystem structure and function, competition and community dynamics, human impacts from local to global levels. Physiology of tree growth and development from a whole plant perspective. Spring.

Prerequisites: EFB 101/EFB 102 or equivalent (organismal biology).

**FOR 296 Special Topics in Resource Management/Forestry (1 - 3)**

Experimental, interdisciplinary or special coursework at the freshman or sophomore levels. Subject matter and course format vary from semester to semester. Fall or Spring.

**FOR 301 Adirondack Forest Ecology and Dendrology (1)**

Intensive field study, presented as the first portion of the Summer Program in Field Forestry. Field identification and ecology of common trees and some shrub and herbaceous species of the Adirondack region. Natural and cultural history of the area as it affects the growth and development of forest vegetation. Summer.

**FOR 303 Introduction to Forest Resources Measurements (3)**

Ten hours of lecture and 30 hours of laboratory per week for approximately three weeks. Summer Program in Field Forestry. Principles and methods used in the measurement of spatial and vegetative attributes of forest landscapes. Course stresses development of field ability in the areas of overland navigation, timber measurements, and habitat measurements. Summer.

Prerequisite: FOR 301.

**FOR 304 Adirondack Field Studies (4)**

Four-week field course with five hours of lecture and 30 hours of field laboratory per week. Introduction to silvics, forest ecology and natural and cultural history as a basis for understanding forest vegetation and other natural resources. Principles and methods for the measurement of spatial and vegetative attributes of forested landscapes. Course stresses development of field ability in common plant identification, overland navigation and timber, tree, forest and habitat measurements, and synthesis of field data. Summer.

**FOR 312 Sociology of Natural Resources (3)**

Three hours of lecture per week. The concepts and principles of sociology as applied to natural resource questions. Concepts of community, forest-dependent communities, shared identity, and social structures of resource-based groups. The forest as an integrated social and biological community. Spring.

**FOR 321 Forest Ecology and Silviculture (3)**

Two hours of classroom lecture with weekly three-hour trips and labs to forests across Central New York. Survey of forest tree and stand ecology (silvics) and silviculture concepts, applications and implications for treatment of forest stands for various values. Experiential learning emphasized through a strong field component of assessing vegetation, site quality and land use history variables, and treatment alternatives to create different forest conditions. For students outside forest resources management curriculum; not open to students taking FOR 332 and FOR 334. Fall.

Prerequisite: Botany or general biology. Note: Credit will not be granted for both FOR 321 and FOR 521.

**FOR 322 Forest Mensuration (3)**

Two hours of lecture and three hours of laboratory per week. Principles and methods used in the measurement of standing trees, forest stands, forest products and growth. Application of sampling designs and analysis for forest valuation and inventory planning. Fall.

Prerequisites: FOR 304 or equivalent. Co-requisite: APM 391 or equivalent. Note: Credit will not be granted for both FOR 322 and FOR 522.

**FOR 323 Forest Biometrics (3)**

Three hours lecture per week. Statistical techniques for analyzing problems in forest resource management including hypothesis testing, analysis of variance, simple and multiple linear regressions, and weighted least squares regression. Spring.

Prerequisite: APM 391 or equivalent.

**FOR 324 Natural Resources Information Systems (3)**

Two hours of lecture and three hours of laboratory per week. Introduction to, and foundation in the use of, the concepts and principles of geographic information systems, remote sensing, and global positioning systems, with particular emphasis in forest resource management applications. Spring.

**FOR 330 Studies in Silviculture (3)**

Three hours of lecture per week, with reading assignments, exams, and projects. Students gain an appreciation of silviculture and its use for influencing the character, composition, and development of forest stands, and the conceptual framework for those practices. Projects provide opportunities to explore techniques for analyzing forest stands and developing prescriptions. Fall

**FOR 332 Forest Ecology (3)**

Two hours of lecture/discussion and three hours of laboratory per week. Principles of ecology and their application to the understanding and analysis of forest ecosystems. The role of human activities and management interventions on the ecosystem functions of forest communities from local to global levels. Fall.

Prerequisite: EFB 232 Natural Resources Ecology or equivalent. Note: Credit will not be granted for both FOR 332 and FOR 532.

**FOR 333 Natural Resources Managerial Economics (3)**

Three hours of lecture per week. Applying economic tools and models to natural resource management decisions. Identifying and defining the economic information necessary to help in making better business decisions with respect to managing natural resources. Spring.

Prerequisite: FOR 207 or equivalent. Note: Credit will not be granted for both FOR 333 and FOR 533.

**FOR 334 Silviculture (4)**

Three hours of lecture and three hours of lab per week. The practice of silviculture in managing stands to serve various landowner interests. Field trips and exercises provide opportunities to see examples of silvicultural methods under different management scenarios, and to learn

and practice techniques for analyzing forest stands and developing prescriptions for their treatment. Fall.  
Note: Credit will not be granted for both FOR 334 and FOR 534.

**FOR 338 Meteorology (3)**

Three hours of lecture/discussion per week. This is a shared resource course with FOR 538. An introduction to the atmospheric physical processes important to understanding weather and weather forecasting at the surface of the earth and macro-, synoptic-, meso-, and micro-climates. The emphasis is on synoptic and microscale phenomena. Students will learn how to access weather data on the Internet and use the data to forecast weather. At the microscale, emphasis is on describing conditions and projecting change. Fall.

Note: Credit will not be granted for both FOR 338 and FOR 538.

**FOR 340 Watershed Hydrology (3)**

Three hours of lecture per week. Basic principles of physical hydrology, including the movement of water through hydrologic reservoirs on global and watershed scales, measurement and quantification of hydrological data, runoff generation processes and water quality in the natural environment. Course content includes precipitation, evapotranspiration, streamflow generation, and fundamentals of groundwater flow. Fall.

Prerequisites or Co-requisites: Soils and/or Introductory Geology. Note: Credit will not be granted for both FOR 340 and FOR 540.

**FOR 345 Introduction to Soils (3)**

Two hours of lecture and three hours of lab per week. Introduction to the fundamentals of soil science in the context of soil as an ecosystem component. Fall.

Prerequisite or Co-requisite: 1 semester of Introductory Chemistry. Note: Credit will not be granted for both FOR 345 and FOR 545.

**FOR 356 Introduction to Raster GIS Analysis (3)**

Two hours of lecture/discussion and three hours of laboratory per week. An application of raster Geographic Information System technology to the solution of spatial problems in the fields of planning, forest management, landscape architecture, biology, ecology, and engineering.

Students learn how to obtain raster geographic data, convert it to different spatial coordinates, carry out series of spatial overlay analyses, produce effective maps, and write effective reports. Spring.

Note: Credit will not be granted for both FOR 356 and FOR 556.

**FOR 357 Practical Vector GIS (3)**

Two hours of lecture/discussion and three hours of laboratory per week. This course teaches the application of vector Geographic Information System technology to the solution of spatial problems and the analysis of spatial data in the fields of planning, forest management, landscape architecture, biology, ecology, and engineering. Students will learn how to obtain geographic data, convert it to different spatial coordinates, carry out spatial queries and overlay analyses, produce effective maps, and write effective reports. Fall.

Note: Credit will not be granted for both FOR 357 and FOR 557.

**FOR 360 Principles of Management (3)**

Three hours of lecture per week. This course focuses on the basic theories, concepts, principles and functions of modern management and administration, with an emphasis on the four functions of management: leading, planning, organizing, controlling. The four functions of management are applied to the public and private sectors, as well as for profit and not-for-profit organizations. Environmental management systems, corporate ethics and social responsibility and systematic problem solving are among the principal topics emphasized. Fall.

Note: Credit will not be granted for both FOR 360 and FOR 560.

**FOR 370 Forest Management Decision Making and Planning (3)**

Two hours of lecture/discussion and three hours of laboratory per week. Introduction to the components of forest management decision making and planning. The topics include forest regulation, growth and yield, and harvest scheduling given that a landowner's goals may include more than just commercial timber production. Spring.

Prerequisites: FOR 322 and FOR 334. Note: Credit will not be granted for both FOR 370 and FOR 570.

**FOR 372 Fundamentals of Outdoor Recreation (3)**

Three hours of lecture/discussion per week. Introduction to the programs and practices of federal, state and local agencies and private organizations involved in planning, administration and management of outdoor recreation areas. Emphasis is placed on common resource and social problems faced by area managers, and how they integrate solutions into their plans. Spring.

**FOR 373 Forest Operations (3)**

Two hours of lecture and three hours of lab per week. Overview of forest roads and timber harvesting; planning, construction, and maintenance of forest roads; economic and environmental characteristics of harvesting systems; safety and health; wood procurement systems; and the role of forest operations in the broader context of forest management. Fall.

Prerequisite: FOR 322 or FOR 334 or permission of instructor.

**FOR 402 Professional Forestry Mentoring Program (1)**

One-hour session per week supplemented by a one-day internship with a professional forester. Sessions will focus on contemporary issues in forestry including a historical perspective of the forestry profession, what it means to be a forester today, the role of certification and licensing, and professional ethics. It will serve to increase the professionalism of the forestry students. Fall.

Prerequisites: Junior status or permission of instructor.

**FOR 403 Humans and the Environment: New Zealand (4)**

Three and one-half week study-abroad program examines the natural and cultural history and resource management of New Zealand's South Island. Through class lecture/discussion and field excursions, students obtain an understanding of integrated resource management and sustainability in protected areas. Spring.

**FOR 415 Forestry Consulting and Wood Procurement (3)**

Two hours of lecture, two hours of laboratory, and one hour of independent study per week. This course is designed to provide the skills and professionalism to succeed as forestry consultants and wood procurement foresters. Introduction to the structure of the forest products industry in the United States and more specifically the issues and challenges surrounding wood supply and forest management. Field exercises provide students the opportunity to assume the role of both a forestry consultant and wood procurement forester. Fall.

Note: Credit will not be granted for both FOR 415 and FOR 615.

**FOR 430 Agroforestry (3)**

Two hours of lecture and three hours of laboratory per week. The productivity of stands of trees as well as aggregations of agricultural and forest tree crops in tropical and temperate agroforestry systems are examined from an ecophysiological perspective with an emphasis upon species and species-site interactions. Quantitative techniques and local agroforestry field trips are integrated with lecture material to develop an ecological understanding of the basis for sound agroforestry as well as plantation management. Fall, odd years.

Prerequisites: FOR 332, FOR 323 or equivalent. Note: Credit will not be granted for both FOR 430 and FOR 630.

**FOR 433 Silviculture Workshop (3)**

Three hours of classroom or six hours field instruction, and three hours independent study per week. Advanced study of silviculture in managing stands to serve a variety of landowner objectives. Enhanced problem-solving skills related to stand analysis and prescription making. Field exercises provide practical experience in implementing silvicultural prescriptions. Spring.

Prerequisite: One prior course in silviculture.

**FOR 442 Watershed Ecology and Management (3)**

Three hours of lecture and discussion per week. Introduction to watershed ecology and stream ecosystems. Interactions and linkages among upland, riparian and stream processes. Management and restoration associated with multiple uses of forest and rangelands. Explore influences of spatial and temporal scale, watershed and network position, disturbance regimes, and global change. Fall.

Note: Credit will not be granted for both FOR 442 and FOR 642.

**FOR 455 Forest Genetics and Tree Improvement (3)**

Two hours of lecture and three hours of lab per week. General principles of genetics as applied to conservation and utilization of genetic diversity of forest tree species. Topics include selection of elite trees, pollen testing, tissue culture and seed propagation, field-test design, and germplasm conservation and utilization. Spring.

Prerequisite: EFB 307, or FOR 334, or FOR 321 or permission. Note: Credit will not be granted for both FOR 455 and FOR 655.

**FOR 460 Managing Vegetation Using Integrated Pest Management (3)**

Two hours of lecture, two hours of laboratory, and one hour of independent study per week. Understanding and managing vegetation using principles and practices of Integrated Pest Management. A variety of problem plants (pests or weeds) is considered, including trees, in the context of various terrestrial, non-crop ecosystems; natural areas; cultural landscapes and historic sites; and recreational trails, roadside, railroad, pipeline and powerline corridors. Individual research and management projects. Regular field trips and labs. Spring.

Note: Credit will not be granted for both FOR 460 and FOR 660. This course was added to the on-line catalog on October 23, 2009.

**FOR 465 Natural Resources Policy (3)**

Three hours of lecture/discussion per week. Examination of US and NYS government roles in natural resource policy, and how government policies influence the management of public and private lands. Analysis of institutions, participants, and drivers of public lands, forest, water, wetlands, wildlife, fisheries, and fire policies. Fall.

**FOR 475 Human Behavior and Recreation Visitor Management (3)**

Three hours of lecture per week and a one-day field trip. Applies sociological and psychological concepts to: 1) individual preferences for recreation activities and settings, 2) description of recreation visitor behavior, 3) sources of management problems, 4) developing direct and indirect visitor management practices, and 5) recreation planning decisions necessary to manage recreation settings and experiences. Students have the opportunity to apply concepts to personal recreation experiences. Spring.

Prerequisite: FOR 372 or equivalent. Note: Credit will not be granted for both FOR 475 and FOR 675.

**FOR 476 Ecotourism and Nature Tourism (3)**

Three hours of instruction per week. Overview of ecotourism and nature tourism programs and efforts around the world. Community, business, and organizational structures necessary for managing ecotourism and nature tourism programs are discussed, as are related environmental, social, and economic impacts. One-day field trip. Fall.

Prerequisite: FOR 372. Note: Credit will not be granted for both FOR 476 and FOR 676.

**FOR 478 Wilderness and Wildlands Management (3)**

Three hours of lecture per week. One, two-day, overnight field trip. Review of the state and federal legislation and agency policies that frame the planning and management of public lands designated as wilderness or wildlands. Emphasizes stewardship and management for protection of natural resources and human values. Concepts include carrying capacity, preservation of ecological conditions and processes, visitor management, dispersed recreation management, human values and benefits, and planning frameworks. Fall.

Prerequisite: FOR 372 or equivalent. Note: Credit will not be granted for both FOR 478 and FOR 678.

**FOR 480 Urban Forestry (3)**

Three hours of lecture per week. Evaluation and management of urban greenspace resources, with emphasis on urban trees, in the context of other values and management processes in urban areas. Class practice in evaluating urban greenspace and tree resources. Spring.

Prerequisite: Junior or senior status in any Forest and Natural Resources Management programs or permission of instructor for juniors and seniors in other programs. Note: Credit will not be granted for both FOR 480 and FOR 680.

**FOR 481 Introduction to Arboriculture (3)**

Two hours of lecture and one three-hour laboratory per week. Overview of the practice of arboriculture. Emphasis will be on site evaluation for species selection, planting, pruning, fertilization and removal of trees in an urban environment. Spring.

Prerequisite: Botany or Ecology.

**FOR 485 Business and Managerial Law (3)**

Three hours lecture/discussion per week. An introduction to the law governing business and management. Examination of sources of law, constitutional foundations, ethics, court systems and trials, contracts, agency, consumer law, security interests, bankruptcy, entrepreneurship law, corporations, torts, criminal law, personal property, real property, and wills and estates. Spring.

**FOR 487 Environmental Law and Policy (3)**

Three hours of lecture/discussion per week. Introduction to the approaches used in US environmental law. Analysis of common law and statutory designs and strategies used to address environmental problems. Examination of common law environmental remedies, Clean Air Act, Clean Water Act, Endangered Species Act, hazardous waste, and other environmental laws. Fall.

Prerequisite: Junior or Senior standing. Note: Credit will not be granted for both FOR 487 and FOR 687.

**FOR 488 Natural Resources Agencies and Administration (3)**

Three hours of lecture per week. Advanced examination of the public agencies responsible for the management of natural resources and the political and legal constraints on their powers and procedures. Analysis of agency rule making, agency adjudication, disclosure of information, political controls over agencies, judicial review of agency action, and laws administered by natural resource agencies. Spring.

Prerequisite: Junior or senior status and a course in American government or American history, or natural resources or environmental policy. Note: Credit will not be granted for both FOR 488 and FOR 688.

**FOR 489 Natural Resources Law and Policy (3)**

Three hours of lecture/discussion per week. An introduction to the law governing the management of natural resources. Examination of the history and constitutional basis of natural resources law, wildlife and biodiversity law, protected lands law, water law, marine fisheries law, rangelands law, minerals law, and forest law. Spring.

Prerequisites: Junior or senior standing. Note: Credit will not be granted for both FOR 489 and FOR 689.

**FOR 490 Integrated Resources Management (3)**

One hour of lecture, three hours of laboratory, and three hours of supervised work per week. This capstone course emphasizes the assimilation, integration, and interpretation of the biophysical and socioeconomic sciences. It provides students with the opportunity to integrate skills and knowledge accumulated from professional and supporting coursework. A written comprehensive management plan, also presented orally in the field and classroom, provides the central vehicle by which students demonstrate their abilities as future natural resource managers. Spring.

Prerequisite: Senior status in Forest and Natural Resources Management.

**FOR 495 Undergraduate Teaching Assistance (1 - 3)**

Undergraduate students gain experience as teaching assistants. They assist the instructor with the teaching and learning experience, assist students with learning course concepts, and mentor students on how to succeed in an undergraduate course. Responsibilities vary by section and instructor. Fall and Spring.

Prerequisite: Permission of instructor. Prior completion of course to be assisted with grade of B or better.

**FOR 496 Special Topics in Resource Management/Forestry (1 - 3)**

Experimental and developmental courses in new areas of resource management/forestry or areas not covered in regularly scheduled courses. Topics may include but are not limited to the biological, physical, and social dimensions and the many and varied resources of forest lands and forestry. Specific detailed course descriptions for each course taught under the FOR 496 designation are available for student perusal. Fall, Spring and Summer.

**FOR 498 Independent Study in Forest Resources Management (1 - 6)**

Independent research or study in resource management/forestry for selected undergraduate students. Selection of subject area, nature of the research or study, and number of credit hours determined by student in conference with appropriate faculty member; initiative in taking FOR 498 rests with the student. Final written report is required for record. Fall, Spring and Summer.

Prerequisite: Cumulative GPA of at least 2.50 and approval of the adviser and instructor.

**FOR 499 Independent Study/Internship in Forest Resources Management (7 - 12)**

Independent research or study in resource management/forestry for selected undergraduate students; especially designed for internships spent off campus working for a resource management or forestry oriented firm or organization while also pursuing an academically oriented project. The selection of the study topic will be determined by the student in consultation with his/her adviser. Guidance will be provided by a faculty committee. Final written report is required for record. Limited to seniors in forest resources management. Fall, Spring and Summer.

Prerequisite: Must have a cumulative GPA of at least 3.00.

**FOR 501 Introduction to Environmental Resources Management (2)**

Two-week, field-based examination of forest, water, wildlife, recreation, and mineral resources and their management in New York State and surrounding states, framed by public administration, political science, economic, human dimension, and biophysical concepts. Emphasis is on experiential learning via a series of field trips. Fall (mid-August).

Prerequisite(s): Enrollment in the ERM MPS degree program.

**FOR 513 Adirondack Forest Ecology and Management (2 - 3)**

One-week, field-based examination of sustainable forest management in the Adirondacks, framed by concepts and issues associated with plant and wildlife ecology, silviculture, and forest management. Contemporary research on central Adirondack forests is featured based on work at the Huntington Wildlife Forest. Emphasis is on experiential learning via a series of trips to, and laboratories in, the forest. Fall (late summer).

Note: Credit will not be granted for both EFB 513 and FOR 513.

**FOR 519 Green Entrepreneurship (3)**

Three hours of lecture/discussion per week. Explore challenges and goals of creating a start-up venture in environmental science or technology. Recognize trends in the marketplace, and where commercial opportunities can be created. Analyze feasibility and potential to create a sustainable venture. Other topic areas include critical success factors and key start-up issues unique to environmental science and technology firms. Spring.

Prerequisite(s): FOR 207 Introduction to Economics or equivalent; or permission of instructor.

**FOR 521 Forest Ecology and Silviculture (3)**

Two hours of classroom lecture with weekly three-hour trips and labs to forests across Central New York. Study of the conceptual underpinnings and application of forest ecology via explorations of the environmental complex and silvicultural systems. Experiential learning is emphasized through a strong field component of assessing vegetation, site and land use history variables, and treatment alternatives to create different forest conditions. Provides a study of trees as individuals and communities, and how we can manipulate them both using planned methods and techniques to affect sustained production of a wide variety of forest ecosystem benefits, services, and values. Fall.

Prerequisite(s): Botany or general biology. Note: Credit will not be granted for both FOR 321 and FOR 521. Note: Not open to students taking FOR 534.

**FOR 522 Forest Mensuration (3)**

Two hours of lecture and three hours of laboratory per week. Principles and methods used in the measurement of standing trees, forest stands, forest products and growth. The application of sampling designs and analysis for forest valuation and inventory planning. Graduate students

will be required to complete two additional term projects in addition to those required of undergraduate students. Fall.  
Prerequisites: FOR 304 or equivalent. Co-requisites: APM 391 or equivalent. Note: Credit will not be granted for both FOR 322 and FOR 522.

**FOR 523 Tropical Ecology (3)**

Preparatory lectures(1.5 hr/wk) coupled with intensive spring break field study on a tropical island in the Caribbean. Principles of tropical ecology, resource management, and island biogeography are presented. Field trips to a variety of tropical ecosystems including rain forest, coral reefs, crater lakes, montane rain forest with comparison to north temperate ecosystems. Additional fee covers costs of travel, lodging. Spring. Prerequisite(s): General Ecology  
Prerequisite: General Ecology.

**FOR 524 Forest Biometrics (3)**

Three hours of lecture per week. Statistical methods and techniques including hypothesis testing, analysis of variance, simple and multiple linear regressions used for analyzing forest resource management problems and developing forest growth and yield models. Graduate students will be required to write a research paper in addition to those required of undergraduate students. Spring.  
Prerequisite: APM 391 or equivalent. Note: Credit will not be granted for both FOR 323 and FOR 524.

**FOR 530 Studies in Silviculture (3)**

Three hours of lecture per week, with reading assignments, exams, and projects. Students gain an appreciation of silviculture and its use for influencing the character, composition, and development of forest stands, and the conceptual framework for those practices. Projects provide opportunities to explore techniques for analyzing forest stands and developing prescriptions. Fall

**FOR 532 Forest Ecology (3)**

Two hours of lecture/discussion and three hours of laboratory per week. Principles of ecology and their application to the understanding and analysis of forest ecosystems. The role of human activities and management interventions on the ecosystem functions of forest communities from local to global levels. Emphasis on application of knowledge, requiring a written report with a problem-solving focus. Fall.  
Prerequisites: EFB 101, EFB 102 or equivalent and FOR 232 or equivalent. Note: Credit will not be granted for both FOR 332 and FOR 532.

**FOR 533 Natural Resources Managerial Economics (3)**

Three hours of lecture per week. An introductory course applying economic tools and models to natural resource management decisions. Identifying and defining economic information necessary to help in making better business decisions with respect to managing natural resources. Systematically analyzing the economic tools and models used in natural resources management. Spring.  
Prerequisite(s): FOR 207 or equivalent and APM 105 or equivalent or permission of the instructor. Note: Credit will not be granted for both FOR 333 and FOR 533.

**FOR 534 Silvicultural Practice (4)**

Three hours of lecture and three hours of laboratory per week. The practice of silviculture in managing stands to serve various landowner interests, and explore the conceptual framework for those practices. Field trips and exercises provide opportunities to see examples of silvicultural methods under different management scenarios and to learn and practice techniques for analyzing forest stands and developing prescriptions for their treatment. Laboratory projects include reports that explore the conceptual and technical rationale for silvicultural decisions. Fall.  
Note: Credit will not be granted for both FOR 334 and FOR 534.

**FOR 535 Advanced Forest Soils (3)**

Three hours of lecture/discussion per week concerning the current state-of-the-art in forest soils. Effect of intensive forest management on soil, soil-site-species relationships, forest fertilization tree nutrition. Application of forest soils information to silviculture. Spring.  
Prerequisite: FOR 332 or beginning courses in soils and silviculture.

**FOR 538 Meteorology (3)**

Three hours of lecture/discussion per week. An introduction to the atmospheric physical processes important to understanding weather and weather forecasting at the surface of the earth and macro-, synoptic-, meso-, and micro-climates. The emphasis is on synoptic and micro-scale phenomena. Students will learn how to access weather data on the Internet and use that data to forecast weather. At the micro-scale, emphasis is on describing conditions and projecting change. Fall.  
Note: Credit will not be granted for both FOR 338 and FOR 538.

**FOR 540 Watershed Hydrology (3)**

Three hours of lecture per week. The course covers basic principles of physical hydrology, including the movement of water through hydrologic reservoirs on global and watershed scales, measurement and quantification of hydrological data, runoff generation processes and water quality in the natural environment. Course content includes precipitation, evapotranspiration, streamflow generation, and fundamentals of groundwater flow. Students are expected to apply course concepts to an independent research project. Fall.  
Prerequisite or Co-requisite: Soils and/or Introductory Geology. Note: Credit will not be granted for both FOR 340 and FOR 540.

**FOR 545 Introduction to Soils (3)**

Two hours of lecture and three hours of laboratory per week. Introduction to the fundamentals of soil science in the context of soil as an ecosystem component. Fall.  
Prerequisite or Co-requisite: one semester of Introductory Chemistry or permission of instructor. Note: Credit will not be granted for both FOR 345 and FOR 545.

**FOR 546 Forest Soil Genesis, Classification, and Mapping (3)**

Three hours of lecture per week during the first two-thirds of the semester. The last third of the semester is devoted to fieldwork and production of a soil map. Models of soil genesis, application of the U.S. system of soil taxonomy, and soil mapping. Spring.  
Prerequisite: Introductory course in soil science.

**FOR 556 Introduction to Raster GIS Analysis (3)**

Two hours of lecture/discussion and three hours of laboratory per week. An application of raster Geographic Information System technology to the solution of spatial problems in the fields of planning, forest management, landscape architecture, biology, ecology, and engineering. Students learn how to obtain raster geographic data, convert it to different spatial coordinates, carry out spatial overlay analyses, produce effective maps, and write effective reports. Students complete a final project, prepare a comprehensive report and present the results to the

class. Spring.

Note: Credit will not be granted for both FOR 356 and FOR 556.

### **FOR 557 Practical Vector GIS (3)**

Two hours of lecture/discussion and three hours of laboratory per week. This course teaches the application of vector Geographic Information System technology to the solution of spatial problems and the analysis of spatial data in the fields of planning, forest management, landscape architecture, biology, ecology, and engineering. Students will learn how to obtain geographic data, convert it to different spatial coordinates, carry out spatial queries and overlay analyses, produce effective maps, and write effective reports. Students complete a final project, prepare a comprehensive report and present the results to the class. Fall.

Note: Credit will not be granted for both FOR 357 and FOR 557.

### **FOR 558 Advanced Topics in GIS (3)**

Two hours of lecture/discussion and three hours of laboratory per week. This course builds on knowledge gained in introductory vector GIS courses and provides instruction in data structures, data models, between layer topologies, and geographic editing. Spring.

Prerequisite: FOR 357 or FOR 557 or equivalent experience with vector GIS.

### **FOR 560 Principles of Management (3)**

Three hours of lecture per week. This course focuses on the basic theories, concepts, principles and functions of modern management and administration, with an emphasis on the four functions of management: leading, planning, organizing, controlling. The four functions of management are applied to the public and private sectors, as well as for profit and not-for-profit organizations. Environmental management systems, corporate ethics and social responsibility and systematic problem solving are among the principal topics emphasized. Graduate students lead the discussion of case studies and have a separate recitation section. Fall.

Prerequisite: graduate status. Note: Credit will not be granted for both FOR 360 and FOR 560.

### **FOR 570 Forest Management Decision Making and Planning (3)**

Two hours of lecture/discussion and three hours of laboratory per week. Introduction to the components of forest management decision making and planning. The topics include forest regulation, growth and yield, and harvest scheduling given that a landowner's goals may include more than just commercial timber production. Sensitivity analysis of parameters used in forest management planning. Spring.

Prerequisites: FOR 322/522 and FOR 334/534 or permission of the instructor. Note: Credit will not be granted for both FOR 370 and FOR 570.

### **FOR 573 Forest Operations (3)**

Two hours lecture and three hours of laboratory per week. Overview of forest roads and timber harvesting; planning, construction, and maintenance of forest roads; economic and environmental characteristics of harvesting systems; safety and health; wood procurement systems; and the role of forest operations in the broader context of forest management. Emphasis on application of knowledge, requiring a written report with a problem-solving focus. Fall.

Prerequisite: FOR 322 and FOR 334 or permission of instructor. Note: Credit will not be granted for both FOR 373 and FOR 573.

### **FOR 601 Environmental Resources Management Workshop (2)**

Three-week examination of a current topic in environmental resources management. Synthesis course that applies environmental resources management knowledge and techniques through a group consulting assignment for a government or non-government environmental resource organization. Spring (late Spring).

Prerequisite(s): 501: Introduction to Environmental Resources Management and completion of majority of ERM MPS coursework.

### **FOR 607 Restoration Ecology (3)**

Three hours of lecture per week. Students investigate and apply major ecological concepts to ecosystem restoration, including abiotic and biotic resource limitation, ecophysiology, trophic webs, disturbance, climate change, and alternative ecosystem states. Diverse readings and interactive class discussions have broad relevance to restoration practitioners, conservation biologists, and environmental engineers. Fall.

Prerequisite(s): an ecology course or permission of instructor.

### **FOR 610 Environmental Resources Business (3)**

Three hours of lecture per week. This course introduces the student to the fundamentals of business accounting and finance and their application to environmental management. The course is small enterprise oriented with emphasis on practical applications and problem solving techniques. The primary objective is to provide the student with the tools to understand and solve the basic accounting and financial problems confronting businesses and organizations in the environmental management field. Topics covered include basic accounting techniques, financial analysis, time value of money, valuation of assets, capital budgeting techniques, capital structure theory. Spring.

### **FOR 615 Forestry Consulting and Wood Procurement (3)**

Two hours of lecture, two hours of laboratory, and one hour of independent study per week. This course is designed to provide the skills and professionalism to succeed as forestry consultants and wood procurement foresters. Introduction to the structure of the forest products industry in the United States and more specifically the issues and challenges surrounding wood supply and forest management. Field exercises provide students the opportunity to assume the role of both a forestry consultant and wood procurement forester. Fall.

Note: Credit will not be granted for both FOR 415 and FOR 615.

### **FOR 620 Silvicultural Concepts and Applications (3)**

Three hours of lecture or six hours of field studies and three hours of independent study per week. Advanced study of silviculture, including the conceptual basis for designing prescriptions to serve a variety of landowner objectives. Concurrent independent work on assigned projects enhances problem-solving skills related to stand analysis and prescription making. Reports articulate the conceptual basis for recommendations, and discuss likely outcomes based upon findings from research and computer simulations. Field exercises provide practical experience in implementing silvicultural prescriptions. Spring.

Prerequisite: previous studies in silviculture at the baccalaureate or higher level.

### **FOR 626 Plant Tissue Culture Methods (3)**

Two hours of lecture and discussion and three hours of laboratory per week. Introduction to plant tissue culture for biotechnology research and as a propagation method. Emphasis will be on learning laboratory instrumentation and techniques for establishing cell cultures, producing transgenic cell lines, and regenerating whole plants. In addition to the scheduled lab exercises, an independent micropropagation or transformation project will be required. Fall.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both BTC 426 and FOR/EFB 626.



**FOR 630 Agroforestry (3)**

Two hours of lecture and three hours of laboratory per week. The productivity of stands of trees as well as aggregations of agricultural and forest tree crops in tropical and temperate agroforestry systems are examined from an ecophysiological perspective with an emphasis upon species and species-site interactions. Quantitative techniques and local agroforestry field trips are integrated with lecture material. Critically analyze ecological factors as the basis for sound agroforestry as well as plantation management. Fall, odd years.  
Prerequisite: FOR 332 or FOR 323 or equivalent. Note: Credit will not be granted for both FOR 430 and FOR 630.

**FOR 635 Forest Soils and Their Analyses (3)**

One hour of lecture, one hour of recitation, four hours of field and laboratory study of forest soils, emphasizing plant-soil relationships per week. Stress on quantification of plant-soil diagnostic techniques and their interpretation. Spring (odd years).  
Prerequisite: FOR 446. Note: Background in physical and biological sciences recommended.

**FOR 642 Watershed Ecology and Management (3)**

Three hours of lecture and discussion per week. Introduction to watershed ecology and stream ecosystems. Interactions and linkages among upland, riparian and stream processes. Management and restoration associated with multiple uses of forest and rangelands. Explore influences of spatial and temporal scale, watershed and network position, disturbance regimes, and global change. Students will apply course concepts to an independent research project. Fall.

Note: Credit will not be granted for both FOR 442 and FOR 642.

**FOR 645 Hydrological Techniques (2)**

One hour of lecture and three hours of laboratory per week. Course will provide a hands-on learning experience in current instrument and measuring techniques in hydrology, meteorology and hydrogeology, necessary for research in the environmental sciences. The objective will be to explore the principles that govern the use of sensors and the operation of data acquisition systems. Spring.  
Prerequisite: FOR 643. Note: Credit will not be granted for both FOR 445 and FOR 645.

**FOR 655 Advanced Forest Genetics and Tree Improvement (3)**

Two hours of lecture and three hours of laboratory per week. General principles of genetics as applied to conservation and utilization of genetic diversity of forest tree species. Topics include selection of elite trees, pollen testing, tissue culture and seed propagation, field-test design, and germplasm conservation and utilization. An independent research problem will be undertaken by the student. Spring.  
Prerequisite: permission of instructor. Note: Credit will not be granted for both FOR 455 and FOR 655.

**FOR 660 Managing Vegetation Using Integrated Pest Management (3)**

Two hours of lecture, two hours of laboratory, and one hour of independent study per week. Understanding and managing vegetation using principles and practices of Integrated Pest Management. Variety of problem plants (pests or weeds) are considered, including trees, in the context of terrestrial, non-crop ecosystems: natural areas; cultural landscapes and historic sites; and recreational trail, roadside, railroad, pipeline and powerline corridors. Individual research and management projects. Regular field trips and labs. Spring.  
Note: Credit will not be granted for both FOR 460 and FOR 660.

**FOR 665 Natural Resources Policy (3)**

Three hours of lecture per week. Analysis and application of political, policy formation, and policy administration theories to natural resources. Examination of drivers of U.S. natural resources policies. Analysis of private lands, public lands, forest, wildlife, endangered species, water, fire, and certification policies. Focus is on U.S. natural resources policies. Spring.  
Prerequisite: graduate standing.

**FOR 670 Resource and Environmental Economics (3)**

Three hours of lecture per week. An introductory course in resource and environmental economics. Apply economic theories and models to analyze decisions concerning the use of forest, marine, and water resources and to analyze policy tools for mitigating pollution created as a result of production and consumption. Fall.  
Prerequisite: A course in economics.

**FOR 675 Human Behavior and Recreation Visitor Management (3)**

Three hours of lecture per week and a one-day field trip. Applies sociological and psychological concepts to: 1) individual preferences for recreation activities and settings, 2) description of recreation visitor behavior, 3) sources of management problems, 4) developing direct and indirect visitor management practices, and 5) recreation planning decisions necessary to manage recreation settings and experiences. Students have the opportunity to apply concepts to personal recreation experiences. Lectures concurrent with FOR 475, additional lectures, reading, and data analysis required. Spring.

Prerequisite: graduate standing, instructor permission. Note: Credit will not be granted for both FOR 475 and FOR 675.

**FOR 676 Ecotourism and Nature Tourism (3)**

Three hours of instruction per week. Overview of ecotourism and nature tourism programs and efforts around the world. Community, business, and organizational structures necessary for managing ecotourism and nature tourism programs. Environmental, social, and economic impacts. One-day field trip. Graduate level readings, assignments, and exams. Fall.

Prerequisite: FOR 372. Note: Credit will not be granted for both FOR 476 and FOR 676.

**FOR 677 Recreation Research Theory and Application (3)**

Three hours of lecture per week. The major components of this course are: 1) how to apply a theoretical construct to create operational definitions used in social science, 2) identification of the inter-disciplinary approaches/theories used to investigate social/recreation behavior, and 3) a comparison of the various methods used in social research. Students have the opportunity to apply class objectives to their personal research. Fall.

Prerequisite: graduate standing, instructor permission.

**FOR 678 Wilderness and Wildlands Management (3)**

Three hours of lecture per week and one, two-day, overnight field trip. Reviews the state and federal legislation and agency policies that frame the planning and management of public lands designated as wilderness or wildlands. Emphasizes the use of wilderness research information for adaptive management approaches to stewardship of and planning for protection of natural resources and human values. Fall.

Prerequisite: FOR 372 or equivalent. Note: Credit will not be granted for both FOR 478 and FOR 678.

**FOR 680 Urban Forestry (3)**

Three hours of lecture per week. Evaluation and management of urban greenspace resources, with emphasis on urban trees, in the context of other values and management processes in urban areas. Class practice in evaluating urban greenspace and tree resources, development of a research paper on urban forestry. Spring.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both FOR 480 and FOR 680.

**FOR 685 Business and Managerial Law (3)**

Three hours lecture/discussion per week. An introduction to the law governing business and management. Examination of sources of law, constitutional foundations, ethics, court systems and trials, contracts, agency, consumer law, security interests, bankruptcy, entrepreneurship law, corporations, torts, criminal law, personal property, real property, and wills and estates. Spring.

**FOR 687 Environmental Law and Policy (3)**

Three hours of lecture/discussion per week. Introduction to the approaches used in US environmental law. Analysis of common law and statutory designs and strategies used to address environmental problems. Examination of common law environmental remedies, Clean Air Act, Clean Water Act, Endangered Species Act, hazardous waste, and other environmental laws. Analysis and application of primary and secondary legal sources to business and management problems. Fall.

Note: Credit will not be granted for both FOR 487 and FOR 687.

**FOR 688 Natural Resources Agencies and Administration (3)**

Three hours of lecture per week. Advanced examination of the public agencies responsible for the management of natural resources and the political and legal constraints on their powers and procedures. Analysis of agency rule making, agency adjudication, disclosure of information, political controls over agencies, judicial review of agency action, and laws administered by natural resource agencies. Analysis and application of natural resource law agencies and public administration peer-review literature. Spring.

Prerequisite: A course in American government, American history, or natural resources or environmental policy. Note: Credit will not be granted for both FOR 488 and FOR 688.

**FOR 689 Natural Resources Law and Policy (3)**

Three hours of lecture/discussion per week. An introduction to the law governing the management of natural resources. Examination of the history and constitutional basis of natural resources law, wildlife and biodiversity law, protected lands law, water law, marine fisheries law, rangelands law, minerals law, and forest law. Analysis and application of natural resources law research and commentary. Spring.

Note: Credit will not be granted for both FOR 489 and FOR 689.

**FOR 690 Integrated Resources Management (3)**

One hour of lecture, three hours of laboratory and three hours of supervised work per week. This capstone course emphasizes the assimilation, integration and interpretation of the biophysical and socioeconomic sciences. It provides students with the opportunity to integrate skills and knowledge accumulated from professional and supporting coursework. The final deliverable is a written management plan. Spring.

**FOR 692 Capstone in Forest and Natural Resources Management (3)**

Three hours of seminar discussions and presentations per week. Students will integrate and apply their knowledge of forest natural resources management to practical problems of their own design in their areas of interest, in consultation with clients whom they identify to be in need of their professional services. Class sessions include opportunities to develop advanced knowledge and professional skills, such as research, analysis, management, and communication. The final project outcomes are delivered through written reports and oral presentations. Fall.

**FOR 694 Writing for Scientific Publication (3)**

Three hours of lecture and discussion per week. Students will improve their skills in technical reporting by preparing a manuscript suitable for submission to a scientific journal. Topics include selection of an appropriate journal, design of effective figures and tables, sequential preparation of sections of the manuscript, writing tips, peer review and ethical issues. Spring.

**FOR 695 Research Methods for Natural Resources (3)**

Three hours of lecture and discussion per week. The conduct of scientific research in natural resources. Students design research questions and write a feasible research proposal. Issues include researchable questions, scientific literature, theory, practice, design, measurement, and analysis. Fall.

Pre- or co-requisite(s): Graduate student standing.

**FOR 753 Advanced Natural Resource and Environmental Policy (3)**

Three hours of lecture and discussion per week. Course takes a social history approach to examine the working principles forming the foundation for natural resource and environmental policies. These principles will be directed toward an appreciation of the institutional context for the domestic and global natural resource and environmental issues, and an understanding of the values, institutions, policies and rules, which govern societies and their relationship to their environment. Fall.

Note: Highly desired is previous coursework in public policy, natural resource or environmental policy, environmental law, public administration or property law.

**FOR 770 Ecological Economics and Policy (3)**

Three hours of seminar per week. A transdisciplinary approach to understand the interface of human and ecological systems, includes concepts and methods of ecologists, economists, and social scientists. Focus is on historical, conceptual and epistemological foundations. Draws on contemporary economic and policy thought, evolutionary biology, ecology, systems theory, social psychology, and environmental ethics. Spring.

Prerequisite: Graduate coursework in ecology or economics; doctoral student standing, or permission of instructor.

**FOR 796 Special Topics in Forest Resources Management (1 - 3)**

Lectures, seminars, and discussion. Advanced topics in resource management and policy. Check schedule of classes for details of subject matter. Fall and/or Spring.

**FOR 797 Seminar (1)**

Individual presentation and group discussion concerning current topics of concern to natural resources or their management. Fall and Spring.

**FOR 798 Research Problems in Forest and Natural Resources Management (1 - 12)**

Special investigation and analysis of forest and natural resources management topics. A study plan and a final written report are required. Fall and Spring.

**FOR 898 Professional Experience/Internship (1 - 6)**

Professional experience/internship which applies, enriches, or complements formal coursework. All professional experiences/internships must have a signed experience/internship agreement on record with the advisor. Graded on an "S/U" basis. Fall, Spring, and Summer.

**FOR 899 Master's Thesis Research (1 - 12)**

Investigation leading to the completion of a Master's thesis. Graded on an "S/U" basis. Fall, Spring, and Summer.

**FOR 999 Doctoral Thesis Research (1 - 12)**

Investigation leading to the completion of the doctoral thesis. Graded on an "S/U" basis. Fall, Spring and Summer.

**FTC - Forest Technology****FTC 101 Trigonometry for Natural Resource Technicians (3)**

Forty hours of lecture and sixteen hours of recitation conducted over a four-week period. A review of selected geometry and algebra topics, and an introduction to trigonometry and its applications. Emphasis on pythagorean theorem, quadratic equations, rectangular coordinate systems, right triangle trigonometry, oblique triangle trigonometry, the Law of Sines, the Law of Cosines and the graphing of trigonometric functions. Graphic calculator required. Summer.

**FTC 105 Tree and Forest Biology (4)**

A four-week summer program having 45 hours of lecture and 45 hours of lab. An introduction to the biology of trees and the diversity of animal life commonly found in forests. Field labs concentrate on biological relationships in Adirondack forests. Summer.

Pre- or co-requisite(s): Four credits in biology.

**FTC 200 Dendrology (3)**

Thirty eight hours of lecture, and forty hours of field laboratory. Characteristics, distribution, and uses of tree species in North America. Identifying plant species using common and scientific names, from leaf, twig, fruit, or bark samples. Habitats, species associates, and succession of plants, including some invasive species. Fall.

**FTC 202 Introduction to Surveying (3)**

Fifty hours of lecture and 80 hours of laboratory and field exercises. The course is an introduction to the theory and practice of plane surveying. Emphasis is on developing individual skills and techniques through small crew projects where it is necessary to handle typical surveying equipment in actual field situations. Lecture topics include the theory of measurements and errors, field record keeping procedures, mathematics for plane surveying, introduction to field problems, introduction to map use and preparation, concepts of land tenure systems and basic computer aided drafting. Students tour the various offices found at the County courthouse and participate in a research exercise. Field projects include traversing using common forester's and surveyor's tools and instruments, mapping including field and office procedure, and proficiency projects in handling various surveying instruments. Fall.

**FTC 204 Introduction to Natural Resources Measurements (4)**

Sixty hours of lecture and forty-five hours of field/laboratory. A study of the tools and techniques used to measure primary forest products and inventory natural resources, such as timber, biomass, carbon stocks, wildlife habitat, recreation use and impact, and plant diversity.

Professional presentation of forest inventory data in the form of technical reports. Basic forest sampling methods are used and compared, and associated statistical analyses are learned and applied. Fall.

Co-requisites: FTC 200, FTC 202, FTC 208.

**FTC 206 Forest Ecology (4)**

Fifty-one hours of lecture and fifty-six hours of laboratory and field. Study of interactions between forest vegetation and the environment.

Considers how sunlight, moisture, soils and climate impact species presence, composition and growth. Human dimension of forest ecology, including critical thinking and evaluation of environmental issues. Fall.

**FTC 207 Forest Safety (1)**

Ten hours lecture and twenty two hours laboratory provides students with technical competence and decision-making abilities. Students receive training on the proper use and maintenance of forest hand tools and chainsaws. First Aid and CPR/AED are covered. Safety hazards, and prevention, classification, and reporting of accidents are covered. Fall.

**FTC 208 Geographic Information Technology (3)**

Thirty-four hours of lecture and forty-nine hours of laboratory. An introduction to geographic theory and applications. Use and interpretation of topographic and other paper maps, aerial photographs, and digital imagery. Proficiency in hand-lettering and creation of scaled field maps including required map elements. Transfer mapping skills to computer using geographic information system software. Fall.

**FTC 209 Adirondack Cultural Ecology (3)**

Thirty hours of lecture and forty-six hours of field laboratory. A study of the changing perceptions for using the natural resources associated with the Adirondack Mountain region. An historical review of past exploitations of minerals and timber, the development of the Adirondack Park, and the evolution of economic and political issues regulating the Park. Fall.

**FTC 210 Leadership and Forest Technology (3)**

Thirty-two hours of lecture and thirty-six hours of laboratory time. Provides students with technical competence and decision-making abilities. Students receive training in the proper design and maintenance of forest hand tools, chainsaws, and skidding equipment. Maps, route surveys, and trail development are covered. Students learn about company and agency organization; the selection, placement, training, and evaluation of workers; managing crews and the techniques of foremanship; and human relations in the workplace, with emphasis on the special personnel problems of the forest and surveying industry. Fall.

**FTC 211 Silviculture (4)**

Forty-five hours lecture and sixty hours field lab. Regeneration and tending of forest stands. Physical and chemical treatments used for growing forests in the northeastern states. Introduction to silviculture in the southern and western states. Methods for quantifying and predicting forest growth. Marking timber stands for harvesting. Establishing new stands. Spring.

Prerequisites: FTC 200, FTC 204, and FTC 206.

**FTC 213 Forest Inventory Practicum (2)**

Six hours of lecture and sixty four hours of field/laboratory. A practical field problem requiring students to use professional methods of collecting, analyzing, and presenting forest inventory data. Inventory of the timber/biomass resource and the development of a forest type map are emphasized. Spring.

Prerequisites: FTC 200, FTC 202, FTC 204, and FTC 208.

**FTC 215 Timber Harvesting (2)**

Fifteen hours of lecture and forty-five hours of field and laboratory time. Student learns basic harvesting methods with Northeast emphasis and its relationship to other forest uses. A technical competence in timber sale contract administration and basic timber appraisal is gained. Spring.

Prerequisites: FTC 208, FTC 210.

**FTC 217 Wildland Firefighting and Ecology (2)**

Twenty-five hours of lecture and sixteen hours of laboratory and field. An introduction to fire science. Learn basic principles of fire ecology, behavior, danger rating and control. Practical experience conducting a prescribed burn. Spring.

Prerequisite(s): FTC 200, FTC 204, FTC 206, FTC 210.

**FTC 219 Introduction to Forest Recreation (1)**

Fourteen hours of lecture and twenty hours field and laboratory time. A study of forest-recreation resources, their importance to humans, and of the basic history, laws and principles underlying forest-recreation management in the United States. The technical aspects of recreation management are emphasized, as is the study of public-land management, including wilderness. Spring.

Pre-requisites: FTC 207.

**FTC 221 Natural Resources Management (3)**

Thirty-five hours of lecture and thirty hours of laboratory and field. Addresses common issues in organizing a forest property to meet stakeholder goals. Techniques of growth and resource measurement, monitoring, and evaluation are emphasized. Examples and case studies of forest management and production activities are presented. A final project involves the application of knowledge accumulated at the ESF Ranger School in a management plan for an assigned forest property. Spring.

Prerequisites: FTC 204, FTC 206 and FTC 208.

**FTC 223 Water Measurements (1)**

Ten hours of lecture and sixteen hours of laboratory time. An introduction to water resources covering measurements taken at weather stations, snow courses, stream gauging stations, and other stream sample points. The hydrologic cycle, concept of flow, and the water balance equation are studied in detail. Students learn the management practices used to control erosion and water quality. Spring.

Prerequisite: FTC 202.

**FTC 225 Timber Transportation and Utilization (3)**

Forty three lecture hours and forty three laboratory hours. Students gain knowledge of graveled forest road administration, location, design, construction, and maintenance. Differences in wood structure, and their effects on wood products of various species are studied. Spring.

Prerequisites: FTC 208, and FTC 210. Co-requisite: 259.

**FTC 232 Wildlife Techniques (2)**

Fourteen hours of lecture and forty-eight hours field and laboratory time. Standard methods and techniques for measuring, monitoring, controlling and evaluating wildlife populations are discussed, demonstrated and/or practiced. Further practice in measuring and evaluating wildlife habitat. Identification of common birds, amphibians, reptiles and mammals by sight and sound.

Prerequisites: FTC 200, FTC 202, and FTC 204.

**FTC 234 Wildlife Conservation (3)**

Thirty-eight hours of lecture and twenty hours field and laboratory time. An introduction to the history and evolution of wildlife-related policies and laws, and to the biological, ecological, economical and sociological principles underlying wildlife management and conservation efforts in the United States. Terrestrial vertebrate animals serve as the basis of discussions and case studies. Students improve their communication skills by presenting papers and speeches on wildlife-related topics. Spring.

Prerequisite: FTC 206.

**FTC 236 Interpretive Techniques in Forest Recreation (2)**

Twenty-eight hours of lecture and twenty-four hours field and laboratory time. Students complete NAI's Certified Interpretive Guide course, and more closely study the relationship between interpretation and recreation management. Students improve their communication skills by presenting papers, speeches and interpretive posters. Spring.

Pre-requisites: FTC 200, FTC 202, FTC 204, and FTC 208.

**FTC 237 Introduction to Water and Soil Resources (3)**

Thirty-seven hours of lecture and twenty-four hours of laboratory and field. Introduction to watershed ecology and soil science. Interactions among upland, riparian, stream and wetland systems, including the hydrologic cycle. Study and measurement of soil physical, chemical and biological characteristics and processes. Recognize soil and water resource management and protection issues associated with multiple uses of forest lands. Spring.

Prerequisites: FTC 202, FTC 206, and FTC 208.

**FTC 238 Forest Insects and Disease (3)**

Thirty-five hours of lecture and twenty-six hours of laboratory and field. An introduction to forest insects and diseases. Explore ecological roles and identify selected insects and pathogens based on morphology, signs and symptoms. Discuss integrated pest management and other control measures. Spring.

Prerequisites: FTC 200, and FTC 206.

**FTC 239 GIS Applications (2)**

Fifteen hours of lecture and forty-five hours of laboratory. Introduction to acquisition, manipulation, and creation of geospatial data using geographic information systems. Build geodatabases, use geoprocessing tools, work with attribute data in both Excel and ArcGIS. Plan and conduct a simple geospatial analysis project. Spring.

Prerequisites: FTC 202, and FTC 208.

**FTC 251 Advanced Surveying Measurements and Computations (5)**

Fifty-five hours of lecture and sixty hours of field and laboratory time. Advanced survey measurements and computational techniques including traverse calculations, rectangular coordinates, statistical analysis of surveying data, state plane coordinates, meridian determination, partition of land, trigonometric leveling and horizontal control are explored. Students will make the necessary surveying measurements in the field and be expected to complete various surveying measurements using a calculator and computer. Spring.  
Prerequisite: FTC 202. Co-requisite: FTC 257.

**FTC 253 Survey Law (3)**

Thirty five hours of lecture and 30 hours of laboratory time. The course is a study of courthouse real property research, property boundary determination by various methods, case and statute law as it relates to real property and land surveying, legal research and the liability and professionalism of the practicing land surveyor. Spring.  
Prerequisite: FTC 202.

**FTC 255 Boundary Surveying (3)**

Thirty hours of lecture and forty-five hours of field and laboratory time. A study of the procedures necessary to conduct a retracement survey including preliminary office procedures, field practices, and preparation of final survey documents. Students will complete a retracement survey and use the compiled data in a mock trial. Spring.  
Prerequisite: FTC 202. Co-requisite: FTC 253.

**FTC 256 Subdivision Surveys (2)**

Twenty hours of lecture and 30 hours of laboratory time. An introduction to the preparation of a multi-lot subdivision of a parcel of real estate. Development of a subdivision in relation to topography, zoning requirements, utility services, existing and proposed roads or streets and client requests. Students learn to design minor storm drain facilities in relation to the subdivisions. The student will incorporate all of the above while using survey software. Spring.  
Prerequisite: FTC 202. Co-requisite: FTC 259.

**FTC 257 Construction and Topographic Surveys (3)**

Twenty-five hours lecture and sixty hours field and laboratory. A study of the various methods and techniques used to perform construction and topographic surveys and develop topographic maps. Theory, mathematics, and layout of circular, spiral and vertical curves. Layout of various construction projects including buildings, roads, pipelines and bridges will be discussed. Earthwork, staking and cross-section calculations will also be covered. Students complete a topographic mapping project and develop maps using appropriate surveying and mapping software. Spring.  
Co-requisites: FTC 252 and FTC 259.

**FTC 259 Introduction to Computer Aided Drafting and Design (4)**

Fifty hours of lecture and 60 hours of field and laboratory time. An introduction to the concepts and procedures of using AutoCAD in conjunction with surveying programs to produce boundary, topographic and construction survey maps. Significant laboratory time dedicated to hands-on experience with software and hardware. Spring.

**FTC 298 Independent Study in Forest Technology (1 - 6)**

Independent study in forest technology to apply, enhance or supplement forest technology or related natural resource education. Objectives and scope of the project are negotiated in a learning contract between the student and instructor(s), with course admission based on permission of the instructor(s). Limited to those who have attended the complete regular SFT program, or those who have graduated from another forest technology program or a related natural resource program, or to students enrolled in any ESF program other than SFT. A maximum of six credit hours may be taken by any student in total. Semesters as arranged. Fall, Spring or Summer.

**GNE - General Engineering****GNE 160 Computing Methods for Engineers and Scientists (3)**

Two hours lecture and three hours laboratory per week. Introduction to algorithm design, programming structures, and data structures. Engineering calculation software including programming languages, spreadsheets, and simulation software. Application of computing methods to engineering problems and data analysis. Fall.

**GNE 171 Engineering Mechanic Dynamics (2)**

Two hours of lecture per week. Kinematics and kinetics of particles and rigid bodies; rectangular, normal and tangential, radial and transverse components; translation and rotation; force and acceleration; impulse; momentum; work and energy; impact. Spring.  
Prerequisites: Statics and Calculus II.

**GNE 172 Statics and Dynamics (4)**

Four hours of lecture per week. This course provides fundamental principles, methods and applications of engineering mechanics. Development and discussion of analytic models for rigid-body mechanics are used to apply theories. Rigid bodies of a practical nature and at rest or in motion are covered. Fall.  
Prerequisites: Algebra, derivative and integral calculus.

**GNE 273 Mechanics of Materials (3)**

Three hours of lecture per week. Theories of stress, deformation and stability of common structural materials subjected to various force systems. Spring.  
Prerequisites: Integral calculus and statics.

**GNE 330 Professional Engineering Skills Seminar (0.5)**

Two hour seminar approximately every other week. Professional skills needed by engineers to be successful in their profession including teamwork, ethics, communications, impact of engineering solutions, life-long learning, and contemporary issues. Seminar topics include industry outlook, professional organizations, networking, finance, management, personnel issues, among other topics. Topics will typically be covered on a three-year cycle. Fall and Spring.

**GNE 410 Structures (4)**

Three hours of lecture, three hours of computation laboratory and discussion per week. Engineering principles in the analysis, planning design

and construction of components and framed structures under various types of loadings. The proportioning of wood, steel and composite members and the design of statically determinate structural systems. Emphasis is placed on the relationship between theoretical stress analysis and codes and specifications for appropriate materials and structural design practices. Fall.  
Prerequisite(s): GNE 273 and scientific computing.

**GNE 461 Air Pollution Engineering (3)**

Three hours of lecture and discussion per week. Study of physical, chemical, legislative, and meteorological aspects of air pollution and its control. Air quality and emission standards. Local and global effects of air pollution and atmospheric dispersion modeling. Design principles of air pollution control devices. Fall.

Prerequisites: 1 year of college-level physics, chemistry and calculus. Note: Credit will not be granted for both GNE 461 and GNE 661.

**GNE 530 Professional Engineering Skills Seminar (0.5)**

Two hour seminar approximately every other week. Professional skills needed by engineers to be successful in their profession including teamwork, ethics, communications, impact of engineering solutions, life-long learning, and contemporary issues. Seminar topics include industry outlook, professional organizations, networking, finance, management, personnel issues, among other topics. Topics will typically be covered on a three-year cycle. A project is required. Fall and Spring.

**GNE 661 Air Pollution Engineering (3)**

Three hours of lecture and discussion per week. Study of physical, chemical, legislative, and meteorological aspects of air pollution and its control. Air quality and emission standards. Local and global effects of air pollution and atmospheric dispersion modeling. Design principles of air pollution control devices. Fall.

Prerequisites: 1 year of college-level physics, chemistry and calculus. Note: Credit will not be granted for both GNE 461 and GNE 661.

**LSA - Landscape Architecture**

**LSA 132 Orientation Seminar: Landscape Architecture (1)**

One hour of lecture, discussion and/or exercises per week. Occasional field trips. Orientation to campus resources available to ensure academic success. Introduction to the professional culture and some topics of interest to landscape architects. Fall.

**LSA 182 Drawing Studio (3)**

Six hours of studio and one hour of lecture per week. This drawing course introduces the students to materials, techniques and components of drawing, architectural elements and figure drawing. Fall and Spring.

Prerequisite: Landscape architecture students or permission of instructor.

**LSA 190 Clashing Perspectives in the Built Environment\* (3)**

Three hours of lecture/discussion per week. Can obesity, depression, and other public health issues be linked to the design of cities and suburbs? Examine how past and present social behavior, societal needs and cultural values shape the environment. Explore the complex array of public and private decisions--and their unintended consequences--on our physical communities. Spring and Fall.

\*This course description was added to the on-line catalog on October 21, 2009.

**LSA 200 Basic Computing (1)**

Three hours of lab per week for the first five weeks of the semester. Students learn skills for digital data storage (flash drives, HDs, externals, CD/DVD writing); data management (file formats, file versions, compression and backups); networking (throughput, e-mail, Blackboard, online storage and FTP); typefaces/fonts; scanning; printing; and basic office applications. Software training emphasizes Word, Excel, PowerPoint and scanning software. Summer or Fall.

Prerequisite(s): Undergraduate standing in Landscape Architecture or permission of the instructor.

**LSA 205 Art, Culture and Landscape I (3)**

Three hours of lecture per week. The course will examine the evolution of cultural expression in the arts and allied design professions. Lectures will emphasize the interrelationships between the arts and their cultural contexts from prehistory to the Renaissance. Fall.

**LSA 206 Art, Culture and Landscape II (3)**

Three hours of lecture per week. The course will examine the evolution of cultural expression in the arts and allied design professions. Lectures will emphasize the interrelationships between the arts and their relation to cultural contexts from the Renaissance to the present day. Spring.

**LSA 220 Introduction to Landscape Architecture (3)**

Three hours of lecture per week. LSA 220 presents an overview and introduction to the profession of landscape architecture. It presents a survey of the development of the profession in the United States and how the profession responds to societal needs in providing services to various public and private clients. Emphasis is placed on understanding the significance of environmental, socio/cultural, physical/visual, and aesthetic factors in developing intervention strategies and designs. Contemporary landscape architectural issues, practitioners and work are presented. Fall.

**LSA 226 Foundation Design Studio I (4)**

Five hours of studio and one hour of lecture per week. Studio time devoted to demonstrations, exercises and projects. Content focuses on skills and knowledge necessary to visualize and communicate 2-D and 3-D design ideas using appropriate traditional or digital graphic tools, techniques and technology. An emphasis is placed on the development of a working graphic and spatial design vocabulary and an introduction and application of fundamental design principles and the design process. Fall.

Prerequisite: LSA 182 or permission of instructor.

**LSA 227 Foundation Design Studio II (4)**

Five hours of studio and one hour of lecture per week. Studio time is devoted to demonstrations, exercises and projects. Content focuses on the expansion of skills and knowledge necessary to visualize and communicate 2-D and 3-D design ideas. An emphasis is placed on the development of a working understanding of the design process and its application toward the synthesis of design form in the landscape. Spring.

Prerequisite: LSA 226 or permission of instructor.

**LSA 300 2D Digital Graphics and Documents (3)**

Two hours of lecture and three hours of lab per week. Students learn skills in digital production methods for producing 2D graphics and

documents as posters, reports, and electronic presentations. Content includes image processing, vector drawing, desktop publishing, interactive and presentation document design, and basic computer use and digital workflow management. Software training emphasizes Adobe Creative Suite. Fall and Spring.

Prerequisite(s): Fall, none. Spring, undergraduate standing in landscape architecture or permission of the instructor. Note: Credit will not be granted for both LSA 300 and LSA 500.

### **LSA 301 Digital Graphics and Documents (2)**

Two hours of lecture and three hours of lab per week for the first ten weeks of the semester. Students learn skills for producing digital graphics and documents (posters, reports and electronic presentations). Content includes image processing, vector drawing, desktop publishing, portable digital documents, presentation documents, and digital workflow management. Software training emphasizes Photoshop, Illustrator, InDesign and Acrobat. Spring.

Prerequisite(s): Undergraduate standing in the DLA Bachelor of Landscape Architecture program or the EFB Natural History and Interpretation program, or permission of the instructor. Note: Credit will not be granted for both LSA 301 and LSA 501.

### **LSA 302 3D Modeling (1)**

Two hours of lecture and three hours of lab per week for the last five weeks of the semester. Students learn skills for producing graphic depictions from 3D digital models. Content includes 3D vector modeling and 2D bitmap image rendering to produce graphic output suitable for use in electronic presentations and digital print documents. Software training emphasizes Google SketchUp and Adobe Photoshop applications. Spring.

Prerequisite(s): Undergraduate standing in the DLA Bachelor of Landscape Architecture program, the EFB Natural History and Interpretation program, or permission of the instructor. Completion of LSA 301 recommended.

### **LSA 303 Computer Aided Design (2)**

Two hours of lecture and three hours of lab per week for the first ten weeks of the semester. Students learn skills for producing digital technical drawings used mainly for construction documentation. Content emphasizes production of scale-specific vector drawings for print and portable electronic documents, and addresses digital workflow management. Software training emphasizes AutoCAD by Autodesk. Fall.

Prerequisite(s): Undergraduate standing in the DLA Bachelor of Landscape Architecture program or permission of the instructor. Completion of LSA 301 and 302 recommended.

### **LSA 304 Integrated Digital Graphic Methods (1)**

Two hours of lecture and three hours of lab per week for the last five weeks of the semester. Students learn skills for producing graphics derived from collaborative digital processing (CAD, vector drawing, bitmap image processing, 3D modeling and GIS software). Content emphasizes graphics for print, report documents, and electronic display and distribution. Software training emphasizes AutoCAD, Adobe Creative Suite and SketchUp. Fall.

Prerequisite(s): Undergraduate standing in the DLA Bachelor of Landscape Architecture degree program or permission of the instructor. Completion of LSA 301, 302 and 303 recommended.

### **LSA 305 History of Landscape Architecture I (3)**

Three hours of lecture per week. This course offers a survey of landscape architecture and urban design in the context of the cultural history of the western world. Prior to taking this class, students should have passed at least one semester of college-level art (LSA 206) or architectural history.

### **LSA 306 History of Landscape Architecture II (3)**

Three hours of lecture per week. Survey of landscape design in the modern era, emphasizing the 20th century through the emergence of contemporary practice. Lectures and readings on significant movements, works and designers in the cultural, social and environmental context of the period. Fall.

Prerequisites: LSA 305, or permission of instructor.

### **LSA 311 Natural Processes in Design and Planning (3)**

Three hours of lecture per week. An overview of basic principles and processes of physical and biological landscape systems with respect to their roles in landscape design and planning. Emphasizes landform, soil, slope, hydrology, climate, energy and general ecological issues as common elements influencing landscape design and the land use decision-making process. Sources and uses of environmental data are discussed. Fall.

Note: Credit will not be granted for both EST 311 and LSA 311.

### **LSA 312 Place/Culture/Design (3)**

Three hours of lecture/discussion per week. Introduction to the interpretation of common places (streets, plazas, shopping malls, neighborhoods, parks, etc.) as expressions of culture. The course uses an interdisciplinary cultural studies approach to analyze the cultural processes and practices that shape places and applies these understandings in the context of design professions. Course requirements include readings, discussions, projects, reports and examinations. Field trips may be scheduled. Fall.

### **LSA 321 Ecological Applications in Planning and Design (3)**

Three hours of lecture per week. Introduction to concepts of ecology and landscape ecology related to sustainable land planning and design. Emphasis on using theory to guide planning and design decision making, with a goal of greater integration of ecological concepts into professional work. Fall.

Prerequisite(s): Junior standing in the Bachelor of Landscape Architecture program or permission of the instructor.

### **LSA 326 Landscape Architectural Design Studio I (5)**

Seven hours of studio and one hour of lecture per week. This course will instruct those enrolled in the processes of measuring various physical qualities of a site or landscape, and then how to apply knowledge of ecology, natural processes, and human behavior and culture to assess the viability of potential design uses and forms. The material addressed will include land measurement and measurement systems, physiography and landform, soils, hydrology, climate, and plant, animal and human ecology. A variety of manual and computer techniques for data collection, analysis and synthesis of natural and cultural systems information will be explored. The course will concentrate on the comparison of synthesis techniques and their use in land use and site design decision-making. Occasional local field trips will be utilized. Fall.

Prerequisites: LSA 182, LSA 226, LSA 227 and LSA 311 (or their equivalent) with grades of "C" or better, or permission of instructor.

**LSA 327 Landscape Architectural Design Studio II (5)**

Seven hours of studio and one hour of lecture per week. This course addresses intermediate to advanced level site design, including skill development, theory and strategies as they relate to design issues and process. Emphasis is placed on in-depth investigation of concept and form expression in small-scale site design. Focus is on the form implications of applying specific materials, plantings and structural systems through design development and detailing. Occasional field trips to illustrate various design solutions. (Student field trip and materials expenses \$300-\$400).

Prerequisite: LSA 326 with a minimum grade of "C" or better, or permission of instructor. Co-requisite: LSA 342.

**LSA 333 Plants Materials (2)**

One hour of lecture followed by three hours of field identification lab per week. Course provides an introduction to the identification, site requirements, natural and cultural history, community ecology, and landscape value of native and exotic woody and herbaceous plant materials typical of landscape architectural practice. Field identification labs include on-campus site walks and trips to local gardens, arboreta and natural areas to demonstrate the use of plants in designed and ecological settings. Fall.

**LSA 342 Landscape Architectural Construction Technology (4)**

Three hours of lecture and three hours of studio/laboratory per week. Lectures, project, and assigned readings. This course provides an introduction to important site construction basics, including landscape grading and landform manipulation. Topics addressed will include appropriate slopes for various site uses, surface and subsurface drainage, principles of cut/fill analysis, pedestrian and vehicular circulation design, horizontal and vertical road alignment, storm water management, and soil erosion control. Appropriate methods and technologies will be demonstrated through studio projects and exercises. Spring.

Prerequisite: College math (with algebra and trigonometry), LSA 326, or permission of instructor.

**LSA 343 Landscape Materials and Structures (3)**

Three hours of lecture and discussion per week. This course introduces the properties of various "hardscape" design materials used in landscape architectural construction, as well as the appropriate structural systems and design detailing typical for design elements. Occasional local field trips. Spring.

**LSA 422 Landscape Architectural Design Studio III (5)**

Seven hours of studio and one hour of lecture per week. This course introduces and applies concepts urban and regional planning, environmental planning, and landscape ecology, in the context of large-scale landscape architectural, community, and urban design. Emphasis will be placed upon the application of appropriate technologies and strategies to foster environmentally and economically sustainable community forms, as well as greater environmental and social equity. Occasional field trips to illustrate various design solutions. (Student field trip and materials expenses \$300-\$400). Spring.

Prerequisites: LSA 327 with a minimum grade of "C" or better, or permission of instructor.

**LSA 423 Landscape Architectural Design Studio IV (5)**

Seven hours of studio and one hour of lecture per week. LSA 423 addresses the final refining stages of small-scale site design, design detailing, precise layout and grading, selection of individual plant specimens and other materials, and the production of "working drawings" or contract documentation. Projects will include development of a complete set of working "contract documents," including layout plans, grading plans, planting plans and design details and specification. Occasional field trips to illustrate various design solutions. (Student field trip and materials expenses \$300-\$400). Spring.

Prerequisite: LSA 422 with a minimum grade of "C" or better, or permission of instructor.

**LSA 424 Preparation for Off-Campus Design Thesis Studio (1)**

One hour of lecture and discussion per week. The initial orientation and exploration of suitable landscape architecture or environmental studies topics for study during LSA 460. Students will tentatively select topics, form off-campus groups and be assigned a faculty advisor. Fall.

Prerequisite: Senior BLA standing, or permission of instructor.

**LSA 425 Orientation for Off-Campus Design Thesis Studio (3)**

Three hours of lecture and/or discussion per week. The initial orientation and exploration of suitable landscape architecture or environmental studies topics for study during LSA 460. Students undertake a detailed literature review, identify and refine research/study methods and prepare a detailed study proposal, including logistical details for LSA 460 (Off-Campus Design Thesis Studio). Spring.

Prerequisite: LSA 424 and senior BLA standing, or permission of Off-Campus Program Director.

**LSA 433 Planting Design and Practice (3)**

Two hours of lecture and three hours of lab/studio exercises per week. This course concentrates on the ecological, aesthetic and technical considerations of woody and herbaceous plant use in landscape architectural design. Concepts covered include ecological relationships among plants, cultural requirements of plants, nursery production, planting design and composition, planting plans and specifications, and plant establishment and maintenance. Course utilizes field trips to gardens, arboreta and natural areas to demonstrate planting design concepts. Fall.

Prerequisite: LSA 333 or permission of instructor. Note: Credit will not be granted for both LSA 433 and LSA 633.

**LSA 451 Comprehensive Land Planning (3)**

Three hours of lecture per week. Introduction to the planning process including survey and analysis techniques, the comprehensive plan, political context, and land use controls. Selected functional planning areas such as land use, environmental, growth management, regional planning, and economic development planning. Legal and historical basis. Spring.

Prerequisite: LSA 311 or permission of instructor. Note: Credit will not be granted for both LSA 451 and LSA 651.

**LSA 455 Professional Practice in Landscape Architecture (3)**

Three hours of lecture per week. This course examines the historic and contemporary modes of landscape architectural practice including practice types, ethics, operations, and client systems. Particular emphasis is given to the projected trends of professional practice and with impact on future roles for the landscape architect. Professional development is reviewed as it relates to internship, licensing, and continuing education. Spring.

Prerequisites: Upper division standing in landscape architecture or permission of the instructor. Note: Credit will not be granted for both LSA 455 and LSA 655.

**LSA 458 Off-Campus Design Thesis Studio: Faculty Advisor Visit, Weekly Reports and Field Studies (4)**

Twelve hours of individual field study per week conducted in an international or domestic location. Short field studies executed through on-site



observation, sketching and analysis exercises. Study progress is communicated through weekly reports to an advisor and presented during the advisor's visit, the fifth week of the Off-Campus semester. Summer or Fall.

Prerequisites: LSA 423 and LSA 425 with a minimum grade of "C". Co-requisites: LSA 459, LSA 460.

**LSA 459 Off-Campus Design Thesis Studio: Design Journal and Project Notebook (4)**

Twelve hours of individual field study per week conducted in an international or domestic location. Field observations and travel experiences documented through daily graphic and narrative entries in a design journal/sketchbook. Thesis project studies and research documented through daily entries in a project notebook. Summer or Fall.

Prerequisites: LSA 423 and LSA 425 with a minimum grade of "C". Co-requisites: LSA 458, LSA 460.

**LSA 460 Off-Campus Design Thesis Studio: Thesis Project (7)**

Twenty-one hours of individual field research and studio per week conducted in an international or domestic location. The completion of a thesis project as delineated in a proposal prepared by the student and approved by the Off-Campus faculty advisor in LSA 425. Summer or Fall.

Prerequisites: LSA 423 and LSA 425 with a minimum grade of "C". Co-requisites: LSA 458 and LSA 459.

**LSA 461 Off-Campus Final Presentation Seminar (1)**

One hour of seminar per week. Seminar time devoted to individual presentations and critique. Content focuses on individual projects undertaken as a component of LSA 460. Spring.

Prerequisite: LSA 460.

**LSA 470 Thematic Landscape Design Studio (6)**

Eight and one-half hours of studio and one hour of lecture per week. Studio time devoted to demonstrations, exercises and projects. Content focuses on different themes, topics, and scales each year, traditionally addressing sub-disciplines in landscape architecture such as urban design, community design and planning, ecological design and restoration and cultural landscape preservation. Spring.

Prerequisite: LSA 423 or permission of the instructor. Note: Credit will not be granted for both LSA 470 and LSA 670.

**LSA 480 Seminar in Urban Design (3)**

Three hours of seminar per week. This course is an exploration of literature and case studies that address the history, theories, principles and practice of 19th and 20th century North American and European urban design. The format includes readings, discussion and presentations, papers, and a three-day field trip. Fall.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 480 and LSA 680.

**LSA 481 Cultural Landscape Preservation (3)**

Two hours of presentation and one hour of discussion per week. The course provides an overview and introduction to cultural landscape preservation and the general preservation movement in the United States. Philosophy, history, and legislation of the preservation movement will be presented. The focus will be on preservation terminology and application, standards, guidelines and procedures. Research, identification, evaluation of significance, and integrity and treatment of cultural resources will be explored. Limited enrollment. Spring.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 481 and LSA 681.

**LSA 495 Selected Readings in Landscape Architecture (1 - 3)**

Exploration of selected readings in depth with individual independent study upon a plan submitted by the student and related to credit hours assigned. Upon approval of the instructor, the student may systematically investigate some subject area encountered in regularly scheduled courses or may initiate research on a variety of subject areas of determined relevance. Fall and Spring.

Prerequisite: Permission of instructor.

**LSA 496 Special Topics in Landscape Architecture (1 - 6)**

One to three hours of class meetings per week. Special topics of current interest to undergraduate students in landscape architecture and related fields. A detailed course subject description will be presented as a topic area is identified and developed. Fall and Spring.

Prerequisite: Permission of instructor. Note: Credit will not be granted for the same topic in LSA 496 and LSA 696.

**LSA 498 Introductory Research Problem (1 - 3)**

Guided study of a selection of problems relating to landscape architecture and environmental design. Emphasis on study procedure and methods employed. Enrollment at periodic intervals throughout the semester. Fall, Spring and Summer.

Prerequisite: Permission of instructor.

**LSA 500 2D Digital Graphics and Documents (3)**

Two hours of lecture and three hours of lab per week. Students learn skills in digital production methods for producing 2D graphics and documents as posters, reports, and electronic presentations. Content includes image processing, vector drawing, desktop publishing, interactive and presentation document design, and basic computer use and digital workflow management. Students prepare and present a comprehensive digital portfolio designed for electronic display and distribution. Software training emphasizes Adobe Creative Suite. Fall and Spring.

Prerequisite: Fall, none; Spring, graduate standing in landscape architecture, or permission of instructor. Note: Credit will not be granted for both LSA 300 and LSA 500.

**LSA 501 Computer Graphics II (3)**

Three hours of lecture and lab per week. Knowledge and skills are developed in advanced processing techniques for digital photography, photorealistic visual simulation and 3-D modeling. Methods include 2-D drawing and image processing; 3-D modeling, rendering, animation, video and VR; and content assembly and conveyance using electronic publishing and business presentations. Additional readings and a supplementary research component. Fall and Spring.

Prerequisite: LSA 500 or permission of instructor. Note: Credit will not be granted for both LSA 301 and LSA 501.

**LSA 552 Graphic Communication (3)**

Two three-hour studios and one one-hour lecture per week. Studio time devoted to demonstrations, exercises, and projects focusing on sketching, drafting, drawing construction and rendering techniques used in the landscape architecture field. Introduction to drawing reproduction and technologies. Emphasis on skill development, use of graphics in the design process. Drawings, examinations and a final project constitute basis for grades. Fall.

Prerequisite: Graduate status in landscape architecture or permission of instructor.

**LSA 596 Special Topics in Landscape Architecture (1 - 3)**

Experimental or special coursework in landscape architecture for graduate and undergraduate students. Subject matter and method of presentation vary from semester to semester. Fall and Spring.

Prerequisite: Permission of instructor.

**LSA 600 Design Studio I (4)**

Nine hours of studio and one hour of lecture/discussion per week. The first in a sequence of studios focusing on the concepts, skills and methods of design. This course introduces students to the basic vocabulary of theoretical design principles, to the application and operation of these in the physical environment, and to the development of three-dimensional spatial concepts in community scale patterns. The requirements for the course include readings, examinations, field trips, design exercises and projects. Fall.

Prerequisite: Graduate status in landscape architecture or permission of instructor.

**LSA 601 Design Studio II (4)**

Five hours of studio and one hour of lecture per week. The second in a sequence of studios applying the concepts, skills and methods of design in a critical analysis of various natural and human systems in community scale environments. Concentration is on the evaluation of options concerning a variety of land use activities, with special emphasis on landscape analysis and the functional and spatial quality of built environments. The requirements for this course include readings, examinations, field trips, design exercises and projects. Spring.

Prerequisites: Graduate status in landscape architecture and LSA 600, LSA 552, or permission of instructor.

**LSA 605 History of Landscape Architecture (3)**

Three hours of lecture per week. Historical study and style analysis of Western culture on environmental design, and changing attitudes and relationships to the environment. Non-Western influences on Western culture. Study of historical personalities as well as periods that are of environmental concern up to the modern period. Additional readings and a supplementary research/writing component. Spring.

Note: Credit will not be granted for both LSA 405 and LSA 605.

**LSA 610 Computer-Aided Design and Drafting (3)**

One-half hour of lecture, two and one-half hours of laboratory, and a minimum of six hours additional laboratory per week are required. This course introduces the student to the fundamentals of computer-aided design and drafting. It covers the commands needed to create a two-dimensional drawing, with particular emphasis on techniques used in the design profession applications. The requirements for the course include completing self-tutorials, creating drawings and the completion of two major projects. Fall and Spring.

Prerequisite: General knowledge of manual drafting. Note: Credit will not be granted for both LSA 410 and LSA 610.

**LSA 611 Natural Processes in Planning and Design (3)**

Two hours and 40 minutes of lecture and one hour of discussion per week. This course addresses basic principles and processes of physical landscape systems with respect to their roles in landscape design and planning. Sources and uses of environmental data are discussed and illustrated. An emphasis is placed on landform, soil, slope, hydrology, climate and general ecological issues as common elements influencing landscape design and the land use decision making process. Fall.

Prerequisite: Graduate status in landscape architecture or permission of instructor.

**LSA 615 Site Construction Grading, Drainage and Road Layout (3)**

One hour of lecture and six hours of studio per week. This course provides an introduction to important site construction basics, including landscape grading and landform manipulation to achieve appropriate slopes for use and positive surface drainage, principles of cut/fill analysis and subsurface drainage, horizontal and vertical alignment for road design, storm water management, and soil erosion control. Appropriate analysis methods and technologies will be employed through studio projects and exercises. Spring.

Prerequisite: Graduate status in landscape architecture, concurrent enrollment in LSA 601 or permission of instructor.

**LSA 620 Design Studio II--Advanced Site Design (4)**

One hour of lecture and nine hours of studio per week. This course is the third in a sequence of landscape architectural design studios. It focuses on advanced issues in site design and on the integration of project programming and design development into the design process. Concentrations include detailed designing for site layout, grading, storm water management, interior and exterior planting, site furnishing, and site lighting. Design exploration and project communication techniques are pursued such as CAD, reprographics, and computer-based visual simulation. Course requirements include readings, field trips, exercises, and design projects. Fall.

Prerequisites: Graduate status in landscape architecture, LSA 601, LSA 611, LSA 615, or permission of instructor.

**LSA 621 Design Studio IV--Community Design and Planning (4)**

Nine hours of studio and one hour of lecture and discussion per week. Design studio problems addressing principles and practice of community design, the structure and language of human settlements, community design process, natural systems and community design, and an introduction to the history, traditions and literature of the field. Spring.

Prerequisite: LSA 620 or permission of instructor.

**LSA 625 Orientation for Off-Campus Experiential Studio (2)**

This course includes two hours of lecture and discussion per week. It is an exploration of cultural, logistical and academic issues relevant to a research, internship or self-directed study experience abroad. The format also includes research and readings. Open to MLA and MS candidates. Spring.

**LSA 632 Plants and Landscapes (2)**

Twenty hours of instruction per week for two weeks. This course provides an introduction to the identification and use of native and exotic plants typical of landscape architectural practice. It also introduces students to a range of landscape contexts ranging from natural areas to urban settings and establishes a foundation for the discussion of the social, historical and ecological themes and issues of each. Field trips required. Fall.

Prerequisite: Entering MLA status or permission of the instructor.

**LSA 633 Planting Design and Practice (3)**

Two hours of lecture and three hours of lab/studio exercises per week. This course concentrates on the ecological, aesthetic and technical considerations of woody and herbaceous plant use in landscape architectural design. Concepts covered include ecological relationships among plants, cultural requirements of plants, nursery production, planting design and composition, planting plans and specifications, and plant establishment and maintenance. Course utilizes field trips to gardens, arboreta and natural areas to demonstrate planting design concepts.

Students complete a final research project that explores current and emerging trends in the use of plant materials in landscape architectural design. Fall.

Prerequisite: LSA 632 or permission of instructor. Note: Credit will not be granted for both LSA 433 and LSA 633.

**LSA 640 Research Methods (3)**

Three hours of seminar per week. Students learn skills for: (1) performing scholarly activities associated with learning what is known about topics, (2) using accepted methods for producing new knowledge which possesses qualities of validity and reliability, and (3) preparing documents which meet expectations for academic rigor. Parallels between scholarship, research and design are emphasized. Spring.

Prerequisite(s): Graduate standing in DLA graduate programs in Landscape Architecture or permission of the instructor.

**LSA 645 Construction Documentation Studio (3)**

Six hours of studio and one hour of lecture per week. This course covers the production of traditional contract documents for bidding and construction of landscape architectural projects. Taught as a shared resource with LSA 445, students enrolled in LSA 645 participate in a separate studio section. Spring.

Note: Credit will not be granted for both LSA 445 and LSA 645.

**LSA 650 Behavioral Factors of Community Design (3)**

Three hours of lecture and discussion per week. An introduction to the contribution of the behavioral sciences to community design and planning is provided. Readings and discussions concern both theoretical and methodological aspects. Case studies are used to illustrate a variety of current behavioral science applications. Course assignments familiarize the student with basic behavioral science methods including questionnaires, observations and interviews. A final project provides an opportunity to synthesize course materials. Fall or Spring.

Prerequisite: Graduate status in landscape architecture or permission of instructor.

**LSA 651 Comprehensive Land Planning (3)**

Three hours of lecture per week. Survey of urban planning and design and environmental management in terms of contemporary challenges; legal, technological, administrative and political processes; human and ecological processes; the role of design; case studies, and current and projected best practices. Lectures, readings, discussions and presentations. Required field trip. Spring.

Note: Credit will not be granted for both LSA 451 and LSA 651.

**LSA 652 Community Development and Planning Process (3)**

Three hours of lecture per week. This course introduces planning and community development as connected, interdependent processes.

Community dynamics, the participants in the planning and development processes, theories, principles and practices, and the role of design will be explored. Lectures, seminars, guest speakers, research projects, readings and discussion will be used to engage the course material. Fall.

**LSA 655 Professional Practice in Landscape Architecture (3)**

Three hours of lecture per week. This course examines the historic and contemporary modes of landscape architectural practice including practice types, ethics, operations and client systems. Particular emphasis is given to the projected trends of professional practice and with impact on future roles for the landscape architect. Professional development is reviewed as it relates to internship, licensing and continuing education. Students enrolled in LSA 655 will also produce a graduate project portfolio. Spring.

Prerequisite: Graduate status in landscape architecture or permission of instructor. Note: Credit will not be granted for both LSA 455 and LSA 655.

**LSA 670 Thematic Landscape Design Studio (6)**

Eight and one-half hours of studio and one hour of lecture per week. Studio time devoted to demonstrations, exercises and projects. Content focuses on different themes, topics, and scales each year, traditionally addressing sub-disciplines in landscape architecture such as urban design, community design and planning, ecological design and restoration and cultural landscape preservation. Additional readings and a supplementary research/writing component. Spring.

Prerequisite: LSA 423 or permission of instructor. Note: Credit will not be granted for both LSA 470 and LSA 670.

**LSA 680 Seminar in Urban Design (3)**

Three hours of seminar per week. This course is an exploration of literature and case studies that address the history, theories, principles and practice of 19th and 20th century North American and European urban design. The format includes readings, discussion, oral presentations, papers and a three-day field trip. This course fulfills the seminar requirement for students in the Community Design and Planning area of study. Fall.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 480 and LSA 680.

**LSA 681 Cultural Landscape Preservation (3)**

Two hours of presentation and one hour of discussion per week. This course provides an overview and introduction to cultural landscape preservation and the general preservation movement in the United States. The philosophy, history and legislation of the preservation movement will be presented. The focus will be on preservation terminology and application, standards, guidelines and procedures. Research, identification, evaluation of significance and integrity, and treatment of cultural resources will be explored. A major research project and presentation are required. Spring.

Prerequisite: Permission of instructor. Note: Credit will not be granted for both LSA 481 and LSA 681.

**LSA 696 Special Topics in Landscape Architecture (1 - 6)**

One to three hours of class meetings per week. Special topics of current interest to graduate students in landscape architecture and related fields. A detailed course subject description will be presented as a topic area is identified and developed. Additional readings, supplementary research and writing assignments. Fall and Spring.

Prerequisite: Permission of instructor. Note: Credit will not be granted for the same topic in LSA 496 and LSA 696.

**LSA 697 Topics and Issues of Landscape Architecture (1)**

Two hours of lecture and discussion every other week. Topics for discussion are selected to acquaint the entering graduate student with a generalized view and current issues facing landscape architects. Fall.

Pre- or co-requisite: Audit LSA 220 and graduate status in landscape architecture or permission of instructor.

**LSA 699 Landscape Architecture Internship (1 - 12)**

Internships provide students with a supervised field experience to apply and extend their academic abilities in a professional working environment. Enrollment is possible at various times during the semester. Fall, Spring and Summer.

Prerequisites: Fast Track BLA/MS status and written approval of an internship contract by major professor, curriculum director and field supervisor.

**LSA 700 Design Studio V - Integrative Studio (4)**

One hour of lecture and nine hours of studio per week. This studio requires the integration of design/planning processes, research methods and information, and technical skills through focus on large-scale, community-based or multicomunity-based projects. Studio work will require individual and teamwork, as well as consideration of multidisciplinary contributions and interdisciplinary work. This studio is the final studio for all MLA students. Fall.

Prerequisite: LSA 621 or permission of instructor.

**LSA 760 Off-Campus Experiential Studio (12)**

This course involves research, internship or self-directed study abroad with faculty guidance. Activities include field analysis, research, documentation, or directed fieldwork based on faculty-approved student proposals. Immersion in the host culture is a required aspect of this course. A final report is required. The course is open to MLA and MS candidates. Summer and Fall.

Prerequisites: LSA 625 and LSA 799 with a grade of B or better. Note: Credit will not be granted for both LSA 460 and LSA 760.

**LSA 796 Special Topics in Landscape Architecture (1 - 3)**

One to three hours of lecture per week. Special topics of current interest to graduate students in landscape architecture and related fields. A detailed course subject description will be presented as a topic area is identified and developed.

Prerequisite: Permission of instructor.

**LSA 798 Research Problem (1 - 12)**

Special study of assigned problems relating to landscape architecture or planning, with emphasis on critical thinking. Fall, Spring and Summer.

Prerequisite: Permission of instructor.

**LSA 799 Capstone or Thesis Proposal Development (3)**

One hour of lecture/seminar and two hours of tutorial per week. Students develop and defend a proposal for their MLA capstone projects or MS thesis. Fall or Spring.

Prerequisite: LSA 640 or permission of instructor.

**LSA 800 Capstone Studio (6)**

One hour of lecture/seminar and 15 hours of studio per week. Students complete an academic landscape architecture investigation or professional-level project. Public presentations and comprehensive project documentation are required. Grades on an "S/U" basis. This is the final MLA studio prior to graduation. Fall or Spring.

Prerequisite: LSA 799.

**LSA 898 Professional Experience (1 - 12)**

A supervised external professional work experience that satisfies Option 2 of the master's study integration requirement. Graded on an "S/U" basis. Fall, Spring and Summer. Prerequisites: Formation of committee, approval of proposed experience by committee, and the sponsor of the professional experience.

**LSA 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's degree and thesis. Graded on an "S/U" basis. Fall, Spring and Summer.

**PSE - Paper Science and Engineering**

**PSE 132 Orientation Seminar: Paper Science and Engineering (1)**

One hour lecture per week or three-hour lab/field trip per week. Introduction to campus resources available to ensure academic success.

Introduction to paper engineering as a field of inquiry and career path. Fall.

Note: Credit will not be granted for both BPE 132 and PSE 132.

**PSE 200 Introduction to Papermaking (3)**

Three hours of lecture per week. Historical and commercial consideration of the paper industry. Topics include wood handling, pulping, stock furnish, stock preparation and paper machine operation. Introductory discussions of papermaking technology, materials and paper making processes including environmental aspects. Fall.

**PSE 201 The Art and Early History of Papermaking (3)**

Two hours of lecture and three hours of studio per week. This papermaking course provides a historical (Asia - Far East) and artistic perspective in both lecture and studio formats. History lectures will include the influence of paper in non-western cultures as a practical medium for human communication and as a versatile medium for expression of various paper art forms. Studio sessions will vary but generally will focus on historical papermaking by hand using non-western techniques and those paper art forms of far eastern origin. More modern techniques in the creation of paper art forms will also be explored in studio sessions. Fall.

**PSE 202 Pulp and Paper Laboratory Skills (1)**

Three hours of laboratory per week provide a working knowledge of fundamental papermaking concepts. "Survival" skills learned enable students to perform well in subsequent PSE courses as well as summer employment. Operations and skills include: pulp preparation and analysis, papermaking, paper testing, report writing and team work. Spring.

Pre- or co-requisite: PSE 200 (concurrent registration).

**PSE 223 Introduction to Lignocellulosics (3)**

Three hours of lecture and three hours of laboratory per week. Topics included: structure and chemistry of lignocellulosic materials such as wood, including bark, agriculture residues, and grasses; major (cellulose, hemicelluloses, lignin) and minor constituents (extractives, proteins, ash); biosynthesis, distribution, structure, properties, conversion into energy, chemicals, and other products. Spring.

**PSE 296 Special Topics in Engineering (1 - 3)**

Provides experimental, interdisciplinary, or special coursework at the freshman and sophomore levels within the field of environmental resources engineering. Subject matter and course format vary from semester to semester and section to section. Fall and Spring.

**PSE 300 Introduction to Papermaking (3)**

Three hours of lecture per week. Historical and commercial consideration of the paper industry. Topics include wood handling, pulping, stock furnish, stock preparation and paper machine operation. Introductory discussions of papermaking technology, materials and paper making processes including environmental aspects. Fall.

**PSE 302 Pulp and Paper Laboratory Skills (1)**

Three hours of laboratory per week provide a working knowledge of fundamental papermaking concepts. "Survival" skills learned enable students to perform well in subsequent PSE courses as well as summer employment. Operations and skills include: pulp preparation and analysis, papermaking, paper testing, report writing and team work. Spring.

Pre- or co-requisite: PSE 300 (concurrent registration).

**PSE 304 Mill Experience (2)**

Twelve weeks full time pulp or paper mill employment approved by the Department between the junior and senior years. The student must submit a comprehensive report and give a presentation to fulfill this requirement. Fall, Spring and Summer.

Pre- or co-requisites: PSE 300, PSE 302.

**PSE 305 Co-op Experience (2)**

One semester full-time pulp or paper mill experience. Work experience as an engineering intern on company-assigned projects. Traditionally, the student works for a semester and adjacent summer also taking PSE 304. The student must submit a comprehensive report and give a presentation to fulfill this requirement. Fall and Spring.

Pre- or co-requisites: PSE 300, PSE 302.

**PSE 350 Pulping and Bleaching Processes (3)**

Two hours of lecture, three hours of laboratory per week. Discussion of the principles and fundamental chemistry applied in chemical pulping, chemical bleaching, and deinking processes. Transport and physical operations involved in fiber dispersion, washing, screening and refining. Conduct experiments in chemical pulping, chemical bleaching, de-inking, fiber refining and pulp evaluation. Spring.

Prerequisites: PSE 300, FCH 223 or PSE 223. Note: Credit will not be granted for both PSE 350 and PSE 550.

**PSE 351 Pulping and Bleaching Laboratory Skills (3)**

One hour of lecture per week provides background and information necessary for the three hours of laboratory per week. Students learn basic principles of chemical pulping and bleaching in a practical research format. Relative success in laboratory pulping and bleaching is determined by comparing results using over twenty standard test methods. Spring.

Pre- or co-requisites: FCH 223, FCH 360, FCH 380 with PSE 350 (concurrent registration).

**PSE 361 Engineering Thermodynamics (3)**

Three hours of lecture per week. Principles of classical thermodynamics applied to engineering practice. First and second laws; heat effects; property functions and their correlation; physical and chemical equilibrium; solutions and mixtures; power and refrigeration cycles. Thermodynamic analysis of processes and systems via case studies and computer simulation. Spring.

Prerequisites: MAT 296, FCH 152, PHY 211. Note: Credit will not be granted for both PSE 361 and ERE 561.

**PSE 370 Principles of Mass and Energy Balance (3)**

Three hours of lecture per week. Conservation of mass and energy applied to steady-state and dynamic process units and systems. Problem analysis and solution; computational techniques. Thermodynamic data and their use; real vs. perfect gases; steam properties; psychrometry. Fall.

Pre- or co-requisite(s): PHY 211, MAT 296 (or concurrent), FCH 152.

**PSE 371 Fluid Mechanics (3)**

Three hours of lecture per week. Fluid statics. Principles of mass, energy and momentum balance. Bernoulli's equation. Application to pipe flows, flow measurement and porous media. Movement of particles in fluid media. Rheology of fluids and suspensions typical in the pulp and paper industry (pulp, black liquor, etc.). Filtration and sedimentation of fibrous and particulate suspensions. Characteristics of pumps. Flow systems with economic considerations. Fall.

Prerequisites: PHY 211, FCH 152, MAT 296 or APM296. Note: Credit will not be granted for both PSE 371 and PSE 571.

**PSE 436 Pulp and Paper Unit Operations (3)**

Two hours of lecture and three hours of laboratory per week. Applications of momentum, heat, and mass transfer to operations in the pulp and paper industry. Topics include pulp flow, heater and heat exchanger design, black liquor evaporation, humidification, steam systems, paper and pulp drying, gas absorption, pulp washing, leaching, and extraction. Laboratory exercises include paper drying, pulp washing and cleaning, heat exchanger operations, and gas absorption for liquor preparation. Spring.

Prerequisites: PSE 361, PSE 370, PSE 371, BPE 335.

**PSE 437 Equipment Troubleshooting and Maintenance (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides students with fundamental knowledge in troubleshooting and maintenance of industrial machines, processes and systems used in pulp and paper, bioprocess, and chemical engineering field. Spring and/or Fall.

Note: Credit will not be granted for both PSE 437 and PSE 637.

**PSE 438 Biorenewable fibrous and nonfibrous products (3)**

Three hours of lecture per week. Three credit-hour advanced science course through the topics in the production and properties of lignocellulosic products. Topics cover fibrous products including different paper grades, nanocellulose and cellulose derivatives, and nonfibrous products including products of enzymatic and/or chemical conversion of biomass constituents. Spring and/or Fall.

Prerequisite(s): PSE465 Fiber and Paper Properties and/or PSE237 Introduction to Lignocellulosics or consent of instructor. Note: Credit will not be granted for both PSE 438 and PSE 638.

**PSE 450 Pulping and Bleaching Processes (3)**

Two hours of lecture, three hours of laboratory per week plus a critical review of recent literature on assigned topics including a technical write-up and presentation. Discussion of principle and fundamental chemistry in pulping and bleaching processes. Conducted experiments in pulping, bleaching and pulp evaluation. Spring.

Prerequisites: PSE 350. Note: Credit will not be granted for both PSE 450 and PSE 650.

**PSE 456 Management in the Paper Industry (3)**

Three hours of lecture per week. Provides the student with inter-active contact with active executives in the paper and allied industries. The student will develop and present studies of business cases in discussion forum to the class. An understanding of how general managers operate to manage an entire organization will be presented by visiting experts, class participation, group presentations, written papers and examinations. Spring.

Note: Credit will not be granted for both PSE 456 and PSE 656.

**PSE 465 Fiber and Paper Properties (3)**

Two hours of lecture and three hours of laboratory per week. Evaluation, study, and discussion of the physical, optical, and chemical properties of fibers, non-fibrous paper additives, and paper. The interrelationships between papermaking fibers, nonfibrous additives, and manufacturing methods, and their effects on the final quality of paper are discussed in correlation with different test methods. Spring and/or Fall.

Prerequisite: PSE 202 Introduction to Papermaking. Note: Credit will not be granted for both PSE 465 and PSE 665.

**PSE 466 Paper Pigment and Barrier Coating (3)**

Two hours of lecture/discussion per week. Evaluation and study of surface sizing, various pigment coating formulations, and introduction to polymers used in barrier coating. Study of equipment used in coating operations, fundamentals and parameters, which control their use and effects on final paper properties. Spring and/or Fall.

Prerequisite: PSE 465 Fiber and Paper Properties. Note: Credit will not be granted for both PSE 466 and PSE 666.

**PSE 467 Papermaking Wet End Chemistry (3)**

Three hours of lecture per week. Provides the student with the fundamental principles of colloid and surface chemistry as they relate to the interaction of papermaking materials and chemical additives in the wet end of a papermachine system. The topics of retention of fine solids and dewatering are addressed in detail. Application of the various topics presented during the course are made during a pilot papermachine trial. Spring.

Note: Credit will not be granted for both: PSE 467 and BPE 310.

**PSE 468 Papermaking Processes (6)**

One hour of lecture, six hours of laboratory per week. Laboratory study of the papermaking process, with emphasis on operation of the semi-commercial Fourdrinier paper machine. Emphasis is on the fundamentals of pulping, stock preparation, paper machine operation, evaluation of the finished product, and the collection and analysis of data to develop material and energy balances. Results of each paper machine run are evaluated in seminar-type discussions. Spring.

Prerequisites: PSE 300, PSE 370, PSE 465. Note: Credit will not be granted for both PSE 468 and PSE 668.

**PSE 469 Functional and Nano Additives (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides the student with fundamental knowledge of structure, occurrence and preparation of mineral materials, the concepts of mineralogy -with an emphasis on carbonates, silicates (clay, talcum), titanium dioxide, sulphates, aluminum compounds, as well as pigments. The use of mineral materials in paper making applications. Consideration of ecological and economic aspects in relation to the mineral applications. Spring and/or Fall.

Pre- or co-requisites: PSE 465. Note: Credit will not be granted for both PSE 469 and PSE 669.

**PSE 477 Process Control (3)**

Three hours of lecture per week. Presents an introduction to the principles of process control. Linear analysis, Laplace transforms, and nonlinear simulation are presented and applied to feedback, and feedforward control. Examples of process simulation, accuracy and stability of control are drawn from paper industry processes. Fall.

Prerequisite: APM 485 or equivalent. Note: Credit will not be granted for both PSE 477 and PSE 677.

**PSE 480 Engineering Design Economics (3)**

Three hours of lecture per week. Steps of process design, engineering economic analysis, estimation of capital investment, operating costs, profitability measures, evaluation of alternatives, inflation. Modeling and computer simulation of process units and systems; use of software. Design exercises and case studies. Spring.

Prerequisites: PSE 370, MAT 296.

**PSE 481 Engineering Design (3)**

Three hours of lecture per week. Design-project procedure; data sources and development. Application of simulation and computer-aided design to process synthesis and plant layout. Formulation and solution of original design problems. Fall.

Prerequisites: PSE 371, PSE 372, PSE 480. Pre- or co-requisite: PBE 335.

**PSE 492 Research Practice (3)**

One hour of lecture per week and six hours of laboratory and/or recitation discussions, plus literature study of assigned topics, with emphasis on managing and executing a research project in the pulp and paper, bioprocess, chemical and environmental sector. Provides the student with in-depth knowledge of literature and patent search, correct research techniques, research planning, data gathering techniques and reporting. Fall.

Note: Credit will not be granted for both PSE 492 and PSE 792. Student needs to register for PSE 498 in Spring for research project execution.

**PSE 496 Special Topics (1 - 3)**

Lectures, conferences and discussions. Specialized topics in chemistry, chemical engineering and physics as well as topics pertaining to management as related to the pulp, paper, paperboard and allied industries. Fall and Spring.

**PSE 498 Research Problem (1 - 4)**

The student is assigned a research problem in pulping, bleaching, refining, additives, quality control of paper or paper products, or chemical engineering. The student must make a systematic survey of available literature on the assigned problem. Emphasis is on application of correct research technique rather than on the results of commercial importance. The information obtained from the literature survey, along with the data developed as a result of the investigation, is to be presented as a technical report. Fall, Spring and Summer.

**PSE 550 Pulping and Bleaching Processes (3)**

Two hour of lecture, three hours of laboratory per week. Discussion of the principles and fundamental chemistry applied in chemical pulping, chemical bleaching, and deinking processes. Transport and physical operations involved in fiber dispersion, washing, screening and refining.

Conduct experiments in chemical pulping, chemical bleaching, de-inking, fiber refining and pulp evaluation. Spring.  
Prerequisites: Graduate student standing or consent of instructor. Note: Credit will not be granted for both PSE 350 and PSE 550.

### **PSE 552 Recycling (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Topics include advanced process operation and calculations for deinking, dispersion, washing, cleaning and bleaching of recycled fiber raw materials including related chemistry used in the paper processing industry. Spring and or Fall.

### **PSE 570 Principles of Mass and Energy Balances (3)**

Three hours of lecture per week. Conservation of mass and energy applied to steady-state and dynamic process units and systems. Problem analysis and solution; computational techniques. Thermodynamic data and their use; real vs. perfect gases; steam properties; psychrometry. Computer simulation of steady and non-steady state process systems. Fall.

Prerequisites: Physics, Calculus, and General Chemistry. Note: Credit will not be granted for both PSE 370 and PSE 570.

### **PSE 571 Fluid Mechanics (3)**

Three hours of lecture per week. Fluid statics. Principles of mass, energy and momentum balance. Bernoulli's equation. Application to pipe flows, flow measurement and porous media. Movement of particles in fluid media. Rheology of fluids and suspensions typical in the pulp and paper industry (pulp, black liquor, etc.) Filtration and sedimentation of fibrous and particulate suspensions. Characteristics of pumps. Flow systems with economic considerations. Analysis of some papermaking operations such as drainage, dewatering, vacuum dewatering and wet pressing. Fall.

Prerequisites: Physics, Chemistry, Calculus. Note: Credit will not be granted for both PSE 371 and PSE 571.

### **PSE 596 Special Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Topics in environmental and resource engineering not covered in established courses. Designed for the beginning graduate student or selected upper-division undergraduate. Fall and/or Spring.

### **PSE 637 Equipment Troubleshooting and Maintenance (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides students with fundamental knowledge in troubleshooting and maintenance of industrial machines, processes and systems used in pulp and paper, bioprocess, and chemical engineering field. Spring and/or Fall.

Note: Credit will not be granted for both PSE 437 and PSE 637.

### **PSE 638 Biorenewable Fibrous and Nonfibrous Products (3)**

Three hours of lecture per week. Three credit-hour advanced science course through the topics in the production and properties of biorenewable products for graduate students. Topics include fibrous products such as different paper grades; printing and writing paper, paper board, tissue, and specialty papers, and nanocellulose and cellulose derivatives and nonfibrous products such as hemicelluloses, lignin, pectins, extractives and products of enzymatic and chemical conversion of carbohydrates. Independent academic research component required. Spring and/or Fall.

Prerequisite(s): PSE 465 Fiber and paper Properties and/or, PSE 223 Introduction to Lignocellulosics or consent of instructor. Note: Credit will not be granted for both PSE 438 and PSE 638.

### **PSE 650 Pulping and Bleaching Processes (3)**

Two hours of lecture, three hours of laboratory per week plus a critical review of recent literature on assigned topics including a technical write-up and presentation. Discussion of principle and fundamental chemistry in pulping and bleaching processes. Conducted experiments in pulping, bleaching and pulp evaluation. Spring.

Prerequisite(s): Organic, physical and analytic chemistry. Note: Credit will not be granted for both PSE 450 and PSE 650.

### **PSE 656 Management in the Paper Industry (3)**

Three hours of lecture per week. Provides the student with interactive contact with active executives in the paper and allied industries. The student will develop and present studies of business cases in discussion forum to the class. An understanding of how general managers operate to manage an entire organization will be presented by visiting experts, class participation, group presentations, written papers, and examinations. The student will critically review selected literature and present their findings. Spring.

Note: Credit will not be granted for both PSE 456 and PSE 656.

### **PSE 665 Fiber and Paper Properties (3)**

Two hours of lecture and three hours of laboratory per week. Advanced science course in evaluation, study, and discussion of the physical, optical, and chemical properties of fibers, non-fibrous paper additives, and paper. The interrelationships between fibers and nonfibrous paper additives, and manufacturing methods, and their effects on the final paper quality of paper are discussed. Independent academic research required. Spring and/or Fall.

Prerequisite: PSE 202 Introduction to Papermaking. Note: Credit will not be granted for both PSE 465 and PSE 665.

### **PSE 666 Paper Pigment and Barrier Coating (3)**

Two hours of lecture per week. Advanced course in materials and processes used in surface sizing, pigment coating, and barrier coating for graduate students. Study of equipment used in coating operations, fundamentals and parameters, which control their use and effects on final paper properties. Independent literature research with report and presentation on a selected topic. Spring and/or Fall.

Prerequisite: PSE 465 Fiber and Paper Properties. Note: Credit will not be granted for both PSE 466 and PSE 666.

### **PSE 667 Colloidal and Interface Science Applications in Papermaking (3)**

Three hours of lecture per week. Provides the student with the fundamental principles of Colloidal and Interface Science as it relates to the interaction of papermaking materials and chemical additives in the wet end of a paper machine system. The topics of retention of fine solids and dewatering are addressed in detail. Spring.

Pre- or co-requisite: Physical chemistry.

### **PSE 668 Papermaking Processes (3)**

Two hours of lecture and three hours of laboratory per week. Study of the papermaking process from theoretical and practical standpoints featuring the operation of the pilot paper machines. Emphasis is on the fundamentals of stock preparation and paper machine operations, papermaking process and product design, evaluation of the finished product, and the collection and analysis of process data. An independent

project is required in conjunction with the undergraduate paper machine runs. Spring.  
Pre- or co-requisite(s): PSE 300, PSE 370, PSE 665. Note: Credit will not be granted for both PSE 468 and PSE 668.

**PSE 669 Functional and Nano Additives (3)**

Two hours of lecture and three hours of laboratory and/or recitation discussions per week, plus literature study of assigned topics. Provides the student with fundamental knowledge of structure, occurrence and preparation of mineral materials, the concepts of mineralogy -with an emphasis on carbonates, silicates (clay, talcum), titanium dioxide, sulphates, aluminum compounds, as well as pigments. The use of mineral materials in paper making applications. Consideration of ecological and economic aspects in relation to the mineral applications. Spring and/or Fall.

Pre- or co-requisites: PSE465 Note: Credit will not be granted for both PSE 469 and PSE 669.

**PSE 677 Process Control (3)**

Three hours of lecture per week. Presents an introduction to the principles of process control. Linear analysis, Laplace transforms, and nonlinear simulation are presented and applied to feedback, and feedforward control. Examples of process simulation, accuracy and stability of control are drawn from paper industry processes. Process identification using numerical techniques and MATLAB. Fall.

Prerequisite: Differential Equations. Note: Credit will not be granted for both PSE 477 and PSE 677.

**PSE 792 Research Practice (3)**

One hour of lecture per week and six hours of laboratory and/or recitation discussions, plus literature study of assigned topics. with emphasis on managing and executing a research project in the pulp and paper, bioprocess, chemical and environmental sector. Provides the student with in depth knowledge of literature and patent search, correct research techniques, research planning, data gathering techniques and reporting. Fall.

Note: Credit will not be granted for both PSE 492 and PSE 792. Student needs to register for PSE 798 in Spring for research project execution.

**PSE 796 Advanced Topics (1 - 3)**

Lectures, conferences, discussions and laboratory. Advanced topics in forest engineering, paper science and engineering, and wood products engineering. Fall and/or Spring.

Prerequisite: Permission of instructor.

**PSE 797 Seminar (1 - 3)**

Discussion of assigned topics in the fields related to Paper Science Engineering. Spring and Fall.

**PSE 798 Research in Paper Science Engineering (1 - 12)**

Independent research topics in Paper Science Engineering. Fall, Spring or Summer.

Credit hours to be arranged.

**PSE 898 Professional Experience/Synthesis (1 - 6)**

A supervised, documented professional work experience in the Master of Professional Studies degree program. Fall, Spring, or Summer.

Pre- or co-requisite(s): Approval of proposed study plan by advisor, Faculty, and any sponsoring organization.

**PSE 899 Master's Thesis Research (1 - 12)**

Research and independent study for the master's thesis. Fall, Spring or Summer.

Credit hours to be arranged.

**PSE 999 Doctoral Thesis Research (1 - 12)**

Research and independent study for the doctoral dissertation. Fall, Spring or Summer.

Credit hours to be arranged.