1999

A high school curriculum for a course in environmental engineering

David Raymond Hunt

A HIGH SCHOOL CURRICULUM FOR A COURSE IN ENVIRONMENTAL ENGINEERING

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

Master of Art

in

Education: Vocational Education

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Approved by:

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ABSTRACT

The future of our world's environment depends on preparing and educating students for the demands of the twenty-first century. The purpose of this project was to develop an environmental engineering curriculum for high school students. The curriculum is designed to serve Hemet High School students' needs for the upgrading of the drafting program to incorporate current and future technology. Currently, the programs offered at Hemet High School do not address the need for future awareness in the area of environmental engineering. This curriculum was intended to provide students with the introductory knowledge of the career options available to them in the area of environmental engineering as well as a greater awareness of the challenges facing us regarding maintaining our planet into the new millennium.

ACKNOWLEDGMENTS

I would like to thank my parents, Bud and Barbara, who made this all possible by bringing me into this world. Also, I would like to thank my wife, Valerie, for her steadfast love and support. I would like to dedicate this to my children, Hayden and Sydney, in the hope that they will be able to enjoy a clean environment in which to raise their children, and also in memory of my sister, Kristi, who always loved clean mountain air and healthy green trees.

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CHAPTER ONE

Background

Introduction

The contents of Chapter One presents an overview of the project. The context of the problem is discussed, followed by the purpose and significance of the project. Next, the limitations and delimitations that apply to this project are reviewed. Finally, a definition of terms is presented.

Context of the Problem

The need for an awareness in the area of environmental engineering has increased, and continues to increase due to the tremendous demands that are placed on our environmental resources. The accommodation of increasing population, energy requirements, travel, food production and consumption, and almost every area involved in daily living have created this demand. With the increase of computer applications in every part of our lives comes the need for students to become familiar with the computer software applications associated with Environmental Engineering. The areas of Structural Engineering, Civil Engineering, Robotics, Alternate Energy Systems, Invention, Electronics, Hydraulics, Pneumatics, and Transportation will be an essential part of the problem solving process when dealing with environmental issues in the twenty-first century.

Considering this, an Environmental Engineering program would be a valuable addition to the Hemet Unified School District as part of the Hemet High School elective curriculum. Currently, there is no program available to high school students in this area. There are Technology Exploration courses available at the middle school level which would be an ideal feeder program into an Environmental Engineering program.

The need for an exciting and creative elective course has increased with the addition of ninth grade students to the Hemet High School population in 1995.
This increase, combined with the need for student environmental awareness, has highlighted the need for an appropriate and informative course in Environmental Engineering as an elective option for Hemet High School students.

Purpose of the Project

The purpose of this project was to design a one-semester course curriculum in Environmental Engineering for high school students. The curriculum will serve ninth through twelfth grade students in the Hemet Unified School District. The course will also serve as an ideal elective for ninth or tenth grade students who wish to enroll in the Regional Occupational Program (R.O.P.) Manufacturing Technology course. The course will focus on emission-free vehicles that can be designed, built, and tested in this R.O.P. environment. The content of the curriculum consists of computer-aided learning modules in the areas of Structural Engineering, Civil Engineering, Robotics, Alternate Energy Systems, Invention, Electronics, Hydraulics, Pneumatics, and Transportation.

Significance of the Project

The current programs that are offered at Hemet High School do not address the need for student awareness in the area of Environmental Engineering. This proposed curriculum will provide students with the introductory knowledge of the career options available to them in the area of Environmental Engineering as well as a stronger awareness of the challenges facing us in the area of maintaining our planet now and into the new millennium. Students who become creative problem solvers, through the use of team-building skills, will have the ability to become successfully employed in a wide variety of career opportunities. Post-secondary educational avenues will also be explored and discussed as a component of this curriculum.

Limitations and Delimitations

A number of limitations and delimitations surfaced during the development of this project. These limitations and delimitations are presented in the following section.

Limitations - The following number of limitations apply to this project:

1. The Environmental Engineering course will be developed based on the classroom available on the Hemet High School campus.
2. The Environmental Engineering course will be developed based the needs of the Hemet Unified School District and possible grant funding available.
3. The Environmental Engineering course will be developed specifically for the design, construction, and testing of pollution-free hybrid vehicles.

Delimitations - The following delimitations apply to this project:

1. The Environmental Engineering course could be developed for all high school students and districts.

2. The Environmental Engineering course could be transferred for use at the community college level.

3. The Environmental Engineering curriculum could be modified for use across multiple subject matter.

4. The Environmental Engineering course could be used for private corporate training programs.

Definition of Terms

The following terms are defined as they apply to this project:

Alternate Energy- A power supply that originates from an environmentally friendly, non-polluting source (Hacker, 1992).

C.A.D.- Computer aided drafting or design (Seymour, 1996).

C.N.C.- Computer numerical control (Seymour, 1996).

Civil Engineering- The application of scientific principles to the design and construction of public works and communities (Madsen, 1991).

Electronics- The science and technology of devices and systems that use electricity as a power supply (Gerrish, 1979).

Engineering- The application of scientific principles to practical purposes (French, 1978).

Environmental Engineering- The application of scientific principles to methods of protecting our surroundings (Wright, 1996).

Hybrid Vehicle- An environmentally friendly transportation device that is exceptionally lightweight and aerodynamic for efficient power transfer (Wright, 1996).

Hydraulics- The science and technology of the static and dynamic behavior of liquids (Hacker, 1988).

Invention- The act or process of developing a new device, method, or process from study and experimentation (Wright, 1996).

Pneumatics- The science and technology of the static and dynamic behavior of gases (Hacker, 1988).

Robotics- The study of machines or devices that can be programmed to work automatically (Sadamoto, 1981).

Structural Engineering- The application of scientific principles to parts that are arranged or constructed to form a whole, while utilizing efficient strength to weight ratios (Madsen, 1991).

Transportation- The study and design of systems and devices to carry passengers and/or cargo from one place to another (Wright, 1996).

Organization of the Project

This project is divided into five chapters. Chapter One provides an introduction to the Context of the Problem, Purpose of the Project, Significance of the Project, Limitations, Delimitations, and the Definition of terms. Chapter Two consists of a review of the literature. Chapter Three outlines the population to be served and the project design. Chapter Four reviews the budget required for implementing the project. Chapter Five presents the conclusions and recommendations gleaned from the project. The project and references follow Chapter Five.

CHAPTER TWO

Review of the Literature

Introduction

Chapter two consists of a discussion of the relevant literature. Each subsection, or module, to be taught will be covered based on its application to the program. Current energy facts will be discussed, followed by a brief background on hybrid vehicles. The major government programs regarding hybrid vehicle design and production will be given an overview, as well as delivery systems for post-secondary educational and career opportunities. Finally, each curriculum module will be explained as it relates to the Environmental Engineering program.

Historical development for this proposal begins with the industrial revolution. The increased demand for fossil fuels spawned by manufacturing, transportation, population growth, travel, food production, and almost every area of our daily living has created the immediate need for an expanded knowledge base in the area of Environmental Engineering (Hacker, 1988).

Because of the many environmental impacts involved with the consumption of fossil fuels, this curriculum will focus on the design and manufacture of hybrid vehicles. Emerging vehicle propulsion and fuel technologies offer many possible ways to reduce energy consumption and air pollution. One of the many fallacies that is not usually addressed concerning electric vehicles is that they are emission-free. The reality is that most rechargeable batteries are charged with electricity produced by a fossil fuel-fired power plant (Wright, 1996). Although many power plants are very clean, air pollution downwind and in the vicinity of the power plant may increase. In effect, electric vehicles are not truly emission-free. Another problem is the lead-acid batteries that are currently in use are not ecologically sound or environmentally friendly.

In an effort to address these concerns and provide students with the knowledge for overcoming the problems associated with hybrid vehicle design and community planning, this curriculum will be divided into the following eight modules: Structural Engineering, Civil Engineering, Robotics, Alternate Energy Systems, Invention, Electronics, Hydraulics and Pneumatics, and Transportation.

Energy Facts

The following information was compiled by the U.S. Department of Energy at the National Renewable Energy Laboratory in 1995. This information is provided as a reference to the current U.S. dependence on fossil fuels.

- In 1993, total U.S. expenditures for energy amounted to $505 billion, or about eight percent of the gross national product.
- The cost of imported petroleum in 1993 was $56 billion, or almost ten percent of all imports.
- Fifty percent of the petroleum consumed in the United States is imported from foreign markets.
- The United States consumes more than 25 percent of the world's total oil production.

- In the transportation sector alone, the United States uses 38 percent more oil than it produces.
- Ninety-seven percent of the energy used in the transportation sector comes from petroleum.
- Proven U.S. oil reserves represent only two percent of the world's total.
- The transportation sector accounts for almost two-thirds of the total U.S. petroleum consumption.
- Transportation is the nation's largest single source of air pollution, with personal vehicles producing 26 percent of volatile organic compounds, 32 percent of nitrogen oxides, and 62 percent of carbon monoxide emissions.

Because fossil fuels are an exhaustible energy source that cannot be replaced, there is a need for an alternative form of energy to power our transportation systems in the near future.

Hybrid Vehicles

Hybrid vehicles combine two or more propulsion systems in an effort to use fuels more efficiently. Simple hybrid systems have been around as early as 1905, but the vehicles were never developed (Wouk, 1995). The average automobile system is less than 16 percent efficient. Eighty-four percent of the energy available from the fuel is lost through energy conversion as waste heat and through friction dissipated in the moving parts (Lovins, 1995).

Hybrid electric vehicles have advantages over traditional internal combustion engine vehicles. One of these is the recapturing of kinetic energy that is lost through braking by storing it in a battery or flywheel for later use. Another important advantage is the ability to design the engine for average load and let the electric motor handle peak load, thereby reducing engine size and cost while increasing efficiency. Fuel cells will play an important role in the electrical power plant of these vehicles. Fuel cells generate power from a chemical reaction as opposed to the burning of fossil fuels.

A hybrid electric vehicle can employ many types of propulsion and energy storage systems to meet a wide variety of environmental concerns. Hybrid vehicles offer a viable solution to reducing emissions and dependence on oil and are part of a larger picture of responsible transportation and environmental planning, as well as the reduction of economic and security risks that our country could face as a result of our current patterns of oil production and consumption.

Hybrid Vehicle Programs

The Partnership for a New Generation of Vehicles (PNGV) is a national program to develop hybrid vehicles that will achieve 80 miles per gallon. Formed in September 1993, it includes auto makers, the U.S. Council for Automotive Research, and the Departments of Commerce, Transportation, Energy and Defense. The program received $270 million in federal funding in 1996. The PNGV also invited universities, suppliers and others to become involved in the process. The three primary goals are to improve national competitiveness in manufacturing, implement commercially viable innovations from ongoing research to conventional vehicles, and develop a vehicle to achieve up to three times the fuel efficiency of today's comparable vehicle. To achieve the final goal, research and development is needed to improve vehicle propulsion systems in areas such as lightweight materials, efficient energy conversion systems and high power energy storage devices. The Environmental Engineering curriculum is designed to plant the seed in students' minds for further exploration into these and many more areas.

The Department of Energy (DOE) initiated a hybrid vehicle propulsion program under the management of the National Renewable Energy Laboratory (NREL) in 1993. The program is complimentary to the PNGV but more focused on propulsion systems and seeks to design and develop propulsion systems that achieve 55 miles per gallon fuel economy while meeting federal emissions and alternative fuel requirements. The DOE is sponsoring competitions such as the HEV Challenge, which offers universities and research institutions an opportunity to showcase their advanced vehicle technologies. Research suggests, this would be an excellent opportunity to showcase the Hemet High School Environmental Engineering program as well.

Delivery Systems

One of the objectives of this curriculum is to expose students to a wide variety of career options, as well as post-secondary educational opportunities. Each learning module deals with an engineering principle that is applied with an environmental emphasis. The cross-disciplinary studies will encounter problems in mathematics, physics, chemistry, english, physical science, biology, government, social science, history, and physical education.

The main career and educational focus for further training is general engineering. Engineering programs are designed to train people to design and analyze products and processes using principles of mathematics and natural sciences. Many post-secondary schools offer programs in general engineering or in specialized engineering fields. Major specialties include Civil, Mechanical, and Electrical Engineering. Other specialties may include Aeronautical, Agricultural, Architectural, Biomedical, Ceramic, Chemical, Computer, Electronic, Environmental, Metallurgical, Nuclear, Petroleum, Industrial, and Mining Engineering. Bachelor's degree programs usually take four or five years to complete. Master's degree programs usually take one to three additional years, with doctoral programs taking two or more years beyond the master's.

Some schools participate in cooperative transfer programs. Students take the first two to three years of course work at one school and then transfer to a specific engineering school for two to three years of technical training leading to a degree in Engineering. At some schools, specialization may be limited to graduate programs. Graduates of Engineering programs are qualified to take the engineer-in-training examination. A professional engineering examination may be taken after four years of work experience. All states require both tests for a professional engineering license.

Another career and post-secondary educational option for graduates of this course is Environmental Analysts. Sometimes called Ecologists, environmental analysts study the relationships between living organisms and their environment and develop plans for dealing with problems arising from their interaction. These include air and water pollution, waste disposal, and protection of endangered species and natural resources. Some in this field do technical work, conducting tests, analyzing data, and preparing reports, while others are engaged in research.

There are a variety of programs available for further study at community colleges, state universities, private colleges, universities and trade schools. According to the California Employment Development Department, mechanical engineers, upon completion of a degree program, starting salary can range from $1,820 to $3,895 per month with no experience and can climb to over $10,000 per month as top earnings. In California, by 2005, 31,660 mechanical engineers are projected to be employed with 10,790 openings due to separations and 4,660 openings due to growth over a fifteen year period from 1990-2005. Little change in growth is projected through 2005. The emphasis on product quality, greater productivity and efficient use of all forms of energy may increase opportunities. Research and development of new and sustainable energy systems and the need to solve environmental pollution problems are expected to continue. Demand for engineers with knowledge and experience in computer-aided design and manufacturing and robotics are expected to be favorable.

Curriculum Development

The Environmental Engineering course work will be based on computer-aided instruction in eight areas: Structural Engineering, Civil Engineering, Robotics, Alternate Energy Systems, Invention, Electronics, Hydraulics and Pneumatics, and transportation. All areas will have an environmental emphasis, as well as an application towards hybrid vehicle design. Students will work in groups using a team-building approach, as well as individually on self-paced learning modules. The eight areas of instruction are described as follows:

Structural Engineering- computer based instruction on the design of arches, bridges, and buildings using compression, tension, beams, and trusses. Material analysis will be included. The structures that humans have engineered are literally the foundations on which we live and work (Madsen, 1991). Both math and science combine in this field to enable us to span rivers with bridges, transport ourselves over great distances in very little time, and dwell in towers hundreds of feet tall. Engineering is an exciting way of teaching problem solving, physics, and math while fostering students' creativity.

Civil Engineering- computer based instruction on the design and planning of livable communities of tomorrow. Students will use teamwork and problem solving skills to design and manage their own cities. Civil engineers plan bridges, roads, tunnels, dams and towers through the study of math, physics, science, design, and materials (Hacker, 1988).

Robotics- computer based instruction on the fundaments of robotics including parts identification and terminology, industrial robots, micro computer controllers, robot control programming, and robot sensing systems. Although robotics sometimes seems a technology of the future, it has already permeated every aspect of our lives (Sadamoto, 1981). From automobile assembly plants to the multiple CD changer in your home stereo, robotics has automated many of our everyday tasks. Robotics can also be an invaluable teaching tool. Gears, levers, electronics, hydraulics, pneumatics, and computer numerical control programming all apply to robotics, which give students a fun and hands-on way to explore these principles.

Alternate energy systems- the study and design of power supply systems that use environmentally clean systems instead of fossil-fuels. Specifically, solar, wind, human, water, and fuel cell systems will be studied. Fossil fuels are exhaustible energy resources that cannot be replaced. Renewable energy resources are biological materials that can be grown and harvested. Inexhaustible energy resources are part of the solar weather system that exists on earth (Wright, 1996). Energy is the basic need for all technological systems. It is the foundation for all power generation and work. Energy takes the form of thermal, mechanical, electrical, chemical, radiant, and nuclear energy. A major challenge facing society is to shift our use of exhaustible sources to renewable and inexhaustible sources.

Invention- the study of inventions and inventors of the past, as well as problem solving skills for future inventions. Applied physics will also be covered. The search for the how's and why's of the world has taken the human race from the stone age to the information age and given us an insatiable need to understand and to create. The tools and technology that have resulted have brought us new ways to communicate and a greater ability with which to learn and explore. Our search for how's and why's is also the basis for our educational system (Tanner, 1980). Creation and exploration are excellent ways of motivating students to learn and grow.

Electronics- computer based instruction on the principles of electricity including: voltage, amperage, current, resistance, inductance, capacitance, converters, and circuits. The ability to harness the power of electricity is one of the greatest achievements of mankind. Along with countless other contributions, electricity has given us electronics- the controlling components of all kinds of machines that both drive our lives today and shape the life we will have tomorrow. The use of electronics has revolutionized all aspects of technology during the last hundred years (Hacker, 1988). This has happened because people have learned how to use electricity to work with information. Electronics also allows people to communicate with machines, which makes machines more useful.

Hydraulics and Pneumatics- computer based instruction on the power advantages and disadvantages of fluids and gasses. Hydraulics and pneumatics are very important energy converters in manufacturing systems for clamping, positioning, and holding objects during processing (Komcek, 1990). Hydraulics use liquids (usually oil) under pressure, while pneumatics use air under pressure to do work applications.

Transportation- the study of transportation systems of the past, the evolution to the present, and the designs of the future. A special emphasis will be on moving away from the dependence of fossil fuels as energy supplies. The development of transportation and civilization are closely related. Transportation systems have evolved to meet our changing needs. Without transportation, humans are restricted to a very small area. Transportation has become a part of human culture. We think of transportation in the same light as food, clothing, and shelter. It has become a basic need. Twenty percent of the U.S. gross national product is related to transportation and fifteen percent of personal spending goes toward transportation services (Wright, 1996).

Summary

The eight subsections will combine to give students a greater understanding and awareness of the challenges that they will encounter as the human race enters the twenty-first century and places demands on our environment as never before. A strong emphasis will be placed on moving away from our current dependence on the internal combustion engine and fossil fuel-based energy production for transportation, heating, cooling, and electricity. Strong interpersonal skills, team building, creativity, math skills, problem solving, and career options will also be emphasized.

CHAPTER THREE

Methodology

Introduction

Chapter Three details the steps used in developing the project. Specifically, the population served is discussed. Next, the curriculum development process including the curriculum structure and content validation is presented. Lastly, the existing programs are delineated. The Chapter concludes with a summary.

Population Served

This curriculum was developed for students in grades nine through twelve in the Hemet Unified School District, specifically for implementation at Hemet High School. This curriculum could be used in any high school in Riverside County, since it was developed in accordance with Riverside County Office of Education curriculum guidelines.

Curriculum Development

The next section of the project provides an overview of the curriculum development process. Specifically, the curriculum structure and content validation process are reviewed.

<u>Curriculum Structure</u> - This curriculum was developed as an original program for Hemet High School, without an existing outline available. The context of this curriculum

was carefully extracted from many technology modules available. Modules were selected and grouped based on the main objective of designing pollution-free vehicles for manufacture in the R.O.P. Manufacturing Technology class on campus. Specific content revolves around engineering principles, mechanical design, manufacturing practices, energy production, power transfer, and the incorporation of new ideas through creative thinking and problem solving. The curriculum structure was developed in accordance with the outline put forward by the Hemet Unified School District in conjunction with the model curriculum standards, program framework and process guide for industrial and technology education put forward by the California Department of Education. This outline consists of the following: (1) course title, (2) department, (3) grade level, (4) prerequisites, (5) course length, (6) repeatability, (7) college prep or non-college, (8) adoption date, (9) course description, (10) major goals, (11) exit objectives, (12) course content outline, (13) basis of evaluation, (14) textbooks, (15) supplementary materials, and (16) bulletin description.

Content Validation - The content for this curriculum will be validated by assembling a panel of experts in the area of Environmental Engineering, reviewing the curriculum and making suggestions for improvement. The suggestions for improvement made by the panel will be incorporated into the curriculum. Dr. Sandra Schnack, Riverside County Office of Education assistant superintendent for student programs and services, will review and approve the final draft of the curriculum before actual application.

Existing Programs

The curricula for two existing environmental engineering related programs were reviewed. One, the Sacramento County Office of Education R.O.P. Environmental Occupations program was reviewed. The Sacramento R.O.P. Environmental Occupations program revolves around ecosystems, agriculture and pollution. The major emphasis of the program appears to be agricultural soils. Two, the California Department of Education curriculum standards for Principles of Technology was examined. The Principles of Technology curriculum was much more similar to the proposed Environmental Engineering program in that it is based on applied physics and science rather than biological science. Complete outlines of these existing programs follow.

Existing Program Sacramento County Office of Education - The current environmental occupations program used at the Sacramento County R.O.P. is outlined in the next section.

Environmental Related Occupations Curriculum

- ECOSYSTEMS AND HOW THEY WORK 6 Hours
    1. What are Ecosystems
    2. How They Work
    3. Shaping of Ecosystems
    4. Adaptation and Extinction of Ecosystems
- POPULATION 5 Hours
    1. Population Problem

2. Addressing the Problem

- SOIL, WATER, AND AGRICULTURE 158 Hours

    1. Soil and the Soil Ecosystem

    2. Water Management

- POLLUTION 20 Hours

    1. Sediments, Nutrients, and Eutrophication

    2. Sewage and Water Pollution

    3. Groundwater Pollution

    4. Air Pollution

    5. Acid Rain, Greenhouse Effect, and Ozone Layer

    6. Risks and Economics of Pollution

- PESTS AND PEST CONTROL 15 Hours

    1. Pesticide Treadmill

    2. Natural Pest Control Methods

    3. Integrated Pest Management

- RESOURCES: BIOTA, REFUSE, ENERGY, AND LAND 15 Hours

    1. Biota: Biological Resources

    2. Converting Refuse to Resources

    3. Energy Resources and Related Problems

    4. Nuclear Power, Coal, and Synthetic Fuels

    5. Solar and Other Renewable Energy Sources

6. Lifestyle, Land Use, and Environmental Impact

- ENVIRONMENTAL RELATED OCCUPATIONS 51 Hours

1. New and Emerging Careers

2. Job Seeking Skills

TOTAL INSTRUCTIONAL HOURS 270 Hours

Existing Program California Department of Education - The current principles of technology curriculum developed by the California Department of Education is outlined in the next section.

Principles of Technology Curriculum

Principles of Technology is a high school curriculum in applied science for vocational-technical students. It is a two-year curriculum covering fourteen units in applied physics. The units are:

1. Force
2. Work
3. Rate
4. Resistance
5. Energy
6. Power
7. Force Transformers
8. Momentum
9. Waves and Vibrations
10. Energy Converters
11. Transducers
12. Radiation
13. Optical Systems
14. Time Constants

Seven units are taught in the first year and seven more units are taught in the second year. Each unit typically requires 26 class periods of 50 minutes each and shows how a technical concept can be analyzed and applied to equipment and devices in mechanical, fluid, electrical, and thermal energy systems.

Materials developed and tested for a Principles of Technology curriculum include student texts, videocassettes, demonstrations, math labs, hands-on labs, and tests. A teachers guide for each unit provides suggested presentation strategies, information on how to perform classroom demonstrations, and additional information for problem-solving labs.

The Principles of Technology Curriculum was designed to:

- Increase the employability of vocational students.
- Emphasize the principles rather than the specifics of technology and provide an understanding of mathematics associated with these principles.
- Increase the appeal of instruction by using an interest-holding instructional system incorporating video presentations, demonstrations, hands-on laboratory exercises, special exercises for students requiring additional help in mathematics, recommendations for "teaching paths" for the teacher and "learning paths" for the students, and a teacher's guide that explains how to orchestrate the learning package.
- Maintain the academic rigor needed to meet some of the increased requirements for high school graduation in science.

Summary

The steps used in the development of this project were outlined. The population served was described, as was the curriculum development process. Lastly, the existing programs were presented.

CHAPTER FOUR

Budget

Introduction

The contents of Chapter Four presents a cost breakdown of the equipment, furniture, reference and textbooks, supplies, and computer software and hardware needed to implement the project. Other necessary and overhead program costs can be calculated using the program budget form found in Appendix A. Specifically, this budget was developed by examining the many computer-aided educational technology software programs currently available and choosing the program that was determined to have the most appropriate application towards the overall Environmental Engineering curriculum. Pricing was current for the 1998-99 school year. Future cost of the same equipment and materials will undoubtedly vary.

Qty.	Description	Cost	Total
3	60" Work Table	$ 156.00	$ 468.00
3	Corner Connector	$ 69.00	$ 207.00
2	48" Work Table	$ 138.00	$ 276.00
2	Peninsula	$ 166.00	$ 332.00
1	Printer Table	$ 120.00	$ 120.00
10	Computers	$ 2,500.00	$ 25,000.00
1	Sim City 2000	$ 69.65	$ 69.65

5	7 1/2" x 14" Solar Panel	$ 83.00	$ 415.00
4	Solar Engine	$ 225.00	$ 900.00
4	Solar Racer	$ 20.00	$ 80.00
5	Passive Energy Books	$ 24.95	$ 124.75
5	Ecology Books	$ 7.95	$ 39.75
5	Weather & Climate Books	$ 7.95	$ 39.95
5	Hydrogreen House	$ 55.00	$ 275.00
1	Classroom Expansion	$ 8,000.00	$ 8,000.00
1	General Shop Cabinet	$ 4,995.00	$ 4,995.00
1	Power Tech Cabinet	$ 5,895.00	$ 5,895.00
20	Pg. 252- Chair #63-4020	$ 95.00	$ 1,900.00
1	CNC Machining Center	$50,000.00	$ 50,000.00
10	Solar Packs	$ 225.00	$ 2,250.00
1	Aerodynamics Tech.	$ 3,795.00	$ 3,795.00
1	Environment & Ecology	$ 2,995.00	$ 2,995.00
1	Introductory Robotics	$ 1,695.00	$ 1,695.00
1	Advanced Robotics	$ 5,795.00	$ 5,795.00
1	Solar Energy Trainer	$ 2,289.00	$ 2,289.00
1	Transportation Tech.	$ 5,795.00	$ 5,795.00
1	Energy & Power Tech.	$ 1,595.00	$ 1,595.00
1	Hydraulics Career Plus	$ 3,995.00	$ 3,995.00

1	Advanced Plastics	$ 4,695.00	$ 4,695.00
1	Material Supplies- Solar Car	$25,000.00	$25,000.00
	Reference and Text Books	$10,000.00	$10,000.00

TOTAL $169,035.90

Summary

Chapter Four compiled all cost requirements for implementation of the project. Prices will vary according to vendor and are approximate. The budget was designed to give a general idea of the funding necessary to begin the program from scratch. Total cost could be reduced by using existing equipment that might be available from other sources within the school system.

CHAPTER FIVE

Conclusions and Recommendations

Introduction

Included in Chapter Five is a presentation of the conclusions gleaned as a result of completing this project. Further, the recommendations extracted from this project are presented. Lastly, the Chapter concludes with a summary.

Conclusions

Based on the review of the literature and discussion with experts, there is a valid need for a high school course to raise the level of student awareness in the area of Environmental Engineering in the Hemet Unified School District. Also, Students enrolled at Hemet High School do not currently have available to them a course in which several areas of technology can be explored.

Recommendations

The curriculum should be reviewed and updated annually to ensure that the students are receiving the most current instruction possible. Funds should also be set aside on an annual basis so that when the existing hardware and software needs to be updated, the money will be available. This strategy will ensure that the students are working with the most up-to-date equipment possible. Finally, an advisory committee must be established and meetings be arranged on a regular basis so that curriculum will continue to be upgraded to meet current needs, as well as promote industry involvement for equipment and material donations.

Summary

Chapter Five reviewed the conclusions derived from the development of this project. Lastly, the recommendations culminating from this project were presented.

Appendix A: Program Budget Form

PROGRAM BUDGET FORM

Fiscal Year 19____-19____ Program Code No.______________

Program Title______________________________ District ______________________

ESTIMATED ADA AND INCOME

________ x __________ x __________ x .75 / 525 = __________ x __________ = __________

# of sections for 1 year | # slots/sections | # of hours/section in program | ADA | Comp Unit | Income

BUDGET

PLEASE ROUND ALL FRACTIONS OF A DOLLAR UP

1000 CERTIFICATED SALARIES

1110 Teachers' Salaries

__________ x __________ x __________ x __________ = __________

# of teachers | # hours/days | # days | rate of pay | subtotal

1140 Substitute Salaries

__________ x __________ = __________

days | rate of pay | subtotal

TOTAL 1000 CERTIFICATED SALARIES [ ]

2000 CLASSIFIED SALARIES

2100 Vocational Technical Assistant (Direct Teaching Assistance)

__________ x __________ x __________ x __________ = __________

# of aides | # hours/day | # days | rate of pay | subtotal

2300 Clerical

__________ x __________ x __________ = __________

TOTAL 2000 CLASSIFIED SALARIES [ ]

3000 EMPLOYEE BENEFITS

3100 State Teachers' Retirement System %__________ x __________ = __________

subtotal cert sal | subtotal

3200 Public Employee's Retirement fund %__________ x __________ = __________

subtotal clsfd sal | subtotal

3300 Old Age, Survivors, Disability, Health Insurance	%________	x ________ subtotal clsfd sal	= ________ subtotal
3330 Medicare	%________	x ________ subtotal all sal	= ________ subtotal
3350 Alternative Retirement System	%________	x________	= ________ subtotal
3400 Health and Welfare Benefits	%________	x ________ subtotal all sal	=________ subtotal
3500 State Unemployment Insurance	%________	x ________ subtotal cert sal	=________ subtotal
3600 Workers' Compensation Insurance	%________	x ________ subtotal cert sal	=________ subtotal

TOTAL 3000 EMPLOYEE BENEFITS [ ]

4000 BOOKS AND SUPPLIES

4100 textbooks Subtotal =

4200 Other Books Subtotal =

4300 Instructional Supplies Subtotal =

TOTAL 4000 BOOKS AND SUPPLIES [ ]

5000 CONTRACTED SERVICES AND OTHER OPERATING EXPENSES

5100 Consultant Services
________X________ =________

5110 Approved Inservice Activities (See program description form)
________X________ (3 maximum-1 day county,2 days district) =________

5200 Travel/ Conference
________X________ =________

5400 Insurance =________

5500 Utilities and Housekeeping services

$________Water $________ Electric
$________ Waste Disposal $________ Telephone
$________ Gas $________ Other =________

5600 Contracts, Rents and leases
5630 Rents And Leases

________X________ =________

* 5690 Student Transportation
________X________ =________

Total 5000 Contracted services and operation expenses [ ]

6000 New Equipment

* 6490 Equipment (Attach list of equipment, estimated cost and vendor) =__________

* 6590 Equipment Replacement =__________

Total 6000 New Equipment [ ]

Support Service

Subtotal of all items without asterisks (*) __________X__________% [ ]
(not to exceed15%)

Grand Total Program Cost (1000 thru 6000 + Indirect Cost) [ ]

Estimated income From ADA x Conp Unit [ ]

Appendix B: Program Objectives

Environmental Engineering

Program Objectives

By the end of this course, the student will be able to:

1. Describe the basic philosophy and definition of Environmental Eng.
2. Describe career and post-secondary educational opportunities.
3. Demonstrate basic principles and applications of structural eng.
4. Design livable communities using civil engineering concepts.
5. Identify robotic parts and recall robotic terminology.
6. Design and program a simple robot.
7. Describe energy systems and sources.
8. Identify past inventors and inventions that can be applied today.
9. Describe the basic principles of electricity.
10. Design and build a simple micro electronic circuit board.
11. Design and demonstrate hydraulic principles and applications.
12. Design and demonstrate pneumatic principles and applications.
13. Explain how the history of transportation affects our society today.
14. Design a futuristic hybrid vehicle incorporating the above principles.
15. Describe employment opportunities and demonstrate job search techniques.

Appendix C: Course Outline

ENVIRONMENTAL ENGINEERING

Course Outline

1. Introduction to Environmental Engineering — 5 hours
    a. Definition of Environmental Engineering
    b. History of Environmental Engineering
    c. Current philosophy of Environmental Engineering
    d. Career and educational opportunities.
2. Structural Engineering — 10 hours
    a. Arches, bridges, and buildings
    b. Compression, tension, beams, and trusses
    c. Material analysis
    d. Physics
3. Civil Engineering — 10 hours
    a. Futuristic Communities
    b. Maps and roads
    c. Business, industry, and living space
    d. Heating, cooling, recycling, and energy

4. Robotics 10 hours

    a. Terminology and parts identification

    b. Industrial robots

    c. Micro-computer controllers

    d. Programming and sensing systems

5. Alternate Energy Systems 10 hours

    a. Exhaustible, renewable, and inexhaustible sources

    b. Solar, wind, and water power

    c. Human power

    d. Fuel cells

6. Invention 10 hours

    a. Past inventors and inventions

    b. Applied physics

    c. Future possibilities

    d. Student project

7. Electronics 10 hours

    a. History of electronics

    b. Principles of electricity

    c. Communications

    d. Micro-electronics

8. Hydraulics and Pneumatics — 10 hours

   a. Fluids
   b. Gasses
   c. Mechanical transfer
   d. Manufacturing applications

9. Transportation — 10 hours

   a. History of transportation
   b. Power systems
   c. Aerodynamics
   d. Future designs

10. Employability Skills — 5 hours

   a. Job search skills
   b. Resume writing
   c. Interviewing
   d. Job maintenance

TOTAL HOURS — 90 HOURS

Appendix D: Site Approval Form

HEMET HIGH SCHOOL
COURSE OUTLINE

DEPARTMENT: R.O.P. / IND. TECH.

COURSE TITLE: ENVIRONMENTAL ENGINEERING

RECOMMENDED GRADE LEVEL: 10-12

PREREQUISITES: NONE

MAY COURSE BE REPEATED FOR ADD'L. CREDIT? YES

MAXIMUM UNITS OF REPEAT CREDIT PERMITTED: 5 ELECT

LENGTH OF COURSE: SEMES.

I. COURSE DESCRIPTION: This course will address the basic fundamentals of environmental engineering. A major emphasis will be on the designs of emission-free vehicles and the reduction of the consumption of fossil fuels. Areas of instruction will include structural engineering, civil engineering, robotics, alternate energy systems, invention, electronics, hydraulics, pneumatics, and transportation. The course will approach environmental engineering from a technological approach using computer aided programs and applied physics to help solve the environmental concerns of tomorrow. Team work, problem solving, and math skills will be emphasized.

II. MAJOR GOALS AND EXIT OBJECTIVES:
See attached list of program objectives.

III. BASIC COURSE CONTENT IN OUTLINE FORM:

1. Introduction to Environmental Engineering.
2. Structural Engineering.
3. Civil Engineering.
4. Robotics.
5. Alternate Energy Systems.
6. Invention.
7. Electronics.
8. Hydraulics and Pneumatics.
9. Transportation.
10. Employability Skills.

IV. EVALUATION:

Quizzes 5@ 20 points	100 points	10%
Final Exam	100 "	10%
Student Projects	300 "	30%
Text Questions	200 "	20%
Module Programs	200 "	20%
Resume and Application	100 "	10%

90-100%=A 80-89%=B 70-79%=C 60-69%=D 59% and below=Fail

Appendix E: Lesson Plans

LESSON PLAN

ENVIRONMENTAL ENGINEERING INTRODUCTION

Anticipatory Set:

Current events newspaper article on environmental impacts and/or career opportunities.

Behavioral Objective:

Students will demonstrate an introductory knowledge of the philosophy of this course in environmental engineering by correctly describing how this course will apply to the field of environmental engineering and by correctly defining environmental engineering. Students will also correctly list four post-secondary schools with programs in environmental engineering and two possible career fields in environmental engineering.

Input/Content:

-Relevant discussion regarding current environmental issues worldwide.
-Student input on philosophy and definition of environmental engineering
-Career opportunities in the environmental engineering field.
-Post-secondary educational opportunities.

Modeling:

Instruction on the use of the career center computer programs and Internet search.

Check for Understanding:

List steps for career program and internet access.

Guided Practice:

Show how to locate schools with environmental programs and internet sources for environmental study.

Independent Practice:

Students Locate four Schools with environmental engineering programs and locate four environmental websites.

Evaluation/Closure:

Students submit written report on assigned information retrieval and give oral presentation to class.

LESSON PLAN

STRUCTURAL ENGINEERING

Anticipatory Set:

Photographs of World structures: Bridges, Buildings, Arches, etc.

Behavioral Objective:

Students will demonstrate knowledge of the basic principles and applications of structural engineering by successfully designing and building a bridge that can span a given distance and support a specified weight using a given amount and type of materials.

Input/Content:

-Computer assisted learning module on Structural Engineering.
-Student team project relating to objective.

Modeling:

Initial instruction on use of the software. Examples of previous student team bridges.

Check for Understanding:

Vocabulary worksheet completion.

Guided Practice:

Use of computer TV screen while students follow on individual computers for access to correct learning module.

Independent Practice:

Successful completion of Structural Engineering learning module and team bridge activity.

Evaluation/Closure:

Students submit written report on design, construction, and testing of team bridge activity and give oral presentation to class.

LESSON PLAN

CIVIL ENGINEERING

Anticipatory Set:

Civil Engineering maps of local area.

Behavioral Objective:

Students will demonstrate knowledge of the basic principles and applications of civil engineering by successfully designing a futuristic community that is livable and sustainable as tested by the computer assisted learning module on Civil Engineering.

Input/Content:

-Computer assisted learning module on Civil Engineering.
-Student team project relating to objective.

Modeling:

Initial instruction on use of the software. Examples of previous student team communities.

Check for Understanding:

Vocabulary worksheet completion.

Guided Practice:

Use of computer TV screen while students follow on individual computers for access to correct learning module.

Independent Practice:

Successful completion of Civil Engineering learning module and team community design activity.

Evaluation/Closure:

Students submit written report on community design activity and give oral presentation to class.

LESSON PLAN

ROBOTICS

Anticipatory Set:

Short film clip on "Robots in the Manufacturing Industry".

Behavioral Objective:

Students will demonstrate knowledge of the basic principles and applications of robotics by successfully designing, programming, and building a working robot that can perform a variety of specified tasks in a set amount of time.

Input/Content:

-Computer assisted learning module on Robotics.
-Student team project relating to the objective.

Modeling:

Initial instruction on use of the software. Example of operation of classroom robot.

Check for understanding:

Vocabulary worksheet completion.

Guided Practice:

Use of computer TV screen while students follow on individual computers for access to correct learning module.

Independent Practice:

Successful completion of Robotics learning module and team robot design, program, and construction activity.

Evaluation/Closure:

Students submit written report on design, programming, and construction of robot and give oral presentation to class.

LESSON PLAN

ALTERNATE ENERGY SYSTEMS

Anticipatory Set:

Current events newspaper articles on futuristic automobiles or energy sources.

Behavioral Objective:

Students will demonstrate knowledge of the basic principles and applications of alternate energy systems by researching five approved sources and developing a five page technical report that compares and contrasts three different sources following a given format and specifications.

Input/Content:

-Types of approved sources.
-APA format.
-Reference style.
-Technical writing.
-Oral Presentation.

Check for Understanding:

Students list process on board for each step.

Guided Practice/Modeling:

Examples of presentation techniques by instructor.

Independent Practice:

Successful completion of technical report following required guidelines.

Evaluation/Closure:

Students give oral presentation to class and submit written report.

LESSON PLAN

INVENTION

Anticipatory Set:

World famous inventions of the past: Da Vinci, Franklin, Bell, etc.

Behavioral Objective:

Students will demonstrate knowledge of the basic principles and applications of invention by correctly identifying five past inventors and the corresponding contribution by that inventor.

Input/Content:

-Computer assisted learning module on invention.
-Student team project relating to objective.

Modeling:

Initial instruction on use of the software. Examples of previous inventions of the past.

Check for Understanding:

Inventor and invention matching worksheet.

Guided Practice:

Use of computer TV screen while students follow on individual computers for access to correct learning module.

Independent Practice:

Successful completion of Invention learning module and team invention activity.

Evaluation/Closure:

Students submit written report on one major inventor of the past and the contribution by that inventor that changed our lifestyle and give oral presentation to class.

LESSON PLAN

ELECTRONICS

Anticipatory Set:

Micro-electronic circuit boards passed around classroom.

Behavioral Objective:

Students will demonstrate knowledge of the basic principles and applications of electricity and electronics by successfully designing and building a working micro-electronic circuit board to given specifications with a given set of components.

Input/Content:

-Computer assisted learning module on electricity and electronics.
-Student team project relating to objective.

Modeling/Guided Practice:

Demonstration of correct connection and soldering techniques.

Check for Understanding:

Electronic symbol worksheet completion.

Independent Practice:

Successful completion of Electronics learning module and team circuit board activity.

Evaluation/Closure:

Students submit written report on design, construction, and testing of team circuit board activity and give oral presentation to class.

LESSON PLAN

HYDRAULICS AND PNEUMATICS

Anticipatory Set:

Pneumatic and Hydraulic test board displayed in center of room.

Behavioral Objective:

Students will demonstrate knowledge of the basic principles and applications of pneumatics and hydraulics by successfully designing and constructing a working model of a hydraulic and pneumatic system to achieve a specified result.

Input/Content:

-Computer assisted learning module on Hydraulics and Pneumatics.
-Student team project relating to objective.

Modeling/Guided Practice:

Use and application of test board principles.

Check for Understanding:

Vocabulary worksheet completion.

Independent Practice:

Successful completion of Hydraulic/Pneumatic learning module and team system design activity.

Evaluation/Closure:

Students submit written report on design, construction, and testing of team hydraulic/pneumatic system activity and give oral presentation to class.

LESSON PLAN

TRANSPORTATION

Anticipatory Set:
Current events newspaper article on transportation issue.

Behavioral Objective:
Students will demonstrate an understanding of the transportation sector by correctly recalling major chronological events in transportation that affect our society today. Students will also design a futuristic hybrid vehicle that will incorporate all principles covered in class.

Input/Content:
-Computer assisted learning module on Transportation.
-Student team design project of futuristic hybrid vehicle.

Modeling:
Examples of Kinetic Sculpture World Championship Race Vehicles.

Check for Understanding:
Vocabulary worksheet completion. Matching timeline worksheet completion.

Guided Practice:
Use of computer TV screen to show C.A.D. design features.

Independent Practice:
Successful completion of Transportation learning module and team vehicle design activity.

Evaluation/Closure:
Students submit written report on design of futuristic hybrid vehicle and give oral presentation to class.

Appendix F: Class Rules

Mr. Hunt's 10 easy-to-follow Class Rules

1. Come to class "calm, cool & collected"... ON TIME !
2. No talking during roll.
3. Follow your teachers directions the first time they are given.
4. Do Not leave the classroom without your teachers permission.
5. Keep your hands, feet, and objects to yourself.
6. Obey All SAFETY rules.
7. No yelling, swearing, eating, drinking, or chewing gum.
8. Do Not start working on your project until the teacher says to.
9. Every student will share in shop clean-up every day.
10. You are not dismissed from class until your teacher dismisses you.

Please READ and KNOW these 10 rules. It is your responsibility to know and understand them. They are very easy to follow, and if everyone follows them, there should be no problems in class. If they are not followed, a discipline record sheet will be kept with the students name, date, rule broken, and consequences provided. If a rule is broken, a behavior sheet will be assigned to be completed by the next school day. If the behavior sheet is not returned the following day, the assignment will be doubled. If the doubled assignment is not turned in the following day, a referral will be sent to the students counselor requesting after school detention and/or Saturday school. Please follow the rules...

I HAVE READ AND UNDERSTOOD MR. HUNTS 10 CLASS RULES--

Student Signature: ______________________________

Parent
Acknowledgement______________________________

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