



University of Nebraska at Omaha  
DigitalCommons@UNO

Student Learning


Portfolio/Visit 2016-18

5-1-2015

# UNO STEM Annual Report 2015

UNO STEM Leadership Team  
*University of Nebraska at Omaha*

Follow this and additional works at: <http://digitalcommons.unomaha.edu/oiestudentlearning>

 Part of the [Higher Education Administration Commons](#), and the [Science and Mathematics Education Commons](#)

## Recommended Citation

STEM Leadership Team, UNO, "UNO STEM Annual Report 2015" (2015). *Student Learning*. Paper 31.  
<http://digitalcommons.unomaha.edu/oiestudentlearning/31>

This Report is brought to you for free and open access by the Portfolio/Visit 2016-18 at DigitalCommons@UNO. It has been accepted for inclusion in Student Learning by an authorized administrator of DigitalCommons@UNO. For more information, please contact [unodigitalcommons@unomaha.edu](mailto:unodigitalcommons@unomaha.edu).



# UNO STEM ANNUAL REPORT

2015



# UNIVERSITY OF NEBRASKA AT OMAHA **STEM ANNUAL REPORT**

## **Dear Colleagues and Friends of UNO STEM Education,**

The following document is a brief Annual Report for the STEM Priority at UNO as of May 1, 2015. The document builds upon past strategic planning discussions, meetings, and conversations and aligns with the UNO STEM Strategic Plan, as first published in the Fall of 2013. It is important to note that the annual report is essentially a “work in progress” and will be continually refined during the next year and updated as initiatives progress. It is also a “springboard” for a continued and strategic review of our local STEM statistics and the professional literature on STEM learning, and it serves as a frame of reference for our interpretations of what other universities are doing to enhance STEM learning. The annual report is intended to be a very dynamic document that will be revisited yearly as we continue to move steadily forward.

As a STEM Leadership Team, we are certainly appreciative of the many ideas, suggestions, and thoughts that are shared with us, and we continue to move forward to an increasingly bright and collaborative future for UNO STEM education initiatives and efforts.

Your input thus continues to be a very important element of our collective action and success in STEM. If you are willing to provide further feedback for this report, or would like to make us aware of your own STEM-related initiatives, or simply want to join the conversation and collaborative efforts, please contact:

Sincerely,

The UNO STEM Leadership

Committee Members: Neal Grandgenett (Chair), Christine Cutucache, Brian Dorn, Alisa Gilmore, Jim Harrington, Angie Hodge, Vicki Lentfer, Carol Mitchell, Michael O’Hara, Mark Pauley, Iulia Podariu, Dana Richter-Egger, Chris Schaben, Bob Shuster, Amelia Squires, Rose Strasser, Scott Tarry, Neal Topp, Scott Vlasek, Sandy Vlasnik

With Assistance From:

Technical Writing Consultant: Sarah Moulton

Deans: Dave Boocker, Nancy Edick, Hesham Ali

# TABLE OF CONTENTS

Status of STEM Priority Executive Summary ..... 4

Purpose of the UNO STEM Annual Report ..... 8

Connection of the UNO STEM Strategic Plan to local and national needs ..... 8

STEM Priority Mission and Current Status by goal and objective ..... 9

    Goal 1: Teaching/Learning ..... 10

    Goal 2: Research ..... 14

    Goal 3: Service/Community Engagement ..... 16

    Goal 4: STEM Infrastructure ..... 19

Final Comments ..... 22

References ..... 23

# STATUS OF STEM PRIORITY EXECUTIVE SUMMARY

This annual report describes the status of the UNO STEM Priority as of May 1, 2015. It represents a collaborative effort by the UNO STEM Leadership Team and other faculty to assess progress to date on each objective of UNO STEM Strategic Plan. The narrative thus focuses on UNO efforts associated with each objective under the four overarching goal areas of STEM teaching, research, service, and infrastructure. This executive summary provides an overview of the key successes, persistent challenges, and anticipated next steps across all objectives.

## KEY SUCCESSES

It has been nearly two years since the STEM Strategic Plan was developed, a 17-member STEM Leadership Team was established, and the concept of a STEM Community Chair Team (STEM, Mathematics, Science, Computer Science) was put fully into place. Progress has been both steady and relatively rapid on various initiatives. The key successes identified in the report are now described.

### Teaching/Learning

A number of teaching/learning initiatives of note have been implemented. In particular, three disciplinary pathways have been established (in mathematics, physics, and chemistry) that allow a student to simultaneously pursue both a discipline and education major. There are now 24 students in the mathematics pathway, 2 in physics, and 1 in chemistry. The current pathways and overall program were showcased as the lead article in a 2014 issue of the well-known Mathematics and Computer Education (MACE) Journal. Further, a supplemental endorsement for K12 teachers in computer science has been established, with options for both undergraduate and graduate students. At the master's level, this endorsement can lead to new graduate-degree STEM pathways in either computer science or teacher education. This work in computer science education is some of the most innovative and groundbreaking in the nation. Other STEM efforts have led to a series of interdisciplinary departmental initiatives, including communities of practice built on foundations of shared interests in freshman chemistry, biology education, elementary science education, inquiry-based learning, and computer science education. New first-year general education courses have included a successful course at Glacier Creek, and new conceptual efforts and discussions are underway regarding a potential high altitude balloon course.

### Research

Interdisciplinary teams of STEM faculty have had great success in acquiring external funding for STEM learning and education research, drawing upon the strengths of their collaborative work in a metropolitan university setting. Some of the more collaborative STEM learning proposals that have recently been funded include the following: NSF Noyce - Teacher Scholarship Program NebraskaMATH Omaha Partnership (\$1.2 M); NSF ITEST - Strategic Problem-based Approach to Rouse Computer Science (\$1.1 M); NSF ITEST - Wearable Technology in STEM (\$1.2 M); US and Nebraska Department of Labor - conNEct, Nebraska's IT Educational Pathway (\$9.1 M overall/UNO \$1 M); NSF Cyberlearning: Transforming Education - Exploring Spatial-Temporal Anchored Collaboration in Asynchronous Learning Experiences (\$448,000); NSF Computing Education for the 21st Century - openHTML, a Scaffolded Web Development Tool to Support Elementary Computational Literacy (\$442,000 overall; UNO \$52,645); Sherwood Foundation - OPS/UNO Science Innovations (\$4.2 M overall / UNO Tuition); Sherwood Foundation - Science Teacher Research (\$628,208); Girls Inc. - Middle School Girls in STEM (\$70,000); Online World Wide - Computer Science Education Coursework (\$35,000). Peer reviewed publications have also greatly accelerated and have been aligned with new efforts on discipline-based education research. Journals that have included UNO STEM learning publications (either published or accepted) include: Undergraduate Studies; Mathematics and Computer Education Journal; Computer Science Education; CBE Life Sciences Education; Metropolitan Universities Journal; Journal for Leadership in Education; International Journal of Science Education; PLOS Computational Biology; Community College Journal of Research and Practice; ACM Transactions on Computer Science Education; IEEE Computer; Science Education; and PRIMUS: Problems, Resources, and Issues in Mathematics Undergraduate Studies. Several book chapters have been completed as well, including chapters in Online Learning, Girls and Women of Color in STEM, and the STEM Education Handbook, which is also being edited by UNO faculty.

### Service

We have made great strides in STEM service and outreach as a campus, and as of May 1, 2015, the STEM Leadership Team could identify 140 STEM-related outreach camps, with an estimated 3,000 students involved annually with camps alone, while specialized outreach programs to the schools, such as NE STEM 4U, reached an estimated 5,000 youth. The NE STEM 4U program itself reached more than 2,000 youth directly in the schools with after school STEM programming. Programs such as Aim for the Stars, Eureka, Tech Academy, Chemistry and Physics on Wheels (CAPOW), BioBlitz, and various individual camps are well established, and the number of community youth participating in these camps is limited primarily by space and STEM outreach personnel. Innovative STEM outreach is ramping up across UNO and has included numerous visits by P12 schools to Glacier Creek as well as events on the main campuses, such as the Calculus Bee, Kiewit Teacher Day, Code Crush, the IT Innovation Cup, and numerous other UNO-hosted events. Partnerships with the community for wider Omaha metropolitan and state events are also extensive.

and include events such as The Nebraska Science Festival, River City Rodeo STEM, Collective For Youth Lights On, Nebraska Metropolitan Science and Engineering Fair, Nebraska Association of the Gifted Showcase, Nebraska Teacher Professional Development Series, Strategic Air and Space Museum STEM Conference, Celebration of the Mind, Partnership for Kids, NE 4H Extension, and Science Olympiad, to name just a few. UNO is also increasingly partnering with P12 teachers in relatively complex STEM outreach efforts, such as designing mobile apps (MATTERS), designing open source robots (Nebraska Robotics Expo), and launching high altitude balloons (HALON). Citizen science is also becoming well established, with the Nebraska Watershed Network particularly leading the way in this important new STEM outreach strategy. Some UNO STEM outreach efforts, such as NE STEM 4U, involve a large number of UNO STEM students and have direct impacts for P12 STEM learning.

## Infrastructure

We have had some significant successes in building STEM capacity by using innovative approaches to collaborative funding of personnel. These include funding for the following: Position of Excellence Professor in STEM and Early Childhood (NU funding), a Glacier Creek STEM Learning Instructor (Hubbard Foundation with A&S Match), and a K12 Engineering Education Instructor (minority faculty development position). NE STEM 4U also hired a part-time administrator in Biology throughout the academic year to assist in hiring the nearly 60 employees paid off of this grant. In addition, using funds from the NE STEM 4U grant's indirect costs, the program will soon be hiring a part-time coordinator. Four STEM Community Chairs are now in place (STEM, Mathematics, Science, Computer Science) in three colleges and are working collaboratively to help to lead the UNO STEM initiative on an ongoing basis. Members of the UNO STEM Leadership Team are active, engaged, and working closely with STEM department chairs, while also leading their own initiatives and supporting colleagues. A STEM librarian is in place and, working with colleagues, has recently rolled out a STEM Education Library Research Guide that promises to further support UNO STEM faculty. The NU Foundation is a close partner with UNO STEM and continues to help find additional partners and donors for innovative STEM efforts, such as several curriculum development efforts and infrastructure supports for the Glacier Creek Preserve.

---

## PERSISTANT CHALLENGES

We have had some significant successes in building STEM capacity by using innovative approaches to collaborative funding of personnel. These include funding for the following: Position of Excellence Professor in STEM and Early Childhood (NU funding), a Glacier Creek STEM Learning Instructor (Hubbard Foundation with A&S Match), and a K12 Engineering Education Instructor (minority faculty development position). NE STEM 4U also hired a part-time administrator in Biology throughout the academic year to assist in hiring the nearly 60 employees paid off of this grant. In addition, using funds from the NE STEM 4U grant's indirect costs, the program will soon be hiring a part-time coordinator. Four STEM Community Chairs are now in place (STEM, Mathematics, Science, Computer Science) in three colleges and are working collaboratively to help to lead the UNO STEM initiative on an ongoing basis. Members of the UNO STEM Leadership Team are active, engaged, and working closely with STEM department chairs, while also leading their own initiatives and supporting colleagues. A STEM librarian is in place and, working with colleagues, has recently rolled out a STEM Education Library Research Guide that promises to further support UNO STEM faculty. The NU Foundation is a close partner with UNO STEM and continues to help find additional partners and donors for innovative STEM efforts, such as several curriculum development efforts and infrastructure supports for the Glacier Creek Preserve.

### 1. Overwhelming STEM Outreach Requests

One of the most difficult and rapidly increasing challenges for UNO STEM is associated with our growing success in service and outreach, as well as new partner emphases in STEM. We now receive relatively major outreach and collaboration requests nearly weekly, and some events, such as the Nebraska Science Festival, the Metropolitan Science and Engineering Fair, Collective for Youth Lights On, and the Partnership 4 Kids, take the form of very large-scale efforts involving many UNO STEM faculty, students, and collaborators. Other smaller events, such as the UNO Calculus Bee, Code Crush, BioBlitz, and the Kiewit Teacher Day, are still relatively large in scale and involve key partners. Faculty and students are often involved in these events on Saturdays and even Sundays (such as at the River City Rodeo). New guidelines for volunteer background checks and growing needs for expense processing are also increasing already heavy staff and faculty workloads, and STEM outreach increasingly needs a focused support mechanism, such as a STEM Outreach Office with administrative support.

### 2. Facility Needs

STEM departments, and particularly the sciences (Biology, Physics, Chemistry, Geology, Mathematics, Computer Science, etc.), have generally outgrown their instructional facilities. Biology in particular is confronted with desperate space needs as its programs grow to support various education, medical, and biological science initiatives. Further, because of their increasing outreach engagements, programs such as Aim for the Stars, the Tech Academy, and Eureka are running into critical challenges as they compete for very limited space in facilities that are already supporting UNO classes and research. The need for a well-planned, operationalized STEM facility with systematic input from STEM faculty, chairs, and deans is becoming increasingly apparent.

### 3. Faculty Credit for Publishing Discipline-Based Education Research

Much of UNO STEM external funding is becoming closely aligned with STEM learning and STEM education research. Larger scale NSF grants recently attained by UNO STEM faculty have particularly focused on this key STEM contribution that aligns perfectly with the UNO metropolitan mission. However, it is still difficult for some disciplinary faculty to receive “credit” for discipline-based education research articles from their reappointment, promotion, and tenure committees, even though such research is certainly a national priority associated with numerous “calls to action.” The challenge is primarily one of institutional culture that is steadily changing, but the changes need to be continually reinforced.

### 4. Collaborative Course Loads for Faculty

New innovations in STEM coursework, especially related to first-year and summer bridge programs, increasingly need the flexibility to reach across department load structures for collaborative course staffing. New STEM courses currently in planning, such as a high altitude ballooning course that would be offered for general education science credit, increasingly need to rely on interdisciplinary teams of faculty, making load assignment relatively complex. Discussions suggest that a “STEM” prefix option that crosses departments has some promise but also will involve significant load-credit discussions.

### 5. Breaking Down the Wider STEM Silo

The UNO STEM faculty have become relatively synergistic across UNO STEM departments and have made progress on breaking down internal STEM silos, but they are also aware that they need to prevent a wider STEM silo from forming that is generally associated with an inadvertent tendency to think from a historical “STEM versus non-STEM” perspective. Departments such as Psychology, Sociology, Arts and Art History, Criminal Justice, and departments in the College of Business Administration have growing STEM initiatives and interests that overlap with more traditional STEM departments. Using STEM as a context for collaboration across departments of all types is increasingly becoming of interest to STEM faculty, but such collaboration also needs to be carefully managed to prevent a loss of UNO STEM identity that has helped to fuel progress across the traditional STEM disciplines.

---

## ANTICIPATED KEY NEXT STEPS

It has been nearly two years since the STEM Strategic Plan was developed, a 17-member STEM Leadership Team was established, and the concept of a STEM Community Chair Team (STEM, Mathematics, Science, Computer Science) was put fully into place. Progress has been both steady and relatively rapid on various initiatives. The key successes identified in the report are now described.

#### 1. STEM Outreach Office Planning

Many reflections by the STEM Leadership Team surrounded the need for conceptualizing a “STEM Outreach Office” that could help to manage the overwhelming STEM outreach events and efforts that are underway and are often led by UNO. Several models are available to consider, such as a well-functioning one at UNMC, as well as the very extensive one at the Henry Doorly Zoo. The STEM Leadership Team will now take a look at this possibility in order to make an eventual proposal to the UNO administration.

#### 2. STEM Enrollment Management and Facilities White Paper

As a byproduct of the STEM Annual Report reflections, we decided that the evolving STEM conversations on campus (dual enrollment, STEM outreach, STEM building, etc.) would benefit from a faculty conversation more directly focused on increasing STEM enrollments, but that would also consider facilities and building needs (in the context of enrollment growth). This is of interest to both the STEM Leadership Team and the STEM department chairs. The target timeframe for completing the white paper would be during the Fall semester of 2015. This would also help to increase the faculty voice for a STEM building in a thoughtful way, without weakening the process to this point.

#### 3. Prioritizing of Next Initiatives by Objective

The STEM Leadership Team will also use this document, and particularly the objectives status section, as a basis for its next set of meetings on where to increasingly focus collaborative efforts, and in particular to emphasize what areas have the most potential teaching impact (freshman courses), research impact (grants and publications), and service/outreach impact (events most supportive of future UNO STEM enrollments). This will allow some important discussions to be conducted to help further widen the STEM pipelines, increase faculty participation, and effectively manage resources.

## 4. Better STEM Enrollment, Retention, and Graduation Data Models

As this annual report was being developed and edited, it became increasingly apparent that more defined data modeling for STEM enrollments, retention, and graduation data will be important. Who to count as a STEM major, how they are counted, how double majors should be integrated, dual enrollment opportunities, and STEM pipeline analytics were all identified as needing more definition. Much of the data is available, such as from PING, but STEM faculty and the STEM Leadership Team have not yet adequately engaged with the process to fully drive STEM initiatives by the data available. Discussions will be initiated in the STEM Leadership Team, in collaboration with STEM departments.

## 5. Building P12 STEM Education Graduate Programs

It is becoming increasingly important for UNO STEM to ramp up graduate program options for P12 teachers. STEM graduate courses are increasingly in demand for teachers, but there is also considerable competition both within and outside of the NU system. The Department of Teacher Education and disciplinary faculty departments have worked particularly well together to establish dual degree undergraduate pathways, graduate programs of study, and new interdisciplinary course options for teachers (such as supporting district dual enrollment). New discussions on how to build successful pathways for Omaha metropolitan area teachers that build an education alumni base and encourage enrollments in UNO programs are critical to keeping a strong STEM pipeline at UNO.

## 6. New STEM Freshman Courses

Increasingly innovative interdisciplinary STEM courses, particularly at the freshman level, are of interest to STEM faculty. There is particular excitement surfacing for courses in high altitude ballooning, in computer science, and involving environmental and science study efforts at Glacier Creek. Such courses will be tentatively proposed for general education credit and will be developed by teams of STEM faculty. Some initial planning has already taken place among interested STEM faculty.

---

# FINAL THOUGHTS

*It is certainly a bright time for UNO STEM, with steadily increasing successes in STEM related to the goals of STEM teaching, research, service, and infrastructure. There are many persistent challenges as well, and some of these challenges need to be carefully addressed with collaborative planning and systematic action. However, the STEM Priority at UNO is certainly one that continues to “ramp up” through the strong engagement and support of UNO faculty, staff, administrators, and community partners working together to make a difference in STEM learning and impact for our UNO metropolitan area. Ultimately, we are striving for a UNO STEM Priority of distinction, as UNO continues its collaborative journey toward a metropolitan university of distinction.*



# PURPOSE OF THE UNO STEM ANNUAL REPORT

It is important to remember that, in general, there is a growing history of collaborative STEM efforts on our campus and in partnership with our community. We recognize the initial foundations of this effort as we continue to strive to increase both its effectiveness and inclusion. Historically, in 2012, UNO formally established STEM learning as one of five key campus priorities, and a STEM Leadership Team was established to conduct a campus-wide strategic planning process for STEM. In 2013, the UNO STEM Strategic Plan was initiated to direct the further and ongoing development and implementation of UNO's STEM Priority and to help ensure that institutional resources are allocated appropriately to accommodate growth and maintain the educational quality of UNO's STEM programs.

The current role of the STEM Leadership Team as we prepared this report includes leading campus efforts on the STEM Priority, strengthening ties to UNO's many current STEM partners, supporting other UNO faculty in STEM initiatives, and helping new STEM-related projects to evolve. To maintain alignment of the STEM Strategic Plan with the university-wide strategic plan, to ensure continued progress toward achieving the STEM strategic goals and objectives, and to facilitate oversight of the STEM Priority, the STEM Leadership Team reviews the goals, objectives, and strategic tasks of the UNO STEM Strategic Plan periodically. Outcomes of the annual review process will now be summarized in a STEM Annual Report that is shared with stakeholders, and this document represents our first report. The UNO STEM Annual Report presented here thus summarizes the status of STEM initiatives at UNO as of May 2015, since initiation of the UNO STEM Strategic Plan in the Fall of 2013.

---

## CONNECTION OF THE UNO STEM STRATEGIC PLAN TO LOCAL AND NATIONAL NEEDS

Our plans, although local, align with national priorities, where there continues to be a growing concern that the United States is not producing enough professionals in science, technology, engineering, and mathematics (STEM) to meet our needs, especially as compared to many other countries around the world. National reports, such as the 2010 *Rising Above the Gathering Storm Revisited*, paint an alarming picture (National Academy of Sciences, 2010), and projections indicate a need for several million new college graduates with STEM degrees by 2018 (Carnevale, Smith, & Stoll, 2010).

UNO, through its STEM Priority, is fully committed to contributing to the solution of this national crisis by working cooperatively with its many community partners, including P12 educators and STEM professionals, to expand and improve the local STEM pipeline. UNO is the largest institution of higher education in the Omaha metropolitan area, which has a population of 895,000. UNO has a total student enrollment of 15,227, including 12,221 undergraduates and 3,006 graduates (Fall 2014). Over the past five years, nearly 1 in 8 students, or an average of 1,903 UNO undergraduate students per year, were STEM majors. In response to local and national challenges, UNO is thus actively and continually increasing its organizational capacity to recruit, retain, mentor, and prepare STEM students who will become STEM professionals and educators. We are also increasingly striving to enhance the diversity of our STEM students so that we increasingly become welcoming to all students.

The STEM Strategic Plan established in 2013 has four overarching goals—one each in the areas of teaching/learning, research, service/community engagement, and STEM infrastructure, and this report now references those goals and related objectives. *By targeting these four areas, the plan and this related report continue to serve as powerful and useful tools for faculty and administrators, allowing faculty to directly align their annual professional goals in the areas of teaching, research, and service with the STEM Strategic Plan, which in turn aligns with the university-wide mission and strategic plan.*

## THE UNO MISSION

*As Nebraska's metropolitan University, UNO is characterized by its strong academic foundations and creative community relationships that transform and improve the lives of constituents, the region, and the nation.*

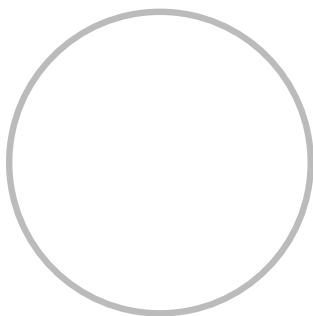
# STEM PRIORITY MISSION AND CURRENT STATUS BY GOAL AND OBJECTIVE

The UNO STEM Strategic Plan was based on the premise that an improved STEM learning environment will provide increased opportunities for engaging STEM undergraduates, graduates, and community partners in teaching, research, and service, thereby facilitating the broader impacts of STEM for our metropolitan area, state, and nation. Thus, our mission statement for the UNO STEM Priority continues to be as follows:

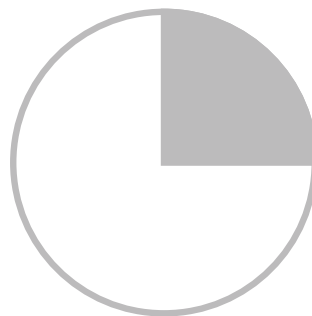
## STEM PRIORITY MISSION

*The mission of the UNO STEM Priority is to advance student understanding and success in STEM education by aggressively leading collaborative partnerships focused on increasing STEM capacity, competency, innovation, and literacy for the betterment of our metropolitan, regional, national, and international communities.*

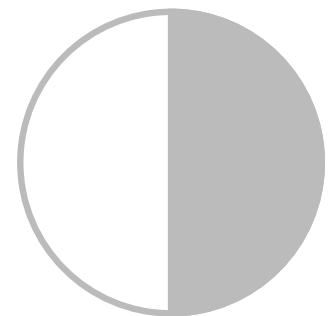
As mentioned above, the UNO STEM Strategic Plan defines four overarching goals and a set of measurable objectives for each goal. The four goal areas for the strategic plan are as follows: 1) teaching/learning, 2) research, 3) service/community engagement, and 4) STEM infrastructure. Each goal and its associated objectives are provided below. For each objective in this report of our progress to date, a brief narrative is included describing the current status of strategic tasks associated with that objective. In addition, a graphic indicator of overall progress is provided for each objective, as follows:



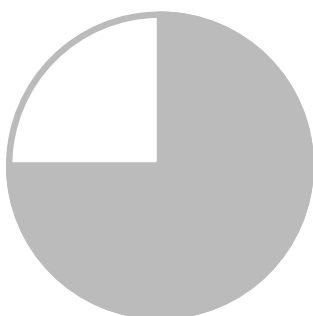
**Not Started**



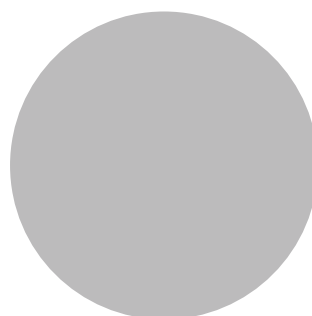
**Initiated**



**Underway**



**Fully Developed**



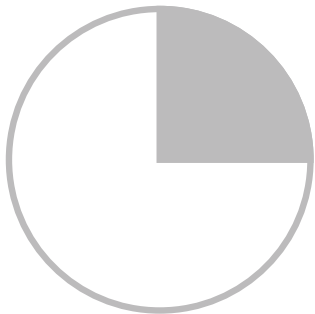
**Completed/Ongoing**



**Abandoned**

## GOAL 1: TEACHING/LEARNING

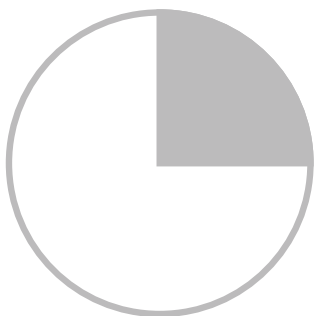
*To strengthen the P16 STEM educational pipeline through innovative and interdisciplinary UNO STEM learning initiatives and to thus increase interest, involvement, and success in the STEM disciplines among all UNO students, especially those from underrepresented groups.*



### Objective 1.1: STEM Learning Inventory

Engage an external consulting team to undertake a STEM Learning Inventory that would appraise the underlying strengths and challenges associated with the existing UNO STEM undergraduate pipeline and make written recommendations for alignment with best national practices.

The departments of Biology and Chemistry have taken the lead in analyzing their undergraduate programs to determine their alignment with best national practices. For example, Biology has initiated faculty meetings to discuss the strengths and weaknesses of UNO's undergraduate biology curriculum in relationship to the core concepts and competencies defined in Vision and Change in Undergraduate Biology Education: A Call to Action. Chemistry has also established a community of practice and established a focus group process for freshman students. These discussions have been open to other departments, and it appears now that the most effective STEM Learning Inventory approach is to work within the context of department-based initiatives.

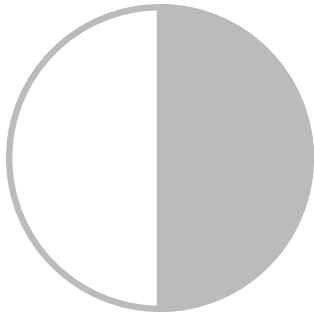


### Objective 1.2: Create a STEM Summer Bridge Program

Develop a STEM Summer Bridge Program that offers engaging summer bridge courses in areas such as space, water, and mobile technology and that enrolls at least 200 high school and community college students within three years.

The departments of Biology and Chemistry have taken the lead in analyzing their undergraduate programs to determine their alignment with best national practices. For example, Biology has initiated faculty meetings to discuss the strengths and weaknesses of UNO's undergraduate biology curriculum in relationship to the core concepts and competencies defined in Vision and Change in Undergraduate Biology Education: A Call to Action. Chemistry has also established a community of practice and established a focus group process UNO STEM is working closely with OPS and other interested school districts to design and develop a High Altitude Balloon Course available for summer bridge experiences and STEM recruiting at UNO. This course would expand upon Project HALON (High Altitude Learning Over Nebraska), a collaborative STEM outreach pilot project designed to provide a unique opportunity for students in Nebraska to get hands-on experience with a near-space research experiment. Leveraging high altitude weather balloons as the lifting platform, student researchers and faculty mentors from UNO, the University of Nebraska-Lincoln (UNL), and the Peter Kiewit Institute (PKI) developed an experimental research platform that allowed high school teams from Bellevue West and Omaha North to develop sensor packages that were lifted to the edge of space. During the experiment development process, undergraduate students and faculty served as mentors to the high school teams and helped them learn the fundamentals of NASA's space systems engineering process as they proposed an experiment, designed sensors, and built, tested, and flew their experiment on Project HALON's inaugural flight on April 14, 2015. A story about the launch and the collaboration with Offutt Air Force Base is available at: <http://www.offutt.af.mil/news/story.asp%3Fid%3D123445627>.

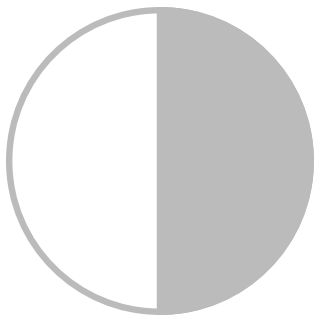
Project HALON has become a foundational experience for students interested in pursuing more sophisticated space experiments as part of the Space Technology and Exploration Laboratory (STELa) at UNO. STELa is a collaborative effort to provide a progression of experiential learning activities to students interested in space and technology. The ultimate goal of STELa is to launch Nebraska's first nanosatellite in collaboration with NASA's Advanced Exploration Systems Office. Project HALON and STELa are funded in part by the NASA Nebraska Space Grant and EPSCoR Office, which is housed in UNO's College of Public Affairs and Community Service.



### Objective 1.3: Establish Academic Learning Communities for First-Year Students Interested in STEM Majors or Careers

In alignment with UNO's new initiative to establish academic learning communities in support of its strategic priorities, pilot STEM academic learning communities for first-year students that provide focused shared-learning experiences. [Note: Objective updated to reflect multiple academic learning communities]

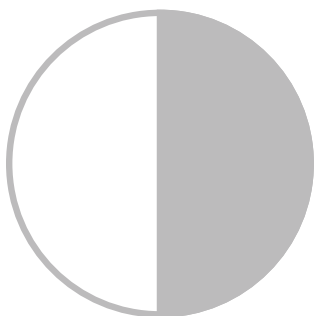
Efforts related to establishing academic learning communities led to a new interdisciplinary general education science course targeting pre-service elementary teachers fearful of science. It was taught successfully with 22 students in the Fall of 2014 at the Glacier Creek Preserve. The new STEM class was a collaborative effort among faculty in the departments of Teacher Education, Biology, Geology, Chemistry, and Computer Science. The success of the class also led to new funding (partially external) for a STEM Learning Instructor at Glacier Creek who will continue to teach it and other specialized courses at the preserve. Discussions for other freshman style classes are underway, and topics discussed have included robotics, water, and high altitude ballooning. In addition, a new academic learning community called "Maverick Mathletes" was established for first-year students enrolled in Calculus I classes taught using inquiry-based learning (IBL). Students in the community work collaboratively on IBL Calculus homework, participate in Math Club activities, and are mentored by faculty and upper-level Math Club students. The goal is to form working groups of students who learn to study together and bond as students of mathematics/STEM.



### Objective 1.4: Support New or Enhanced Courses that Innovatively Engage Students in STEM Concepts

Aligning with campus and faculty interests in new STEM coursework, particularly at introductory levels, support faculty collaboration for the development of innovative STEM coursework.

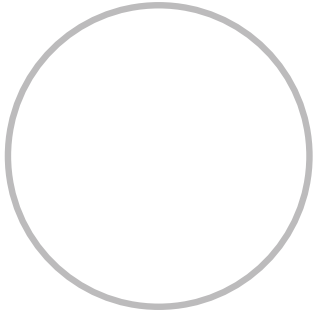
A variety of new STEM courses have been developed for students in STEM, including the following undergraduate courses: Inquiry-Based Learning in STEM and Environmental Geology, both of which are particularly for teachers, and Computer Science STEM offerings, which have expanded to include topics such as mobile app developments, textual programming, and the teaching of computer science. In addition, innovative new courses at the graduate level are being offered in Discipline-Based Education Research, Data Driven Decision Making, Engineering Education, and Problem Solving with Number Sense & Geometry for Teachers. Each of these courses has been designed collaboratively across STEM departments, and more courses are being discussed in STEM leadership and departmental meetings.



### Objective 1.5: Support Faculty Teaching Circles Focused On STEM Curriculum Development

Establish interdisciplinary and UNO-based STEM teaching circles, with faculty compensation options, to support the development of new STEM modules, workshops, courses, programs, certificates, degrees, and advising materials, as indicated by yearly increases in the number of STEM curriculum initiatives documented in the STEM Annual Report.

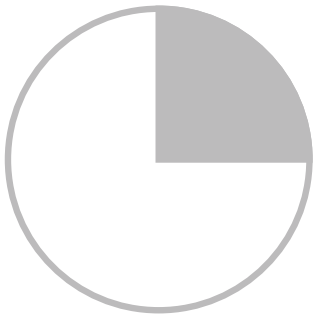
Faculty teaching circles (Communities of Practice) related to STEM have developed good momentum in the last year. Some efforts of note include Chemistry's efforts to enhance freshman coursework and laboratories, Biology's efforts to align its curriculum with national Vision and Change recommendations and another departmental effort associated with discipline-based education research, Computer Science's efforts to establish a Supplemental Endorsement for Teachers, Mathematics' Noyce Scholarship efforts, and Teacher Education's efforts on K12 engineering education. Geology and Physics also have significant community-of-practice efforts underway for teacher engagement and outreach involving numerous faculty. Each of these shared planning efforts has been multidisciplinary and across departments, and most of them have been across colleges as well.



### Objective 1.6: Expand Tutoring and Support Services for STEM

Develop innovative student support models, such as enhanced STEM tutoring and student study-group services, that lead to increased student satisfaction with STEM-related academic support services, as documented by student surveys.

Computer Science faculty received a Department of Labor Grant that has allowed them to add a Tutoring Center for CS in PKI. Expanding tutoring to include collaborative high school opportunities has been discussed by STEM Leadership, but little has been done at this point in time to operationalize what could be significant external funding opportunities along these lines. This will be the focus of one of our more important planning efforts for the next year and will fold into discussions related to a potential "STEM Outreach Office."



### Objective 1.7: Expand Faculty Professional Development in Active Learning Strategies for STEM Teaching

Expand professional development and instructional support opportunities for faculty members interested in using active learning strategies to improve their STEM-related teaching, especially in introductory coursework, as documented by course syllabi identifying the use of active learning strategies and increased student success in those courses.

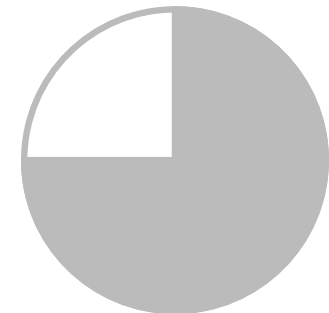
As led by Mathematics, some significant IBL training efforts have been implemented and have involved faculty across colleges. In addition, Biology has led some excellent professional development efforts on discipline-based education research. The expertise of STEM guest speakers and external consultants is increasingly being shared across the UNO campus.



### Objective 1.8: Establish an Interdisciplinary STEM Teaching Award

Increase annual faculty recognition for interdisciplinary STEM teaching success by creating an interdisciplinary STEM teaching award that directly supports the STEM Priority and that is awarded to a group of collaborating faculty.

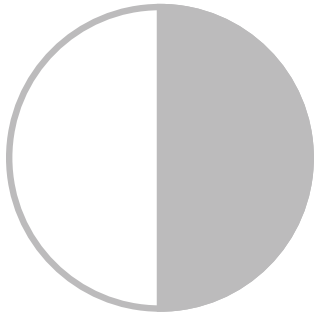
This objective was discussed and abandoned by the STEM Leadership Team; it was thought to potentially isolate STEM into a larger silo and diffuse STEM faculty's ability to work with other priority focus areas.



### Objective 1.9: Expand Undergraduate Pathways for P12 STEM Teacher Certification

Expand the STEM teacher certification pathways at UNO associated with Bachelor of Science programs in mathematics, physics, chemistry, biology, geology, and computer science, and increase enrollment in those pathways by 30% within three years.

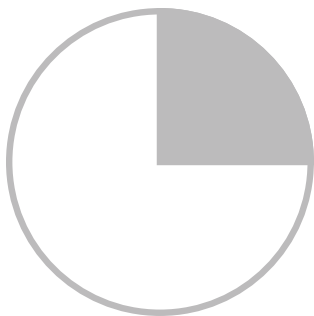
This program is expanding well, based on the success of the teacher certification pathway in mathematics. We now have established such pathways for mathematics, physics, and chemistry, and we are working on new pathways with biology and geology and a supplemental endorsement in computer science. Our next steps include finalizing the supplemental endorsement for CS teaching (7 students in pathway), continuing to work with CS on the Master of Science in Computer Science Education, and continuing to work with the College of Arts and Sciences to build programs and recruit students. It is also important to note that the collaborative work on these new pathways led to a major NSF Noyce scholarship grant for mathematics education students, as led by the Mathematics and Teacher Education departments.



### **Objective 1.10: Expand Graduate Program Pathways to Support STEM Leadership**

**Enhance graduate program pathways to support STEM leadership within P12 schools to enroll at least 5 new teacher leaders yearly in educational leadership master's and doctoral pathways starting in 2014.**

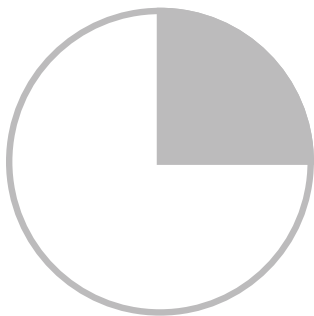
Within the Department of Educational Leadership, we now have a STEM Education doctoral pathway that prepares highly trained educational leaders in STEM. Six students are in the pathway. In Computer Science and Teacher Education, we have established an M.S. in Computer Science Education and new content and pedagogy graduate courses for teachers of STEM. Biology and Geology have both established innovative course opportunities at the graduate level, including Discipline Based Education Research and Environmental Geology. The Department of Teacher Education has updated three graduate-level programs of study options to more closely align with STEM campus goals and to further support teachers who want to undertake dual enrollment coursework.



### **Objective 1.11: Expand Distance Education in STEM**

**Investigate and develop new online and blended learning models in STEM to support student engagement locally, nationally, and internationally.**

Although our investigation of new distance-learning models in STEM is still in the early stages, there are some worthy efforts of note in this area. These include flipped classroom efforts in mathematics that have been showcased in several national and international journals, a collaborative effort between Computer Science and Teacher Education within the context of an Online World Wide Grant, an innovative fully online course taught by Biology to OPS teachers associated with Discipline Based Education Research, and Teacher Education's blended learning graduate course in Data Driven Decision Making. These pilot efforts are encouraging STEM faculty to pursue new directions in distance education.



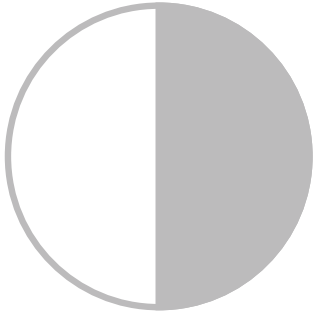
### **Objective 1.12: Expand Student Experiential Opportunities in STEM**

**Expand student experiential opportunities in STEM-related dual-enrollment coursework, student internships, service learning, and other teaching-related partnerships.**

Some excellent new efforts associated with STEM faculty's work with OPS and The Sherwood Foundation (particularly as led by Biology and Geology) have established new opportunities for collaborative teacher research efforts in STEM disciplines, Kiewit Engineering internships, and Glacier Creek field research. Mathematics is providing structured internships for first- and second-year undergraduates as part of a grant from the NSF Robert Noyce Teacher Scholarship Program, and it is supporting Learning Assistantships in Calculus classes as part of a grant from the Association of Public and Land-grant Universities (APLU).

## GOAL 2: RESEARCH

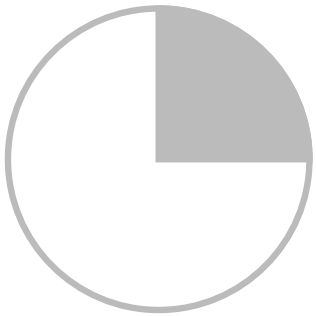
*To become a national leader in the research, development, and refinement of STEM active learning models that particularly support student success in metropolitan settings across the P16 pipeline and into STEM careers.*



### Objective 2.1: Support Active Learning Strategies for STEM Content

Continue to support UNO's evolving national leadership in the research of STEM active learning strategies, including inquiry-based learning (IBL), particularly in STEM-related content areas such as calculus and introductory biology, chemistry, and computer science, as documented by yearly increases in publications and presentations related to active learning strategies for STEM.

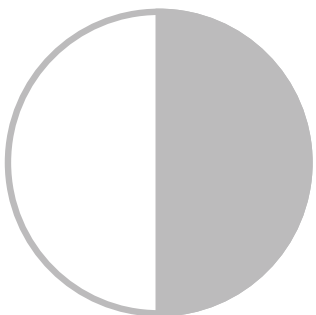
The campus STEM faculty is increasingly engaged in examining strategies for active learning, and several research efforts are underway. Mathematics faculty members are conducting research on active learning in calculus as part of a grant from the APLU. Several STEM pedagogical sessions have been conducted and attended by faculty, and faculty are starting to embrace techniques such as IBL, problem-based learning, project-based learning, and interdisciplinary group work—techniques that are increasingly being understood by STEM faculty for both their advantages and challenges. First-year classes and laboratory sessions are increasingly being targeted for potential reform, and faculty are starting to share ideas across departments. Wider UNO efforts along these lines have certainly been synergistic with those surfacing within STEM departments. Collaborative efforts on STEM active learning and student research experiences are also being expanded to include work with K12 teachers, which has been the focus of several grants, such as from the Sherwood Foundation, the Nebraska Department of Education Teacher Quality Projects, and the Kelly Foundation, to name a few. We now need to find ways to support faculty as they take the risks needed for significant course enhancements.



### Objective 2.2: Develop and Research Technology-Enhanced STEM Learning Models

UNO's growing expertise in areas such as flipped classrooms, mobile technology, authentic scientific data collection and analysis, and educational robotics, as documented by an increase in external funding for the development of technology-enhanced STEM learning models.

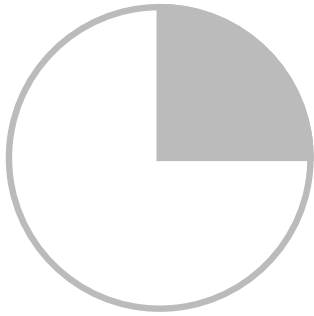
Several strategies have been undertaken to explore innovations in technology-enhanced STEM learning. STEM departments are particularly experimenting with (and refining) technology-based homework assignments, and faculty members are exploring the advantages and disadvantages of various systems and strategies for such assignments. Tablet computers and mobile apps are also being explored. Flipped classrooms are being piloted to some degree in several departments. However, the efforts to date have only just begun to explore some of the powerful technology-related opportunities available for STEM learning. This will become one of the key focus areas for future STEM-related initiatives associated with faculty professional development requests, grant proposals, and collaborative efforts.



### Objective 2.3: Emphasize the Bridge between STEM-Related Learning and Scientific Research

Build nationally recognized interdisciplinary STEM curricula that directly support the broader impacts of funded UNO science projects, and strive to apply new ideas from UNO's growing scientific research endeavors into the P16 STEM learning pipeline, as documented in the STEM Annual Report.

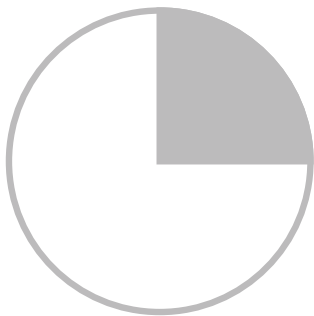
STEM faculty members are increasingly publishing collaborative articles on STEM learning and contributing to the professional literature. Faculty publications along these lines have accelerated, and are continuing to accelerate, since the establishment of the campus STEM Priority. However, publications in this area are not consistently recognized as a valid part of a faculty member’s portfolio within the reappointment, promotion, and tenure (RP&T) process, so next steps will focus on reinforcing the importance of discipline-based education research within the context of RP&T decisions. In discussions to date, STEM faculty have already brainstormed supportive efforts that might include a short white paper documenting the national “call to action” for discipline-based education research in STEM. STEM education articles during the last two years have been published in a wide range of journals. To name just a few, these journals have included the following: Undergraduate Studies; Mathematics and Computer Education Journal; Computer Science Education; CBE Life Sciences Education; Metropolitan Universities Journal; Online Learning; Journal for Leadership in Education; International Journal of Science Education; PLOS Computational Biology; Community College Journal of Research and Practice; ACM Transactions on Computer Science Education; IEEE Computer; Science Education; and PRIMUS: Problems, Resources, and Issues in Mathematics Undergraduate Studies.



### **Objective 2.4: Develop Learning Strategies that Support Diversity in STEM**

**Building upon UNO’s many metropolitan partnerships, become nationally recognized in the research and development of promising STEM learning strategies that support traditionally underrepresented populations, as identified by yearly increases in publications associated with diversity in STEM learning.**

Opportunities are increasing to work with K12 school districts and other community partners to support STEM diversity. Efforts at UNO, such as the Women in STEM, iSTEM, Math Club, and Girls Inc. Eureka, are all good examples of the increasing momentum and synergistic efforts along these lines by UNO STEM faculty. However, there is certainly much more unexplored potential for UNO STEM faculty to undertake innovative diversity building efforts, including ones that draw significant external funding. This also seems to be an area of increasing importance for STEM faculty professional development and an area that is so critically important to addressing challenges in the STEM pipelines, both locally and nationally.



### **Objective 2.5: Collaborate with Traditionally Non-STEM Disciplines**

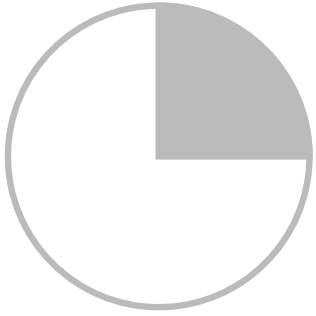
**Team with traditionally non-STEM disciplines, such as art, history, psychology, sociology, and political science, to refine models of UNO interdisciplinary collaboration related to metropolitan-based P16 STEM learning and to increase associated external funding.**

Collaboration is an area of increasing interest for faculty members in the traditionally STEM and traditionally non-STEM disciplines, and it is an important area of potential growth for UNO STEM. Diverse disciplines, such as psychology, sociology, history, the arts, and business (to name just a few), all have significant overlaps with some STEM topics. There is much to learn from these traditionally non-STEM departments that often excel in learning and engagement strategies that are still somewhat new to the STEM disciplines, such as strategies in student recruitment, project-based grading, and interdisciplinary group work. There are also increasing opportunities to receive external funding for interdisciplinary efforts, such as those where STEM is informed by the creativity and design advantages of art in a “STEAM” related project. Some of this collaborative work has already started, such as the integration of innovative art efforts at Glacier Creek. A useful next step may be to host a reception for faculty members from both STEM and historically non-STEM departments who might be interested in working together.



## GOAL 3: SERVICE/COMMUNITY ENGAGEMENT

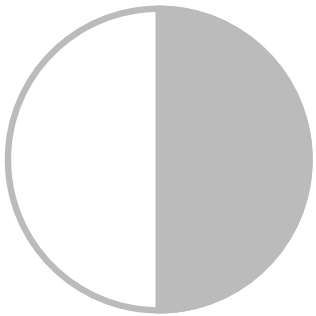
*To foster innovation in STEM service and community engagement in STEM learning through active, synergistic, and sustainable partnerships with the broader STEM community, including STEM educators, business professionals, and informal education partners.*



### Objective 3.1: Strengthen and Expand High School Access to UNO-Based STEM Tutoring

Strengthen and expand programs to provide area high school students with tutoring in the STEM disciplines, such as in calculus and introductory biology, physical science, and computer science, engaging 50% more students within the next three years.

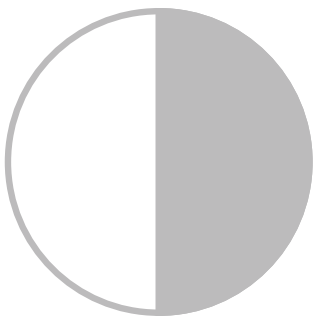
The STEM Leadership Team and the UNO Mathematics and Science Learning Center have initiated discussions about expanding high school access to UNO-based STEM tutoring, and an initial budget has been drafted to approach the NU Foundation for potential funding. In addition, Benson High School has offered to help us to pilot any program with their students, either by offering tutoring at Benson or by implementing strategies to welcome Benson students to campus-based math and science support opportunities. Discussions will be expanded during the next school year.



### Objective 3.2: Expand UNO Thematic STEM Camps and Workshops

Increase UNO based P12 STEM camps, particularly with innovative themes such as space, water quality, natural hazards, and data science, as represented by a 30% increase in the number of active P12 STEM camps and workshops offered within the next three years.

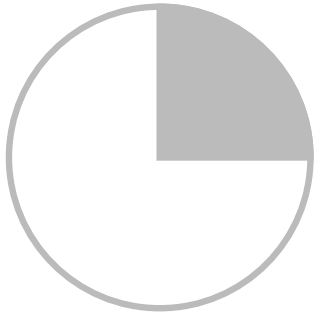
Significant work has been conducted on the Aim for the Stars program, including a strategic planning effort. This program will offer 79 camps in Summer of 2015 and will serve 1,842 students, which is the highest number of students served by the program since the camps began recording such data in 2002. Continued growth of Aim for the Stars is mainly limited by space at this point, as well as by staffing. In addition, the College of Information Science and Technology (IS&T) outreach efforts for iSTEM camps and Tech Academy have also greatly expanded and include more than 30 camps for the Summer of 2015. The College of Education is also offering various summer STEM experiences, including the extensive 4-week Eureka Camp for 60 Girls Inc. students, which is becoming increasingly nationally known. The Aviation Department is also implementing a variety of outreach efforts both on campus and in local schools. Collectively, these efforts equate to nearly 140 STEM-related outreach camps with approximately 2,500 students involved. Increasingly, the internal resources of all colleges are being stretched, and needs to increase coordination of STEM outreach efforts and allocate additional space are becoming more pressing. In addition, the Chemistry and Physics on Wheels (CAPOW) STEM outreach efforts continue, and the impressive leadership for STEM outreach by the Physics department continues for both Aim for the Stars and CAPOW, which is still the most extensive STEM outreach effort at UNO. The innovation, collaboration, and documentation of all STEM outreach is increasingly impressive, such as this video created for the IS&T CodeCrush effort that shows the students in action: <https://www.youtube.com/watch?v=dEal5xx7R-4>.



### Objective 3.3: Expand UNO Workshops for P12 Educators

Increase UNO based STEM workshops for P12 educators, particularly with innovative themes such as space, water quality, natural hazards, and data science, as represented by a 30% increase in the number of workshops offered to P12 educators within the next three years.

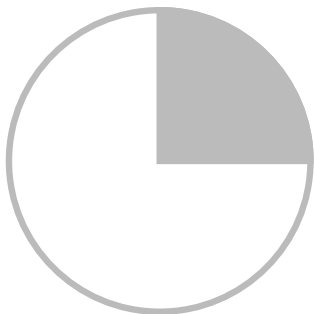
Increasingly, STEM workshops are being held for P12 educators on the UNO campus as a strategy for getting teachers on campus and building opportunities to ramp up UNO graduate enrollments for teachers. Teacher workshops have particularly expanded this last year in two critically needed discipline areas, P12 engineering and P12 computer science. Workshops that have involved coding, mobile apps, engineering design, science research, chemistry, physics, and wearable technologies are all good examples of ongoing efforts. In addition, there have been some strong efforts on IBL in the STEM areas. Increasingly, the Geology and Geography department is also leading STEM field trips for P12 teachers aligned with Glacier Creek efforts that help these teachers to more confidently undertake teaching in geology, earth system science, and environmental studies.



### Objective 3.4: Evolve Business and Industry STEM Partnerships

Aggressively expand and evolve partnerships with area businesses for innovative joint initiatives, such as STEM internships, that contribute to STEM learning in Omaha and beyond, targeting promising areas such as data science, data analytics, water quality, sustainability, mobile technologies, aviation, engineering, and information assurance, and as identified by a chart documenting yearly increases in STEM-related initiatives that include a focused business and industry partnership.

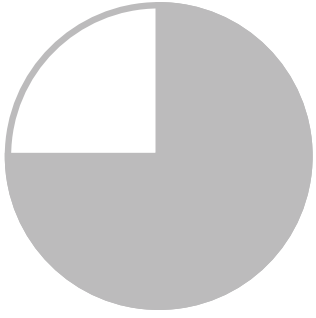
UNO STEM is making progress on business and industry collaborations related to co-sponsoring various STEM education efforts and outreach activities. For example, productive partnerships with UNL engineering at PKI are evident in events such as the Kiewit Engineering Day, the Nebraska Robotics Expo, and the Nebraska Science Festival. In addition, IS&T continues to participate in some impressive outreach and partnership efforts associated with collaborative outreach events, training for IT professionals, shared mobile app development efforts, and various luncheons and co-sponsored events. Many of these provide a model for other UNO-based STEM collaboration efforts. The Department of Mathematics and the Department of Computer Science have also greatly expanded efforts in “big data” collaborations and industry conversations.



### Objective 3.5: Expand Participation in UNO Citizen Science

Assist faculty in developing “citizen-science” outreach efforts that involve P12 students and other community members in UNO research-related initiatives, such as the Nebraska Watershed Network (NWN), the Glacier Creek Preserve (GCP), soil and water testing, and the use of mobile technologies for data collection, as indicated by yearly increases in the number of citizen-science outreach efforts coordinated by UNO faculty.

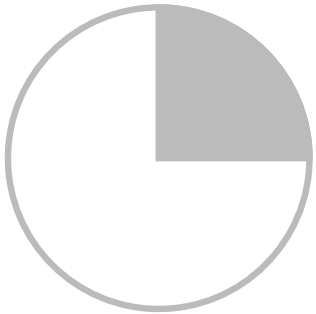
Citizen science efforts are increasingly ramping up at UNO, with an especially effective and innovative STEM model represented by the Nebraska Watershed Network, which runs numerous events—such as Bioblitz and “What’s in my Watershed?”—that help communities examine their local environments assisted by UNO scientists and students. The Glacier Creek Preserve is also heavily involved in various citizen science opportunities in which volunteers help with efforts associated with prairie management. Citizen science represents an important potential growth area for STEM outreach, but also an increasingly complex one, where logistics, volunteer background checks, liability insurance, and other considerations must be addressed. A STEM Outreach Office or something similar may well need to be conceptualized and operationalized to keep pace with this growing community collaboration opportunity.



### Objective 3.6: Strengthen and Expand Informal Education Partnerships

Strengthen and expand partnerships with informal education organizations, such as the Strategic Air and Space Museum, Out of School Time STEM, and the Henry Doorly Zoo and Aquarium, to increasingly undertake joint STEM initiatives, as identified by yearly increases in the number of STEM projects that include a focused partnership with an informal education organization.

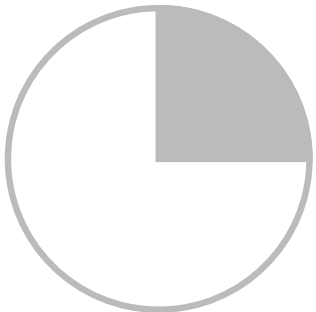
We are continuing to expand our informal education partnerships for various city, state, and national STEM events, including the following: *Nebraska Science Festival, Nebraska Robotics Expo, River City Rodeo STEM, Collective For Youth Lights On, Code Crush and IT Innovation Cup, Calculus Bee, Girls Inc. Eureka Camp, UNO Open Houses, Nebraska Metropolitan Science and Engineering Fair, Kiewit Engineering Day, The Magic of Chemistry, Nebraska Association of the Gifted Showcase, Nebraska Teacher Professional Development Series, Strategic Air and Space Museum STEM Conference, Celebration of the Mind, Bioblitz, Partnership for Kids, NE 4H Extension, and Science Olympiad.* This expansion has been relatively overwhelming to both the faculty and staff, and the STEM Leadership Team is exploring options for systemizing the STEM outreach efforts in some sort of STEM Outreach Office structure. This is particularly important since outreach is becoming increasingly complex with new volunteer background checks and training requirements. While UNO STEM faculty members are interested in continued growth in our collaborations with informal education partners, we may well be nearing our institutional capacity based upon our current STEM infrastructure.



### Objective 3.7: Expand Interdisciplinary Outreach with Traditional STEM as well as Traditionally Non-STEM Disciplines

Expand STEM outreach events and increase the number of events that illustrate the STEM components of disciplines not traditionally recognized as STEM, such as psychology, sociology, art, political science, and history, to increase STEM visibility and engagement in the Omaha community, as documented in the STEM Annual Report.

This is an objective that represents an opportunity to be increasingly inclusive in STEM and to continue to cross the boundaries of how STEM collaborations might be synergistic across the UNO community. Large-scale UNO STEM events that draw press coverage and assist in building partnerships are increasingly of interest to UNO faculty and staff. However, these events also are relatively limited by time and resources. Interdisciplinary STEM events that might only be accomplished on a university campus, with university-level expertise, appear to represent the greatest opportunities with the largest potential return on investments. Project HALON (High Altitude Learning over Nebraska) as facilitated by UNO, UNL, PKI, NASA, OPS, and various other partners such as the PKI ACME labs, represents a real model of interdisciplinary outreach that might only be done on a university campus. This effort launched and collected data from a near-space high altitude balloon using some of the most advanced outreach efforts established to date with high school and college students and will contribute to possible bridge programs as mentioned earlier.



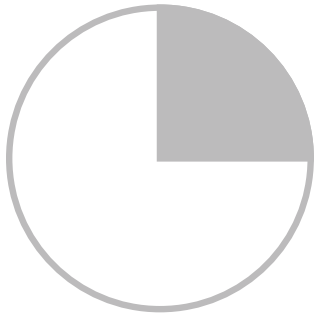
### Objective 3.8: Establish a STEM Learning Discussion Network

Establish a STEM learning discussion network that invites Omaha-area representatives from the UNO faculty, P12 schools, community colleges, businesses, part-time faculty, and informal education agencies to gather quarterly to discuss improving STEM learning across the P16 system, as documented by a web-based calendar of available networking and meeting opportunities.

Establishing a STEM learning discussion network still represents an opportunity for involving a wider number of collaborators, but at this point, the STEM Leadership Team does not believe that there is enough infrastructure in place for UNO STEM to pursue this in a continuous and professional manner. As UNO STEM infrastructure continues to expand to meet the growing needs and opportunities, this objective will continue to be considered and revisited. Currently, this objective is being partially addressed by the Greater Omaha Chamber of Commerce, and the UNO STEM Leadership Team needs to consider whether we duplicate efforts in this area or more directly partner with the wider community efforts along these lines. IS&T has also initiated some excellent efforts along these lines associated with STEM pipelines for IT-related jobs.

## GOAL 4: STEM INFRASTRUCTURE

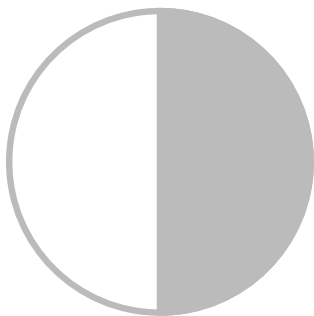
To provide administrative leadership and support through a UNO Center for Metropolitan STEM Learning that plans, coordinates, and encourages STEM-related teaching, research, and service initiatives.



### Objective 4.1: Formalize a UNO-Based Center for Metropolitan STEM Learning

Establish a UNO Center for Metropolitan STEM Learning focused on interdisciplinary STEM learning within metropolitan areas as recognized by the NU Board of Regents.

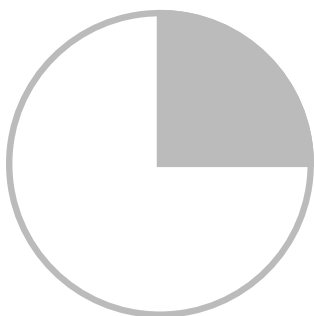
The UNO STEM Leadership Team is just beginning to work on this objective. Some significant internal UNO discussions have been held, particularly among faculty, on whether a Board of Regents approved UNO STEM Center would be helpful to or counterproductive to UNO STEM efforts. Some formal centers have a tendency to be relatively isolated from colleges, and since the UNO STEM effort is so appropriately college-based, this objective needs to be carefully explored. The potential for a STEM building is also an exciting element related to this objective and is becoming more of a direct conversation topic. However, it will be increasingly important to include a diversity of faculty and administrative voices in the conversation to ensure the most important facility needs are considered in order to take full advantage of this exciting opportunity for potential facilities expansion.



### Objective 4.2: Become a National Leader in Receiving External Funding for Innovative P16 STEM Learning Projects and Curriculums

Building on UNO's initial successes in STEM learning projects, help faculty to conceptualize, fund, pilot, and publish innovative P16 STEM learning models, as documented by external funding for STEM learning-related projects. [Note: Objective updated for external funding focus]

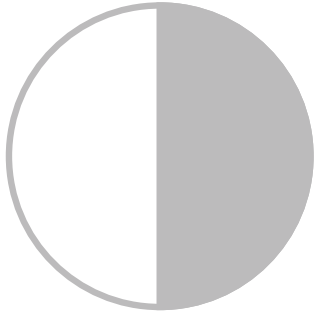
The last year has been one of increasing success for collaborative UNO STEM teams that have focused on writing large-scale external funding proposals for STEM learning. The success has been encouraging. Some of the more collaborative STEM learning proposals that have recently been funded include the following: NSF Noyce - Teacher Scholarship Program NebraskaMATH Omaha Partnership (\$1.2 M); NSF ITTEST - Strategic Problem-based Approach to Rouse Computer Science (\$1.1 M); NSF ITTEST - Wearable Technology in STEM (\$1.2 M); US and Nebraska Department of Labor - conNEct, Nebraska's IT Educational Pathway (\$9.1 M overall/UNO \$1 M); NSF Cyberlearning: Transforming Education - Exploring Spatial-Temporal Anchored Collaboration in Asynchronous Learning Experiences (\$448,000); NSF Computing Education for the 21st Century - openHTML, a Scaffolded Web Development Tool to Support Elementary Computational Literacy (\$442,000 overall; UNO \$52,645); Sherwood Foundation - OPS/UNO Science Innovations (\$4.2 M overall / UNO Tuition); Sherwood Foundation - Science Teacher Research (\$628,208); Girls Inc. - Middle School Girls in STEM (\$70,000); Online World Wide - Computer Science Education Coursework (\$35,000).



### Objective 4.3: Become a Campus of Innovation for the Use of New Technologies in STEM Learning

Through aggressive faculty development, encourage and help establish the integration of new technologies into STEM teaching, research, and service at UNO, as documented in the STEM Annual Report.

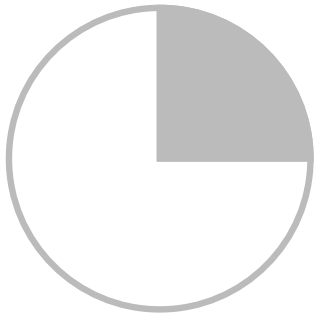
While UNO STEM faculty have initiated discussions and efforts related to the innovative use of new technologies in STEM learning, we will increasingly want to partner not only with each other but with other organizations to expand such efforts. Collaborative efforts associated with software packages such as Mathematica and Wolfram Alpha represent some significant learning potential for STEM courses. Mobile apps are also becoming increasingly impressive for their potential to contribute, often inexpensively, to STEM learning. The UNO STEM Leadership Team will increasingly identify, invite, and help support guest speakers who can help faculty to explore opportunities to enhance STEM learning with new technologies. In addition, efforts such as those that were accomplished by the IS&T “Attic” IT Outreach Office in partnership with organizations like the Nebraska Strategic Air and Space Museum and the Henry Doorly Zoo, as well as other partners around the city, are certainly of note as examples of how UNO can lead and inform Omaha IT partnership efforts.



#### **Objective 4.4: Engage Faculty in STEM Planning that Supports Professional Goals**

Encourage faculty to participate in and develop UNO STEM initiatives that align with their own annual professional goals for teaching, research, and service, as documented by a series of colleague-based workshops that engage 50 or more faculty per year within three years.

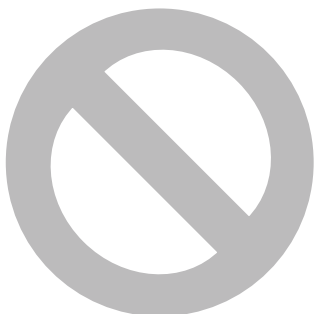
UNO STEM is developing an increasing “culture of inclusion” that we need to grow, refine, support, and advertise. This is particularly true with faculty referencing their work supporting the UNO STEM Priority in their annual reviews, as well as with STEM faculty members referring to themselves as “STEM faculty” or more informally as “STEMers.” In addition, there is increasing acknowledgement of the importance of discipline-based education research and its contributions within a faculty member’s RP&T process. It is important for such efforts to be strongly supported by faculty who are both tenured and more experienced in these endeavors. For example, the STEM community chairs have written letters of support to be included in faculty RP&T files about the importance of particular STEM efforts by faculty who are up for RP&T reviews.



#### **Objective 4.5: Enhance a STEM Recruitment, Retention, and Graduation at UNO**

Operationalize the teaching, research, and service efforts as represented by the STEM learning objectives of this strategic plan to aggressively support recruitment, retention, and graduation in STEM disciplines, as documented by a 25% increase in the number of STEM graduates within five years.

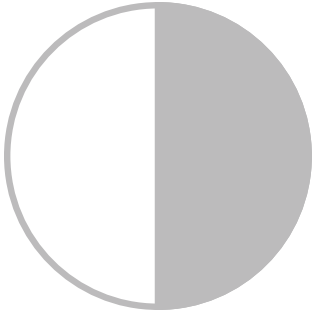
Increasing attention is being given to STEM recruitment, retention, and graduation efforts by all STEM departments and STEM faculty. We are making steady progress, as represented by an updated chart from the UNO STEM Strategic Plan, but we still have a very long way to go, as does the rest of the nation, to build the STEM pipelines, which are often still lagging behind other disciplinary areas. However, optimism is warranted, and momentum is building. Data is increasingly available from UNO support mechanisms as well.



#### **Objective 4.6: Become a Founding Member of a Statewide STEM Effort**

Working closely with the Strategic Air and Space Museum (SASM), other NU campuses, area businesses, school districts, and other Nebraska stakeholders, become a founding member of a statewide STEM organization that would be housed at the SASM and that would ensure a strong and participatory UNO voice in statewide STEM efforts.

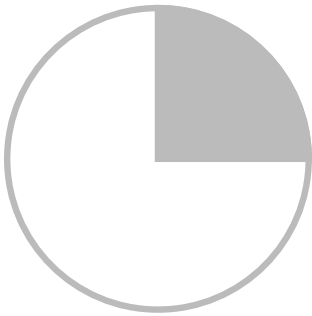
This objective has been selectively abandoned by the UNO STEM Leadership Team, particularly since we feel that a full focus on a metropolitan-based leadership effort will be the most productive for UNO enrollment efforts and continued growth as a metropolitan university of distinction. In addition, leadership has already been established to some degree by the University of Nebraska’s Provost Office in getting NU STEM faculty from different campuses together periodically. We will continue to be strong partners in this wider NU effort, and thus we will not attempt to duplicate that effort.



### Objective 4.7: Work Closely with the NU Foundation on STEM Learning

Work closely with the NU Foundation in efforts such as jointly proposing UNO-based STEM professorships, community chairs, and scholarships, as documented in the STEM Annual Report.

We continue to work very aggressively and closely with the NU Foundation. Work with the UNO Foundation representatives, particularly in the Colleges of Education, IS&T, A&S, and CPACS, has been particularly productive. Such efforts have led to funding for important STEM efforts, such as the STEM community chairs and professorships, Glacier Creek instructional supports, student field trips, and school district science initiatives. We will continue to build on this strong record of past success with the Foundation and will continue to explore funding opportunities.



### Objective 4.8: Conduct Annual Reviews of the STEM Center

Building on UNO's initial successes in STEM learning projects, help faculty to conceptualize, fund, pilot, and publish innovative P16 STEM learning models, as documented by external funding for STEM learning-related projects. [Note: Objective updated for external funding focus]

This current report represents our first efforts to produce a collaborative annual report for the UNO STEM initiative. We will continue to evolve, expand, and refine this report template, as well as to update objectives and conduct further strategic planning based on collaborative faculty, staff, administrator, and UNO partner input.

# FINAL COMMENTS

Since the publication of our STEM Strategic Plan in the Fall of 2013, we have indeed come a long way, but we have much more of our journey still remaining ahead of us. As a metropolitan university of distinction, we will need to continually strive to enhance our “STEM synergy” as it relates to campus teaching, research, service, and infrastructures. We will need to become a “STEM Priority of distinction.” By seeking to engage and welcome many faculty members and community partners into STEM education initiatives, we will continue to build upon our foundation of successful efforts and creativity in this important campus priority in order to support the success of the wider campus. Such innovation also requires both internal and external funding to help provide the time, resources, and experience necessary to be successful.

Internal funding support might include travel to innovative STEM learning opportunities, research in STEM and STEM education, and faculty professional development workshops. Expanded grant writing efforts in STEM, already bearing initial fruit since the more focused efforts for STEM began, will also become increasingly important as more faculty participate and bring their ideas and expertise to the table. The STEM initiatives at UNO will also continue to benefit from an ever-closer working relationship with the NU Foundation and from additional named professorships and community chairs designated for providing campus leadership in STEM.

New positions, such as the STEM Community Chairs, STEM Professorships, and STEM Instructors, exemplify community engagement and represent an excellent opportunity to formalize and expand campus leadership in STEM. To eventually serve expanding populations, some STEM investments will perhaps need to be made in physical infrastructure, such as laboratory space. New opportunities for a STEM building also increasingly deserve the attention of our STEM faculty and are exciting.

As the STEM Priority continues to be operationalized, discussions about the needed resources, infrastructure, and support mechanisms will become increasingly defined and effective and will be an important catalyst for further STEM innovations. It is also important to note that these discussions will need to be ongoing and involve additional stakeholders as new initiatives are undertaken. The strategic plan itself will need to continue to be a very dynamic document that is revisited frequently as the campus grows in its STEM initiatives and efforts and the UNO STEM community moves steadily forward on this important campus priority.

It is important for us to always remember that STEM continues to be a national crisis and a “Sputnik moment” for our nation. Although our progress has been encouraging, we must not lose sight of the fact that bold actions, passionate work, and increasing inclusiveness must continue to be key elements of our ongoing work. UNO has both a responsibility and an opportunity to contribute solutions to this national crisis.

As a campus, we continue to be well positioned not only for contributing to national STEM solutions, but also for leading them. Our close partnerships with the metropolitan community, faculty expertise and passion, and the ongoing recognition of both our strengths and challenges position us to become a catalyst to STEM innovation at a local level as well as a model for STEM reform at a national level.

The time is now for UNO to further assume leadership in STEM and to embrace the STEM Priority with pioneering vision and aggressive action. There is a long and exciting road ahead of us; we have taken the first steps toward excellence and have made some initial progress, but we must not forget that the journey that we continue to take together as a campus and with our many partners is worthy of our very best efforts and commitment.

# REFERENCES

- American College Testing. (2008). *ACT College Readiness Report News Release*. Available from the ACT website: <http://www.act.org/news/releases/2008/crr.html>
- Anderson, W. A., Banerjee, U., Drennan, C. L., Elgin, C. R., Epstein, I. R., Handelsman, J., Hatfull, G., Losick, R., O'Dowd, D. K., Olivera, B. M., Strobel, S. A., Walker, G. C., & Warner, I. M. (2011). Changing the Culture of Science Education at Research Universities. *Science*, 331(6014), 152–153. doi:10.1126/science.1198280
- Banilower, E. R., Smith, P. S., Weiss, I. R., Malzahn, K. A., Campbell, K. M., & Weis, A. M. (2013). *Report of the 2012 national survey of science and mathematics education*. Chapel Hill, NC: Horizon Research, Inc.
- Business Higher Education Forum. (2010). *Increasing the number of STEM graduates: Insights from the U.S. STEM Education and Modeling Project*. Retrieved from the Business Higher Education Forum website: <http://www.bhef.com/publications>
- Carnevale A.P., Smith N., & Stoll, J. (2010). Help wanted: projections of jobs and education requirements through 2018. Available from the Georgetown University Center on Education and the Workforce website: <http://cew.georgetown.edu/jobs2018/>
- Cole, J. (2013, April 11). It's official: 2013 is the Year of STEM Discovery in Nebraska [blog post]. Retrieved from Nebraska Children and Families Foundation website: <http://blog.nebraskachildren.org/2013/04/11/its-official-2013-is-the-year-of-stem-discovery-in-nebraska/>
- Fairweather, J. (2010). *Linking Evidence and Promising Practices in Science, Technology, Engineering, and Mathematics (STEM) Undergraduate Education: A Status Report for The National Academies National Research Council Board of Science Education*. Retrieved from [https://www.nsf.gov/attachments/117803/public/Xc-Linking\\_Evidence-Fairweather.pdf](https://www.nsf.gov/attachments/117803/public/Xc-Linking_Evidence-Fairweather.pdf)
- Foertsch, J., Alexander, B., and Penberthy, D. (2000). Summer Research Opportunity Programs (SROPs) for Minority Undergraduates: A Longitudinal Study of Program Outcomes, 1986–1996. *CUR Quarterly*, 20(3), 114–119.
- Gentile, J. M. (2011). It's time to STEM the loss of science and engineering students. The Huffington Post. Retrieved from [http://www.huffingtonpost.com/james-m-gentile/us-math-and-science-education-\\_b\\_1086177.html](http://www.huffingtonpost.com/james-m-gentile/us-math-and-science-education-_b_1086177.html)
- Gregerman, S. (1999). Improving the Academic Success of Diverse Students through Undergraduate Research. *CUR Quarterly*, 20(2), 54–59.
- Henderson, R. (2012). Industry employment and output projections to 2020. *CUR Quarterly* 20(2), 54–59.
- Ingersoll, R. & Perda, D. (2010). Is the supply of mathematics and science teachers sufficient? *American Educational Research Journal*, 47(3), 563–594.
- Ishiyama, J. (2001). Undergraduate research and the success of first-generation, low-income college students. *CUR Quarterly*, 22(1), 36–41.
- Lopatto, D. (2009). *Science in Solution: the Impact of Undergraduate Research on Student Learning*. Tuscon, AZ: The Research Corporation and the Council on Undergraduate Research.
- Miele, E. A., Hainline, L., Lesser, P., Powell, W. G., Tisch, S., & Tomkiewicz, M. (2011). Early exploration of opportunities in science and careers encourages students to pursue science majors. *Journal of College Science Teaching*, 40(5), 59–64.
- National Academy of Sciences, Institute of Medicine, & National Academy of Engineering. (2010). *Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5*. Written by Members of the 2005 “Rising Above the Gathering Storm” Committee. Available from the National Academies Press website: <http://www.nap.edu/catalog/12999.html>
- National Governors Association. (2012). *Building a STEM Education Agenda: An Update of State Actions*. Washington, DC: NGA Center for Best Practices. Available from <http://www.nga.org>
- National Research Council. (2011). *Successful K-12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics*. Written by the Committee on Highly Successful Schools or Programs in K-12 STEM Education. Available from the National Academies Press website: [http://www.nap.edu/catalog.php?record\\_id=13158](http://www.nap.edu/catalog.php?record_id=13158)
- National Science Board. (2009). *National Science Board STEM Education Recommendations for the Presiden-Elect Obama Administration*. NSB-0901. Available from [http://www.nsf.gov/nsb/publications/2009/01\\_10\\_stem\\_rec\\_obama.pdf](http://www.nsf.gov/nsb/publications/2009/01_10_stem_rec_obama.pdf)
- Nelson Laird, T. F., Sullivan, D. F., Zimmerman, C., & McCormick, A. C. (2011). STEM/Non-STEM differences in engagement at US institutions. *Peer Review*, 13(3), 23–26.
- Nestor-Baker, N., & Kerkor, S. (2009). *Recruitment and retention of underrepresented students in STEM fields*. Paper presented at the 2008 annual meeting of the Association of NROTC Colleges and Universities, Daytona Beach, FL.
- Piquer-Durand, B. (2013, March 26). Working women in the tech world [blog post]. Retrieved from *ComputerWeekly.com* website: <http://www.computerweekly.com/blogs/witsend/2013/03/>
- Rundell Singer, S. (2011). STEM Education: Time for Integration. (2011). *Peer Review*, 13(3), 4–7.
- U.S. Innovations. (2011). *Nebraska's K-12 STEM report card 2011*. Prepared by the Alliance for Science and Technology Research in America. Available from the STEMconnector website: <http://www.stemconnector.org/state-by-state/nebraska>





College of Education  
6001 Dodge Street | Omaha, NE 68182

402.554.2719

**[unomaha.edu](http://unomaha.edu)**

The University of Nebraska at Omaha shall not discriminate based upon age, race, ethnicity, color, national origin, gender-identity, sex, pregnancy, disability, sexual orientation, genetic information, veteran's status, marital status, religion, or political affiliation.