



CENTER FOR  
MATHEMATICS, SCIENCE,  
AND TECHNOLOGY

*Illinois State University*

2010-2011

# CeMaST Annual Report

# INTRODUCTION

## history of CeMaST

The Center for Mathematics, Science, and Technology was founded in 1991 to assist in integrating efforts of diverse departments, drawn from different colleges in the University, in meeting the needs of Illinois schools in addressing issues related to mathematics, science, and technology education. Over the last twenty years, CeMaST has built a national reputation for developing successful projects and activities supporting STEM education.



## our Goals

CeMaST's goals are aligned with Illinois State University's strategic plan, *Educating Illinois 2008-2014: Priorities for Illinois' First Public University*. CeMaST contributes to Illinois State University core values by pursuing and supporting scholarship in STEM education for all students. Our goals are to:

- Stimulate and support activities and research on teaching and learning that aligns with campus, state, and national STEM priorities.
- Provide leadership to foster cross-disciplinary collaborative STEM activities and research on teaching and learning.
- Direct efforts to increase the diversity of STEM communities.

## Current Initiatives

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# A MESSAGE FROM OUR DIRECTOR

As an interdisciplinary unit of Illinois State University under the Provost's Office, with support from the College of Arts and Sciences; the College of Education; and the College of Applied Science and Technology, CeMaST leads collaborative Illinois state and national STEM research and outreach on behalf of the University. Our significant efforts in the **Urban STEM Education Initiative, Public Outreach, K-12 Engineering Education, and Research** all helped to raise the profile of and impact that CeMaST has on campus and across the United States.

**On campus**, in the past 18 months, the CeMaST Director and Associate Directors have made formal visits to faculty meetings in all science departments and schools in CAS and CAST. Each time a visit occurs, at least a few faculty members contact CeMaST with an idea they would like to pursue. These ideas have resulted in six Professional Innovation Grants to faculty in Psychology, Biological Sciences, Technology, Physics, and Curriculum & Instruction last year. These recipients joined faculty in Curriculum & Instruction, Mathematics, Chemistry, Physics, Biological Sciences, Technology, and Health Sciences from the previous year. CeMaST started a new RSO on campus for students in Mathematics, engineering, Science and Technology students interested in public service. This group has a monthly battery and ink cartridge recycling event on campus, held a career day for high school students, and participated in Family Science Day and other CeMaST outreach events.

**Off-campus**, we began supporting major outreach efforts to both support faculty initiatives and raise the profile of Illinois State as a STEM active/leading university. CeMaST is hosting the *10th Annual High School Research Symposium*, which brings high school students and teachers from across Illinois to share their research projects with each other. We have had inquiries about attending from as far a field as New York and Texas. We have also started the *Illinois Summer Research Academy*, a one-week summer experience for high school sophomores and juniors, in which they work with faculty members on a meaningful research project. Last year we had 15 students apply and work in two research areas (Biological Sciences and Geography/Geology). In 2011, we have faculty accepting students in Biological Sciences, Chemistry, Geography, Mathematics and Psychology. On April 17th, CeMaST organized *Family Science Day* at Horton Field House, with 50 exhibitors including NASA, the Field Museum, St. Louis Science Center, Miller Park Zoo, etc. We had 1,500 visitors and hope that this becomes one of CeMaST's signature events.

**State-wide & Nationally**, we continue to support four existing *Mathematics and Science Partnership* grants from the U.S. Department of Education. We also helped write ten new *MSP Workshops and Institutes* proposals over two rounds, four of which were funded at ISU; and two of which were funded at partners at other institutions. As we continue to grow, we invite faculty, staff, students, and the wider community to participate in existing programs and to come to us to help initiate new efforts. It goes without saying that such collaboration is not possible without the total involvement of staff and volunteers who are both talented and dedicated. From volunteers (for Family Science Day, American Solar Challenge, Destination Imagination, etc.) to administrative staff who take ideas and run with them (Bugs for Kids, CeMaST Challenge Cup, Professional Innovation Grants, etc.), to Assistant and Associate Directors who manage both leadership and the hard work of implementation (K-12 Engineering Education, Journals Projects, IMSP projects, etc.), I want to express my gratitude to you for the successes we've shared this past year.



Dr. William Hunter

# Personnel

## *The CeMaST Management Team*

### *Director*

**Dr. William Hunter**, Professor of Chemistry and Curriculum & Instruction

### *Associate Directors*

**Dr. Jeffrey Barrett**, Professor of Mathematics Education

**Dr. Ryan Brown**, Assistant Professor of Curriculum & Instruction

**Dr. Kevin Laudner**, Associate Professor of Kinesiology and Recreation

**Dr. George Rutherford**, Associate Professor of Physics

### *Assistant Directors*

**Dr. Amy Bloom**, CeMaST Assistant Director for Outreach

**Dr. Robert Fisher**, CeMaST Assistant Director for the Urban STEM Initiative

**Dr. Darci Harland**, CeMaST Assistant Director for Research

## *CeMaST Staff*

**Brad Christensen**, CeMaST Research Associate

**Raymond Dixon**, CeMaST Research Associate

**Todd Eddy**, CeMaST Administrative Clerk

**Kate Edler**, CeMaST Research Associate

**Amanda Fain**, CeMaST Technical Editor

**Sara McCubbins**, CeMaST Office and Project Manager

**Ydalisse Pérez**, CeMaST Research Associate

## *CeMaST Fellows*

**Olcay Akman**, Mathematics Department

**David Anderson**, Philosophy Department

**Fuxia Cheng**, Mathematics Department

**Saad El-Zanati**, Mathematics Department

**Greg Ferrence**, Chemistry Department

**Anu Gokhale**, Technology Department

**Shawn Hitchcock**, Chemistry Department

**Marjorie Jones**, Chemistry Department

**Anthony Lorsbach**, Curriculum & Instruction

**Craig McLaughlan**, Chemistry Department

**Cynthia Moore**, Biological Sciences Department

**Do-Yong Park**, Curriculum & Instruction

**Rick Satchwell**, Adventure of the American Mind

**Liza Szczepura**, Chemistry Department

**Carl Wenning**, Physics Department

**Corrine Zimmerman**, Psychology Department

## *CeMaST Student/Extra Help Employees*

**Elora Karim**, Actuarial Science Major

**Mary McCubbins**, Arts Technology Major

**Abby Newcomb**, Math Education Major

**David Shelhamer**, Teaching Certificate in Chemistry



# Urban STEM-Ed

Urban STEM-Ed provides leadership at Illinois State in institutionalizing the efforts of the Chicago Teacher Pipeline within the STEM disciplines. It is also aimed at documenting (in the academic, research, and popular literature) the steps taken to become an urban serving institution in a non-urban environment.

## *Activities During FY11 Included:*

CeMaST appoints Dr. Robert Fisher as Assistant Director for Urban STEM-Ed (33% FTE). His roles included helping to organize alumni events in the Chicago land area for STEM and STEM-Ed alumni (2 this year, 3 per year into the future).

CeMaST helped to support and lead many parts of the *Robert Noyce Teacher Scholarship Program*, including hosting an awards banquet and providing Noyce scholars with the opportunity to judge the annual science fair at Infinity High School, located in Little Village in Chicago.

CeMaST has helped to support the *Louis Stokes-Alliance for Minority Participation (LS-AMP)* at Illinois State University, which provides academic support to students in STEM disciplines from under-represented groups, for the past decade.

CeMaST supported two NSF S-STEM scholarship programs as well as the NSF *Undergraduate Research Center* with the City Colleges of Chicago. CeMaST also played an integral role with TEACHER+PLUS

CeMaST also took leadership in developing a relationship with the Peoria Public Schools and the Rockford Public Schools to further the Urban STEM-Education initiatives.

Researchers at CeMaST used information from the Illinois State University Student Database and Teacher Warehouse Database to explore how well ISU is serving Chicago Public Schools for STEM education, as compared to the rest of the state.



## 12 Students Receive Noyce Scholarship

On September 11th, 2010, the Center for Mathematics, Science, and Technology (CeMaST) hosted the Robert Noyce Scholarship Awards Banquet. *The Robert Noyce Teacher Scholarship Program* at Illinois State University, funded by the National Science Foundation (NSF), provides scholarships and mentoring to Mathematics and Science students who will graduate and become teachers in the Chicago Public Schools (CPS). The banquet honored those who have been awarded this scholarship in the past as well as those who have recently received this award. The event hosted Ray Lesniewski as their speaker. Lesniewski (ISU Chemistry 87), is a former President of the Illinois Association of Chemistry Teachers and recently became a Regional Instructor with Texas Instrument.

# Public Outreach

Public Outreach raises the profile of CeMaST as an important entity within Illinois State University, which in turn, is a major STEM active institution.

## ***Activities During FY11 Included:***

CeMaST appoints Dr. Amy Bloom as Assistant Director for Outreach (50% FTE). Her responsibilities included hosting the *10th Annual High School Research Symposium* (250 attendees – 50% growth), running the *Illinois Summer Research Academy* (10 new faculty hosts – 400% growth, 22 new high school students 33% growth), and supporting the *Bugs for Kids* program (16 events at local schools, community centers, and on ISU's campus).

CeMaST continued to run the *Teach.chem* CD program, sending over 400 of these instructional CDs to teachers around the world.

CeMaST and the Chemistry Department helped to establish the *ACS Regional Chemistry Exam Contest* as a biennial event at ISU.

In April 2011, CeMaST hosted famed roboticist Dr. James McLurkin of Rice University, as part of the Milner Library Speaker Series. Dr. McLurkin's presentation on swarm robots was also sponsored by the School of Information Technology, The Department of Technology, and the College of Applied Science and Technology

CeMaST organized the first annual *Family Science Day* as a signature event for CeMaST at Horton Field House. The event included 50 exhibitors with more than 80 interactive exhibits, including NASA, the Field Museum, St. Louis Science Center, and Miller Park Zoo. The event attracted over 1,400 attendees.

For the third year, CeMaST was a major sponsor of *Science and Technology Week*. CeMaST also helped sponsor the *Solar Car Team*, *Expanding Your Horizons*, and the *Teaching and Learning Symposium* of CTLT.

## **American Solar Challenge Makes Pit Stop at ISU**

In June 2010, CeMaST organized the Normal Stage Stop of the American Solar Challenge. The *American Solar Challenge* is a competition that involves the designing, building, and operating of solar powered cars in a cross-country race. The 2010 race ran from Tulsa to Chicago, with a final pit stop at ISU. The race hosted teams from across the United States as well as teams from Canada, Germany, and Taiwan. Illinois State University's own team, Team Mercury, competed in the race. The two-day pit-stop took place at CeMaST on Friday and at Uptown Normal on Saturday.

On Saturday morning, the Children's Discovery Museum, Uptown Normal, and CeMaST sponsored a procession of the solar car teams around the circle loop in Uptown and a Renewable Resource Day Fair. David Loomis, Director of the Center for Renewable Energy, presented the People's Choice award and waved the solar car teams out at the beginning of the race to their final stop in Naperville, IL. Awards were given to first, second, and third place as well as sportsmanship and peoples choice: 1st, University of Michigan; 2nd, Stanford University; 3rd, Missouri University of Science and Technology; Sportsmanship, University of Minnesota; and People's Choice, Hochschule Bochum, Bochum University of Applied Sciences (Germany).

After the event, the solar car teams voted for the ISU stage stop to receive the *Espirit de Corps Award* for the best stagestop.

CeMaST continues to develop and facilitate new outreach activities and programs with the Children's Discovery Museum (Normal, Illinois) and the Sugar Grove Nature Center (McLean, Illinois).

In June 2010, CeMaST organized the Normal Stage Stop of the *American Solar Challenge*. We hosted 15 solar car teams and 1000 members of the town and university community for two days of activities (street fair, games, and activities for the teams and public,) with the Town of Normal and the Children's Discover Museum. The event was voted by the American Solar Challenge as the most outstanding of their events, and was honorable mention for the ISU Team Excellence award in FY11.





CeMaST hosted the *DestiNation ImagiNation* (DI) State Affiliate Tournament at Illinois State University, and plans to make it a biennial event at ISU. Currently, there are more than 100,000 U.S. students involved in DI as well as 30 participating countries. Teams who competed and won the State tournament at Illinois State University advanced to the Global Finals.

CeMaST helped to form a new STEM Registered Student Organization known as M.I.S.T., which stands for Mathematics, engIneering, Science, and Technology. This student service organization focuses on community outreach and service within the scope of the STEM disciplines. Activities include ink and battery recycling, food drives, volunteering for various STEM focused outreach events, and fundraising to attend national conferences.

CeMaST developed the RSO Challenge Cup, a cross-disciplinary year-long competition between STEM RSOs. The Challenge Cup brought together clubs from Chemistry, UNITE, Biology, Mathematics, Physics, and Geology. Winners received a “bragging rights” trophy and monetary donations for club activities. The purpose of the Challenge Cup was to encourage and promote interdisciplinary activities within STEM organizations and to provide an opportunity for STEM students to give back to the community.

The *10th Annual Illinois State University High School Research Symposium*, sponsored by CeMaST, took place on Friday, April 15th in the Bone Student Center. For a decade, Illinois State University has invited high school students from all over Illinois to showcase their research projects at our annual symposium. Students shared their original work in STEM fields. This year’s symposium included 175 projects from more than 215 students. The poster presentation gave students the opportunity to share their research with an audience of ISU professors, ISU students, and other Illinois high school students. Taking part in the Symposium allows students to gain valuable experience in presenting their research to a diverse audience, to network, and to gain an appreciation of the work of their peers. Activities at this year’s symposium included a guest presentation by Dr. James McLurkin, a prominent robotics engineer from Rice University in Houston.

### First Annual Family Science Day a Huge Success

The Center for Mathematics, Science, and Technology (CeMaST) and the College of Applied Science and Technology (CAST), along with the Children's Discovery Museum and the Challenger Learning Center at Heartland Community College, were pleased to host Family Science Day at Horton Field House on Sunday, April 17th at Illinois State. There were over 80 interactive exhibits from more than 50 organizations and over 1,400 people attended the first annual Family Science Day. The event was developed as a way to educate and inspire pre-K through 8th grade students in the fields of science, technology, engineering, and mathematics by encouraging scientific discovery through the use of hands-on activities, displays, and demonstrations.



Photos by: Jane Camp



# Engineering K-12 STEM

Engineering K-12 STEM is aimed at helping drive the national discussion towards embracing the role of engineering education in K-12 schools. CeMaST recognizes that modern problems are interdisciplinary and advocates for integrated solutions. Engineering education in K-12 schools is one way of achieving integrated solutions.

## ***Activities During FY11 Included:***

CeMaST was chosen as a partner for Stark County High School's new Math and Science Academy. The new academy will begin for junior and senior level students starting in the 2011-2012 school year. Independent research is a key component of this endeavor.

CeMaST continues to work with Belvidere School District CUSD 100 to implement the IMaST curriculum. This is the first adoption of IMaST in over ten years. We anticipate providing significant support to Belvidere and, hopefully, growing the support for the curriculum over a wider audience.

CeMaST continued offering workshops as part of two *Illinois Mathematics and Science Partnership Workshop/Institute Program* grants. These two grants were: *Engaged STEM*, which helps middle school science and math teachers implement the IMaST curriculum into their current curriculum; and *Global Climate Change*, which teaches high school teachers a wide variety of scientific techniques and technologies surrounding climate change.

## **CeMaST and Pontiac Township High School Team Up on Netbook Program**

This past school year, Pontiac high school freshman carried more than just their books to school; they each had their own mini- laptop computer, or netbook. Pontiac Township High School (PTHS) was awarded the "PTHS Netbook Initiative: Enhancing Education Through Technology" (EETT) grant by the Department of Education. The goal of the grant is to improve student academic achievement through the integration of technology.

CeMaST at Illinois State University is part of the grant and helped to facilitate a professional development program for PTHS teachers. Dr. Darci Harland and Dr. Kevin Thompson delivered workshops during the 2010 summer in which teachers developed an understanding of netbooks, tablets, OneNote Microsoft Office software, and Web 2.0 tools. The teachers also learned how to integrate these tools into instruction. A similar netbook program is currently being run at University High School.



CeMaST appointed Associate Directors Ryan Brown and George Rutherford to lead this K-12 STEM effort by attending national and regional meetings about engineering education, lobbying the state and federal government to include engineering education in new legislation, and keeping the *Innovative Design Project* growing to encourage students and faculty to work on the real problems of people in the local community.

In 2011, CeMaST was awarded two new *Illinois Mathematics and Science Partnership Workshop/Institute Program* grants. These two new grants were: *Earthscope*, which allows Illinois teachers and students to become part of a national scientific effort to collect data from transportable seismic stations; and *Formative Assessment in Elementary Mathematics*, which works with elementary teachers to facilitate lesson study and build professional communities in mathematics.

The *Innovative Design Project* is a project supported by CeMaST and the Department of Physics with a goal to solicit technical problems from citizens, businesses, and non-profit groups and to help teams of students create workable solutions to those problems.



# Increased Profile

CeMaST simultaneously develops a greater profile campus-wide, state-wide, regionally, and nationally.

## Campus-Wide

In FY11, we awarded \$25,000 in Professional Innovation Grants (a continuation from FY09 & FY10). We continued the following activities: ISU Open House, STEM department faculty meeting visits, and brown bag lunches with STEM-Ed faculty. We also provided cost-sharing on several grant requests, co-sponsored CAST's Science and Technology Week, and the CTLT Teaching and Learning Symposium. We are also supplying editorial, management, and logistical support to two academic journals. We are also supporting the new arrival to campus of the Journal of Research in Mathematics Education.

Six Professional Innovation Grants were awarded by CeMaST last year. Winners came from a variety of departments throughout campus, including: the Department of Technology, the Department of Curriculum and Instruction, the Department of Geology-Geography, the Department of Psychology, the Department of Physics, the Chicago Teacher Education Pipeline, and the School of Biological Sciences.

## State-Wide

We participated in several state-wide conferences (Connections Project, Project Lead the Way, IMSP, etc.) Colleagues from SIU-E, SIU-C, UIC, UIUC, Bradley, and Loyola all contacted CeMaST and asked for our participation as evaluators on projects.

To promote innovation in the classroom, CeMaST funded five Teacher Innovation Grants to teachers throughout the state of Illinois. Winning proposals covered all grade levels and focused on all areas of science, ranging from weather station data collection to new concept in biotechnology to wind farm controversies.

## Nationally

CeMaST employees attended several meetings, and wrote support letters at the request of and on behalf of national leaders in the K12 Engineering Education movement.

In an effort to increase the grant-writing and leadership potential of faculty securing funding from federal agencies, CeMaST and Research and Sponsored Programs (RSP) arranged a series of visits with program officers at NSF, NIH, DoE, DoEd, and the National Academies. The visits were also supported by the College of Arts and Sciences, the College of Applied Science and Technology, and the College of Education.

Eighteen months ago, CeMaST started providing support to two journals (Illinois Technology Education and the Journal of Physics Teacher Education Online) with the goal of helping faculty bring journals to campus. Our next success was to bring the Journal of Technology Education (the premiere journal in the field) to campus under the direction of Dr. Chris Merrill. CeMaST provides technical editing, subscription, and layout support to Dr. Merrill. The Journal for Research in Mathematics Education has just been brought to ISU under the direction of Dr. Cindy Langrall, and we are working with Dr. Langrall to determine the best level of support that CeMaST can provide. CeMaST continues to actively encourage and support other faculty in bringing journals and editorships to ISU.

## The Illinois State Contingent

CAST: Josh Brown, Rick Boser, Kevin Devine (TECH), Winn Mahatanankoon, and Bryan Hosack (ITK); CAS: Dagmar Budikova (CAS/GEO), Corinne Zimmerman (PSY), Jae Baek, Jennifer Tobias, David Barker (MATH), John Kostelnick, Jon Thayne (GEO), AGeorge Rutherford (PHY/CeMaST), Dave Loomis (ECON CER), and Tak Cheung (BIO); RSP: Rod Custer, Marissa McCord, Cris Embree (RSP), Sara McCubbins, and Willy Hunter (CeMaST); CoE: May Jadallah, Kristina Hesbol (C&I), Sharon Doubet (SED), Pam Hoff, and Isaura Pulido (EAF).

# Research and Publications

Hiring a fulltime Assistant Director for Research has led to specific research projects based upon work housed at CeMaST. Scholarly publications and presentations by CeMaST personnel related to their work at CeMaST include the following:

## *Scholarly Publications*

Barrett, J., Clements, D., Sarama, J., Cullen, C., McCool, J., Witkowski, C., & Klanderman, D. (Accepted, pending satisfactory revisions). Evaluating and Improving a Learning Trajectory for Linear Measurement in Elementary Grades 2 and 3: A Longitudinal Study. *Mathematical Thinking and Learning*.

Barrett, J. E., & Battista, M. (accepted for publication). Comparing Learning Trajectories and Levels of Sophistication in the Development of Students' Reasoning about Length: A Case Study. In J. Confrey, A. Maloney and K. Nguyen (Eds.), *Learning Over Time: Learning Trajectories in Mathematics Education*. (Information Age Publishing): Raleigh North Carolina.

Bergman, J.M., Boesdorfer, S.M., Carver, J.S., Mumba, Hunter, W.J.F. (2010) Student Learning on Atomic Theory using the Photoelectron Spectroscopy Data Method. *The Chemical Educator* 15, 370-375.

Brown, R., Brown, J., & Berkehiser, M. (In Press). *Fundamentals of Engineering*. Tinley Park, IL: Goodheart/Willcox Publishers.

Brown, R., Brown, J., Reardon, K.C., & Merrill, C. (2011). Understanding STEM: Current Perceptions. *The Technology and Engineering Teacher*. 70(6).

Carver, J.S., House, R., Ferrence, G.M., Hunter, W.J.F. (2011) A Comparison of Two-year and Four-year College Students' Undergraduate Research Experiences. Proceedings of the 2011 Annual Meeting National Association of Research in Science Teaching, Orlando, FL, April, 2011.

Cullen, C. J., & Barrett, J. E., (2010) Strategy use indicative of an understanding of units of length. In M. Pinto & T. Kawasaki (Eds.), Proceedings of the 34th Annual Conference of the International Group for the Psychology of Mathematics Education (Vol. 2, pp. 281-288. Belo Horizonte, Brazil: International Group for the Psychology of Mathematics Education.

Cullen, C. J., Witkowski, C., Miller, A. L., Barrett, J. E., Sarama, J. A., & Clements, D. H. (2010). Tasks and Design of Assessment with a Learning Trajectory for Length. Proceedings of the 32nd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. Columbus, OH: Ohio State University.

Dixon, R. A. (2011). Cognitive strategies and selected core thinking skills of an expert and a novice. *Journal of STEM Teacher Education* 48(1), 1-34

Laudner K.G., Moline M., Meister K. There is No Relationship between Glenohumeral External Rotation Strength and Posterior Shoulder Tightness in Baseball Players. *Journal of Sport Rehabilitation* (in press).

Moore S.D., Laudner K.G., McLoda T.A., Shaffer M. A Randomized, Controlled Study of the Acute Effects of Muscle Energy Techniques on Posterior Shoulder Tightness. *Journal of Orthopaedics and Sports Physical Therapy* (in press).

Merrill, C., Devine, K., Brown, J., & Brown, R (2010). Improving geometric and trigonometric knowledge and skill for high school mathematics teachers: A professional development partnership. *The Journal of Technology Studies*. XXXVI (2), 20-30.

McCool, J. K., & Barrett, J. E. (2010). Incorporating a Measurement Learning Trajectory Into a Teacher's Toolbox for Facilitating Student Understanding of Measurement. Proceedings of the 32nd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. Columbus, OH: Ohio State University.



## *Scholarly Presentations*

In an effort to provide leadership, CeMaST representatives were very active in conducting national and state presentations. Examples include:

Bloom, A.M., & Hunter W. (2011, January). CeMaST and Resources for Educators. Presentation at the 2010 Teaching & Learning Symposium, Sustainable Teaching, Sustainable Learning, Sustainable Living, Normal, Illinois.

Bloom, A.M., & Hunter W. (2011, January). Urban Efforts in STEM at Illinois State University Presentation at the 2010 Teaching & Learning Symposium, Sustainable Teaching, Sustainable Learning, Sustainable Living, Normal, Illinois.

Bloom, A.M. 2011. The Global Climate Change: Threatened Species, Threatened Environments Teacher Workshop: Improving Climate Change Literacy in Illinois High Schools. United States Department of Education Mathematics and Science Partnerships Program Regional Conference, Baltimore, Maryland, USA.

Bloom, A.M. Session Organizer and Chair, Geography Education, Association of American Geographers (AAG) West Lakes Division meeting, Western Illinois University, Macomb, Illinois, USA (2010)

Brown, R. & Brown, J. (2010). Pedagogical content knowledge in secondary STEM classrooms. International Technology Education Association, Charlotte, NC.

Brown, J. & Brown, R. (2010). How STEM teacher integrate concepts of Pedagogical Content Knowledge. Connections Conference, St. Charles, IL.

Brown, R. (2010). Engineering Education: What is the Vision for Illinois? Connections Conference, St. Charles, IL.

Devine, K., Merrill, C., Brown, J. & Brown, R. (2010). Using Solid Modeling in High School Mathematics Instruction: A Professional Development Partnership. Proceedings from the 65th Annual American Society for Engineering Education/Engineering Design Graphics Division Mid-Year Meeting, Houghton, MI.

Harland, D. (2010, November). Incorporating Research in the Classroom. Illinois Council for Teachers of Mathematics, Springfield, Illinois.

Harland, D. (2010, October). Incorporating Research in the Classroom. Illinois Science Teachers Association, Springfield, Illinois.

Hunter, W.J.F (2010, March) CeMaST and Resources for Educators. Illinois Science Teachers Association, Springfield, Illinois.

Laudner K.G., Compton B., Walters C., McLoda T.A. The Graston Technique is an Effective Treatment for Posterior Shoulder Tightness. 2010 International Congress of Shoulder and Elbow Therapists. Edinburgh, Scotland.

Merrill, C., Brown, R. & Brown, J. (2010). STEM education and leadership. U.S. Department of Education Math and Science Partnership Conference. San Diego, CA

# Growth and Sustainability

CeMaST develops a funding and expense model that allows for growth and sustainability in the number of personnel and the activities in which they engage.

In FY11, CeMaST led or supported 15 funded projects, ranging in value from \$30,000 to \$11.7 million. From these projects, we were able to leverage through variance buyouts, indirect grant costs, administrative grant costs, and direct grant costs, almost \$425,000 of soft money to put towards the specific programming outlined. We also have 3 grant proposals currently under consideration by various agencies which would leverage an additional \$350,000 over the next two years if all were funded. We also are working with the Chemistry Department and Flinn Scientific on a new set of graduate courses in chemistry, which will result in buyout support for three CeMaST personnel at a total of \$50,000 per year. Depending upon enrollments over the next few years in these courses, this could contribute substantially to our available funds.

## *Operational Efforts*

Dr. Kevin Laudner was appointed CeMaST Associate Director for CAST. He is the second non-STEM-Ed CeMaST Associate Director to be appointed in the past two years. His appointment is designed to enhance the relationship with CAST faculty, departments, and schools and to promote new non-STEM-Ed projects on campus. So far, this new approach has resulted in departmental meetings across CAST, new partnerships between faculty in CJS and GEO, and in work toward establishing a new Sports Medicine and Rehabilitation Therapy (SMART) Clinic on campus for students and faculty.

Dr. Darci Harland continues as Assistant Director for Research and Publications (100% FTE). Her role is to support the research efforts of faculty in CeMaST and to make contributions to the permanent academic literature. So far this has resulted in two book prospectus submissions, four new CeMaST research studies on Urban STEM-Ed being initiated, and a new data-driven research agenda for the Mind Project.

Ms. Sara McCubbins has been hired as a Project and Office Manager (100%FTE). Her role is to coordinate several CeMaST projects (including the 6 MSPs, the Flinn Chemistry project, Outreach, Urban STEM-Ed, and Engineering activities) as well as new grant submissions and to supervise office personnel.

During FY 11, we also hired Dr. Raymond Dixon (100% FTE) as a Research Associate. His role is to lead research projects and provide background to both Engineering Education research and on other grant proposals. He has submitted four manuscripts to national and international journals. His work has been integral on three grant proposal (two to NSF:DR K-12, and one to NSF:TSL)

During FY11, we also hired Kate Edler (100%FTE) as a Research Associate. Her role is to support the projects in southern Illinois, to support the evaluation of all the MSPs on campus, and to work on the Flinn Scientific Project. To date, she has provided improved personal relationships with ISBE, with our partners across Illinois – leading to further requests for CeMaST to partner with other research and professional development organizations.

We have also hired 3 graduate students and 3 undergraduate students to work on various projects and activities.

## On-Going Grant Projects

*A Longitudinal Account of Children's Knowledge of Measurement: Mathematical and Scientific Concept Development from Pre-K through Grade Seven* with J. Barrett and K. Lind. National Science Foundation, \$1,400,000 awarded November, 2006.

*Heartland Partnerships: Inquiry-based Ecological and Environmental Education Program* at SIUC with K. Renzaglia, D. Gipsen, F. Mumba, S. Sipes and W. Hunter. National Science Foundation, \$1,800,000 awarded March, 2007.

*IBIOtech.* W. Hunter with Mary Ann Quivey. Illinois State Board of Education, Federal Grant: CFDA-84.366B NCLB Title II Part B. \$195,000. (2010-2011 – \$750,000) awarded June, 2009.

*Illinois Earthscope.* Illinois State Board of Education, Federal Grant: CFDA-84.366B NCLB Title II Part B. \$204,073. (2010-2011 – \$700,000) awarded June, 2009.

*Illinois State University Computer Science/Information Systems (CS/IS) Scholarship Program* with W. Mahatanankoon and S. El-Zanati. . National Science Foundation, Grant No. #0966226 \$599,979 awarded October, 2009.

*Illinois State University Robert Noyce Scholarship Program* W.J.F. Hunter with R. Lee, E. Palmer, and N. Ellerton. National Science Foundation Grant #0833322 \$750,000 awarded August, 2008.

*Illinois State University Robert Noyce Scholarship Program* supplemental award W. Hunter with R. Lee, E. Palmer, and N. Ellerton. National Science Foundation Grant #0936066 \$149,000 awarded May, 2009.

*Institutes for Integrating Content-knowledge with Classroom-instruction (IICC): A Partnership for Improving Middle-School Mathematics and Science.* C. Langrall, M.K. Morey, with W. Hunter, C. Merrill, J. Barrett, (original) Illinois State Board of Education, Federal Grant: CFDA-84.366B NCLB Title II Part B. Awarded \$198,000. (2008-2010 – \$1,000,000) September, 2007.

*Illinois Master Teacher-Leaders in Chemistry* W. Hunter with C. Merrill, J. Barrett, and M.K. Morey, Illinois State Board of Education. Federal Grant: CFDA-84.366B NCLB Title II Part B. \$196,000 (2008-2010 – \$1,000,000) awarded May, 2007.

*Improving Geometric and Trigonometric Knowledge and Skill for High School Mathematics Teachers* C. Merrill, K. Devine, J. Brown, & R. Brow. Illinois State Board of Education, Federal Grant: CFDA-84.366B NCLB Title II Part B. \$335,119 awarded, March, 2010.

*Science, Mathematics and Action Research for Teachers (SMART)* Illinois Mathematics Science Partnership Program at SIUC with M. Wright, H. Henson, F. Mumba, with W. Hunter. Illinois State Board of Education, Federal Grant: CFDA-84.366B NCLB Title II Part B. awarded \$196,000. (2008-2012 – \$1,000,000) September, 2007.

*STEM Education and Leadership Program*, C. Merrill, W. Hunter, R. Brown, & J. Brown Illinois State Board of Education, Federal Grant: CFDA-84.366B NCLB Title II Part B. \$196,000. (2008-2012 – \$1,000,000) awarded May, 2007.

*Teacher Education and Assessment Continuum for High-need Educators and Resources + Principal Leadership in Urban Schools (TEACHER + PLUS)* with R. Lee, G. Creasey, and 20 others. US Dept of Education, \$12,500,000 awarded September 2009.

# Proposals

## *New Proposals*

### ***Supported By CeMaST***

*An Examination of Science and Technology Teachers' Conceptual Learning through Concept-Based Engineering Professional Development* with R. Custer. National Science Foundation Discovery Research K-12 Grant #1119167 \$2.4 million awarded June, 2011.

*Shoulder Adaptations Over the Course of a Professional Baseball Season.* K.G.Laudner & K.Meister. K. for Major League Baseball Medical Grant. \$49,261.00 awarded May, 2011.

### ***From CeMaST Alone***

*Characterizing a Hierarchy of Authentic Scientific Experiences.* NSF Discovery Research K-12, \$431,885 declined January, 2011.

*Engaged STEM.* Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Awarded \$518,929 June, 2010.

*Engineering Ocean Science in the Midwest.* Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. \$400,000 declined May, 2011.

*Global Climate Change: Threatened Species, Threatened Environments.* Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Awarded \$660,786. June, 2010.

*Performing Research Courses in STEM Education.* National Science Foundation Transforming STEM Learning \$1.7 million pending, March 2011.

*Pontiac Township High School submission to the American Recovery and Reinvestment Act of 2009 (ARRA) Enhancing Education Through Technology (EETT) Competitive Grant:* Illinois School Reform Through Technology Initiative (IL-SRTT) program. Awarded \$17,435, January, 2010.

*Project Lead the Way and the question of conceptual transfer,* National Center for Engineering and Technology Education. Raymond Dixon \$22,789 declined September, 2010.

*Southern Illinois Fellowships for Teachers in Rural Schools* with F. Mumba, H. Henson, K. Renzaglia, and M. Wright. National Science Foundation. Awarded \$73,725 (ISU \$80,000) August, 2010.

*Southern Illinois Partnership for Achievement in Math and Science (SIPAMS)* with F. Mumba, H. Henson, K. Renzaglia, and M. Wright (SIUC). Illinois Board of Higher Education Awarded \$307,015 (SIUC) \$29,876 (ISU) January, 2011.

*Southern Illinois Partnership for Mathematics and Science* with F. Mumba, H. Henson, K. Renzaglia, and M. Wright (SIUC). Illinois Board of Higher Education. Awarded \$896,808 (ISU \$90,000) February 2010.



## ***Driven by CeMaST in Partnership with Other Faculty and CeMaST Fellows***

*Climate Change and Sustainability: Your Backyard and Beyond.* National Science Foundation with A. Bloom, D. Loomis, J. Sedbrook, E. Peterson, and W. Hunter. \$2,842,954 declined May, 2010.

*Collaborative Research: Learning Trajectories to Support the Growth of Measurement Knowledge from Early Childhood* through Middle School National Science Foundation REESE Jeffrey Barrett and others. Declined \$874,225 November, 2010.

*EarthScope and the New Madrid Earthquakes* with R. Nelson and D. Malone. Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Awarded \$400,000 May, 2011.

*Formative Assessment Improving Teachers' Instructional Practice* with J. Barrett, C. Cullen, J. Baek, and J. Tobias. Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Awarded \$400,000 May, 2011.

*Fostering STEM Collaboration* with K. Devine. Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Declined \$400,000 May, 2011.

*GLOBE Partnership for Improved Science Achievement* with D. Park Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Declined \$400,000 May, 2011.

*IBIO Institute* with ROE 45 Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Awarded \$400,000 (ROE45) \$54,403 (ISU) May, 2011.

*IBioTech 3rd year* Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Awarded \$29,223 May, 2011.

*Using Informal Science Education to Increase Public Knowledge of Wind Energy in Illinois.* Illinois State University Scott M. Elliott Cross-Disciplinary Pilot Grant Program with D. Loomis, A. Bloom, M. Adelman, and W. Hunter. Awarded \$13,173 May, 2011.

## ***Newly Funded Projects***

*Engaged STEM.* Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Awarded \$518,929 June, 2010 1st year.

*Global Climate Change: Threatened Species, Threatened Environments.* Illinois State Board of Education Federal Grant: CFDA-84.366B NCLB Title II Part B. Awarded \$660,786. June, 2010 1st year.

*Pontiac Township High School submission to the American Recovery and Reinvestment Act of 2009 (ARRA) Enhancing Education Through Technology (EETT) Competitive Grant:* Illinois School Reform Through Technology Initiative (IL-SRTT) program. Awarded \$17,435, January, 2010 1st year.

*Southern Illinois Partnership for Achievement in Math and Science (SIPAMS)* with F. Mumba, H. Henson, K. Renzaglia, and M. Wright (SIUC). Illinois Board of Higher Education Awarded \$307,015 (SIUC) \$29,876 (ISU) January, 2011 1st year.

*Southern Illinois Fellowships for Teachers in Rural Schools* with F. Mumba, H. Henson, K. Renzaglia, and M. Wright. National Science Foundation. Awarded \$73,725 (ISU \$80,000) August, 2010 1st year.



# CENTER FOR MATHEMATICS, SCIENCE, AND TECHNOLOGY

*Illinois State University*

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