Introduction

**CeMaST Celebrates 20th Anniversary**

On May 3rd, 2012, the Center for Mathematics, Science, and Technology celebrated 20 years since its founding. CeMaST is a leader at Illinois State University in major curriculum and professional development projects funded by state and national agencies. Current and former CeMaST personnel joined at the Bone Student Center to celebrate with refreshments, hors d’oeuvres, cake, and a presentation by Dr. John Dossey on *Education Standards and the Common Core: More Assessment or Improved Instruction?* In addition to Dr. Dossey’s presentation, highlights of the event included: a presentation to Dr. Robert L Fisher, former Director of CeMaST and retiring after 50 years in education as Assistant Director of Urban STEMEd; and a presentation by Dr. Hunter on the many accomplishments of CeMaST. Other former Directors, Associate Directors, and Staff in attendance included: Dr Chris Merrill, Dr. Cindy Langrall, Dr. Franzie Loepp, Ms. Kathy Hatch, Dr. Charles Morris, and Dr. Karen Lind. They were joined by Department Heads, Deans, and Faculty from across campus to celebrate this important work.

**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**

- Message from Our Director
- Annual Update
- IMaST at Home and Abroad
- STEM-Ed Outreach
- Illinois Math and Science Partnership
- Proposals
- Recent Publications
- Presentations
- CeMaST New Fellows

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CeMaST’s mission “to stimulate, conduct, and support integrative STEM education activities and scholarship” is wide-ranging and 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. Three years ago, I was fortunate to be appointed Director of CeMaST. During this time, I have grown to believe even more strongly in the role that the STEM disciplines must play in our society. I believe passionately in the continual and growing need for improved technical education. For the past twenty years, I have been engaged in nearly every level of teaching and learning. From my first experiences as an undergraduate laboratory assistant, through my teacher education, as a high school teacher, and now as a university professor; nothing has ever excited me as much as the smile and self-confidence that appears on the face of a student as he or she grasps a new concept. Having students grasp new concepts, and; in turn, use the new knowledge to make professional and personal choices is what drives me on each day. In the end, all our efforts must lead to the choices that people make daily, both individually and collectively.

At CeMaST, we have expectations for working locally, regionally and nationally. For improved STEM-Education, this past year, we have worked with dozens of faculty and staff as PIs and co-PIs on grant-funded projects (EarthScope, LSAMP, Robert Noyce, CHASE, PRECISE, etc.), we have worked with hundreds of teachers in schools (IMSPs: Real Numbers, Formative Assessment, Flinn, etc.), we have reached thousands of students with our innovative outreach projects (HSRS, Family Science Day, ISRA, etc.), and we have worked on new curricula aligned with the new Common Core Standards adopted by 46 states (Creative Core Curriculum in Mathematics). We also have begun to initiate non-education STEM projects as well (Innovative Design Project and the SMART Clinic). All with the goals of helping to further society’s choices within the domains of the STEM disciplines. As we grow in stature and impact, we hope that CeMaST and Illinois State will become synonymous with excellence in the STEM disciplines.

To accomplish these goals, it takes a team of dedicated, talented people who share the vision, but also are willing to do the every day hard work of making things happen. We have worked with over 60 PIs, Co-PIs, administrators, and graduate students – and at times taken on the various roles of PI, Co-PI, consultant, fiscal agent, editor, evaluator, and gopher. We are always pleased to provide this support, be it in the form of leadership, project design, evaluative skills, and/or budgetary insight. These projects are a team effort —really the combined efforts of many faculty, staff, students, administrators, and volunteers at ISU and across the country. To those volunteers, to administrative staff, to Assistant and Associate Directors, and to colleagues on campus and to our supervisors, I want to express my gratitude to you for the successes we’ve shared this past year.
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 FY12, we awarded $7,000 in Professional Innovation Grants (a continuation from FY09, FY10, & FY11). We continued the following activities: ISU Open House, STEM department faculty meeting visits, brown bag lunches with STEM-Ed faculty, and World Wide Day of Play. We also provided cost-sharing on several grant requests, and presented at the CTLT Teaching and Learning Symposium. We are also supplying editorial, management, and logistical support to two academic journals: the Journal of Research in Mathematics Education and the Journal of Technology Education. Four Professional Innovation Grants were awarded by CeMaST last year, and winners came from a variety of departments throughout campus, including: the Department of Curriculum and Instruction, the Department of Educational and Administrative Foundations, the Department of Psychology, the Department of Physics, and the Chicago Teacher Education Pipeline.

**State-Wide**

We participated in several 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. These efforts have now gained regional and some national recognition as we have been asked to consult and act as evaluators on proposed projects in Texas, Indiana, and Washington, DC.

**Nationally**

CeMaST administrators, faculty and staff attended several national meetings and interacted with national leaders in the K12 Engineering Education movement. Drs. Hunter and Christensen were invited to give a special presentation to the National Academies of Education as the national panel deliberated about the next best steps to take in promoting integrated STEM education. Two years 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 (Department of Technology). CeMaST provides technical editing, subscription, and layout support to Dr. Merrill. Last year, the Journal for Research in Mathematics Education was brought to ISU under the direction of Dr. Cindy Langrall (Department of Mathematics). CeMaST provides personnel support with editing and layout via our technical writer, Amanda Fain. In the next year, we hope to bring an established national or international journal to ISU to be housed at CeMaST. CeMaST continues to actively encourage and support other faculty in bringing journals and editorships to ISU.
Every four years, centers at Illinois State University are reviewed by the Academic Planning Committee and the Provost’s Office to determine the extent to which the centers meet expectations. The Illinois State University strategic plan, Educating Illinois, articulates the university commitment to pursuit of learning and scholarship, individualized attention, public opportunity, diversity, and civic engagement. The following CeMaST goals align with Educating Illinois: 1) to stimulate and support activities and research on teaching and learning that aligns with campus, state, and national STEM priorities; 2) to provide leadership to and foster cross-disciplinary collaborative STEM activities and research on teaching and learning; and 3) to direct efforts to increase the diversity of STEM communities. Public outreach is an important component of the Center through program sponsorship and support of community activities and programs. Since 1991, the Center for Mathematics, Science and Technology Education (CeMaST) has sought to integrate and improve the teaching and learning of science, technology, engineering, and mathematics (STEM) across the K12 and undergraduate experience. As a leader at Illinois State University in major curriculum and professional development projects funded by state and national agencies, CeMaST has established a national reputation and identity for producing a strong record of curricular, policy, and professional development expertise and has achieved national recognition for its work on integrated curriculum development.

National and state leaders seek CeMaST expertise in evaluation, proposal development, and curriculum development because of its growing reputation as a center that can organize and implement innovative and complex initiatives. CeMaST has supported or led dissemination of STEM teaching and learning scholarship through publications in peer-reviewed journals and presentations at national and international conferences. CeMaST initiatives include Urban STEM-Ed, Public Outreach, and K12 Engineering STEM Education. These all involve increasing the quality, quantity, and diversity of STEM students and teachers in the United States. CeMaST has been awarded grant funding by national agencies and foundations including the National Science Foundation, National Institutes of Health, U.S. Department of Education, Illinois Board of Higher Education, and Illinois State Board of Education. Depending on how conservatively grant awards are counted, this work has generated between $8 million (if only counting CeMaST-driven projects) and $20 million (if CeMaST-assisted projects are included) over the past five years. CeMaST initiatives have resulted in the completion of 54 major projects and publications. The Center has supported STEM faculty on campus in their efforts to bring core STEM education journals to Illinois State University. During the past year, CeMaST developed an assessment plan to align with Center goals. CeMaST has worked with other campus units to write proposals and develop projects of mutual benefit.

The Academic Planning Committee at Illinois State University, as a result of this review process, found the Center for Mathematics, Science and Technology Education to be in good standing, commending the Center for its work with University Assessment Services to develop an assessment plan to help guide Center initiatives and ensure their quality.
Integrated Mathematics, Science, and Technology at Home and Abroad

Last year, IMaST was adopted by Washington Academy in Belvidere, Illinois. Starting in sixth grade of the new STEM academy, students were using IMaST as the central curriculum in science and technology classes. Mathematics, however, remained with the district-wide adopted curriculum. As students move into seventh and eighth grade, they would grow into full use of the science and technology portions of IMaST. Based upon the success in the first year, Washington Academy has chosen to not only use the science and technology portions of IMaST, but to move to complete integration and to teach mathematics to seventh grade using IMaST beginning next year.

**IMaST at the National Academy of Engineering**

Dr. Willy Hunter, CeMaST Director, and Dr. Brad Christensen, IMaST Coordinator, went to Washington, DC in mid-January to attend the National Academy of Engineering (NAE) meeting of the Committee on Integrated STEM Education. This meeting was a part of the new study of integrated science, technology, engineering, and mathematics (STEM) education at the K-12 level. Their intent was to determine a research agenda for integrated STEM education. The first step in that process was to identify and invite different integrated STEM programs, such as IMaST, to present to the committee. Of the integrated STEM programs to present at the meeting, IMaST was the only program that was designed to replace traditional curriculum rather than just supplement it. Results from this meeting include valuable publicity with districts from across the country who requested IMaST materials for review.

**IMaST Travels to the United Kingdom and Back**

Not only has IMaST been traveling across the country, but it has also been traveling abroad. CeMaST has partnered with TPS Publishing in the United Kingdom and AlphaGraphics in Texas to promote IMaST in England, Ireland, and Scotland. There have been several teacher conferences with positive results, and pilot testing will be conducted in two academies. The IMaST curriculum is now on display at the science curriculum library in York.

As part of the TPS Publishing and Alphagraphics partnership, CeMaST has written 18 new integrated STEM textbooks for Grades Kindergarten through Eight. These books authored and edited by Brad Christensen, William Hunter, and Sara McCubbins contain project activities designed to teach and assess the new Common Core State Standards for Mathematics. Currently these books are up for adoption (along with 29 other TPS titles) by Florida, Louisiana, and California. In July, the State of Georgia adopted the series and it may now be considered for use by all schools in Georgia.
2011 Teacher Innovation Grant: Vernier Labquest Probes for Science Laboratories and Field Experience Activities

With the Center for Mathematics, Science, and Technology (CeMaST) Teacher Innovation Grant, Dr. John Thurmond of Plainfield North High School purchased laboratory equipment for Honors Physics, AP Chemistry, and AP Environmental Science classes. The laboratory equipment engaged students by providing hands-on science experimentation in the classroom and in the field.

The Labquest equipment allows rapid and versatile data collection in various types of experiments and is a very useful and intuitive interface for science education. It helps teachers bring STEM concepts to life through hands-on learning with modules for educational hardware. Vernier Labquest can be used as a computer interface, a stand-alone device or in the field. It has built-in graphing and analysis software, a vivid color touch screen, and is compatible with existing Vernier sensors. The grant funds allowed Plainfield North High School to purchase more Vernier Labquest equipment for laboratories and field experiences for the students than previously offered, helping to engage students in science and technology.

Second Annual Family Science Day a Huge Success

CeMaST, along with the Children’s Discovery Museum and Challenger Learning Center, hosted its second annual Family Science Day as part of Sibling Weekend on Sunday, April 22, 2012. The event attracted over 1,200 attendees and more than 80 exhibits, including NASA speaker Jim Simek, the St. Louis Science Center, and a transportation showcase of everything from classic cars to electric and solar vehicles. The event was geared towards pre-K through 8th grade students and their families, and this year’s focus was on sustainability and energy conservation in honor of Earth Day.
**American Solar Challenge Makes Pit Stop at ISU**

On July 18-19, 2012, CeMaST organized pit-stop events and accommodations as the American Solar Challenge returned to Illinois State University. The American Solar Challenge is a competition to design, build, and drive solar-powered cars in a cross-country race, covering a 1,200-1,500 mile course. The race is hosted by the Innovators Educational Foundation, an organization devoted to educational opportunities where students are challenged with “hands-on” learning experiences in the areas of science, engineering, and technology. The 2012 race ran from Rochester, NY to St. Paul, MN with an overnight stage stop in Normal. Teams from across the nation, including Illinois State University’s own Team Mercury, competed in the race.

The winners of the 2012 Normal Stage Stop were:

1. **University of Michigan**
2. **Iowa State University**
3. **CalSol – UC Berkeley**

**People’s Choice Award:** Team Mercury Illinois State University

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**Illinois Summer Research Academy**

The 2012 Illinois Summer Research Academy was held from June 25-29, on the campus of Illinois State University. High school freshmen, sophomores, and juniors spent a week with ISU professors and other high school students from across Illinois working on various hands-on research projects. Students were introduced to the current research projects of ISU faculty and were exposed to the tools and techniques that are being used to accomplish this research. Students then made contributions to these research projects and/or worked on their own research projects with their peers. Students worked in a variety of different labs at ISU including: Physiology and Ecology of Aquatic Turtles with Dr. Rachel Bowden, Associate Professor of Biological Sciences; Biochemistry with Dr. Marjorie A. Jones, Professor of Biochemistry; Chemistry with Dr. Jun-Hyun Kim, Assistant Professor of Nanoscience and Materials Chemistry; Mathematics and Physics with Dr. Lucian Ionescu, Associate Professor of Mathematics.
16 Students Receive Noyce Scholarship

Each year, the Center for Mathematics, Science, and Technology hosts 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 honors those who have been awarded this scholarship in the past as well as those who have recently received this award. The 2011 Noyce Scholars include: Alex Kabak, Laura Sedivy, Katy Spencer, Ryan Forner, Daniel Zummo, Robert Cress, Sam Krueger, Michael Burt, Kristina Gee, Matt Greenfield, Rebecca Hess, Michael Tompkins, Steven Clayton, Ryan Cookson, Matthew Miller, and Jack Cozad.

NSTA Press Publishes STEM Student Research Handbook and Forensics in Chemistry: The Case of Kiersten K. by CeMaST Authors

STEM Student Research Handbook: Darci J. Harland, Assistant Director of Research at CeMaST, has reached an agreement with NSTA Press to publish her STEM Student Research Handbook. It is a comprehensive resource for STEM teachers and students, that outlines the various stages of large-scale research project, empowering high school teachers to coach their students through the research process. This handbook provides enough detail to embolden all teachers—even those who have never designed an experiment on their own—to support student-researchers through the entire process of conducting experiments.

Forensics in Chemistry: The Case of Kirsten K: Sara McCubbins, Project and Office Manager at CeMaST, and Angie Codron, chemistry teacher at Normal Community West High School, recently published Forensics in Chemistry: The Case of Kirsten K. through the National Science Teachers Association (NSTA) Press. The book highlights a year-long forensics based chemistry curriculum where students collect data and evidence throughout five different performance assessments and assemble it to solve the case by the end of the year.
ISU Receives Workshop Institute Program Grant

Members of CeMaST at Illinois State will be holding the Real Numbers Summer Workshop in Rockford this summer. This program, funded by the Illinois State Board of Education (ISBE), will be the fifth Illinois Mathematics and Science Partnerships (IMSP): Summer Workshop or Institute (WIP 4) grant to be awarded to Illinois State since the program started.

The IMSP grant program is part of the federal MSP program used to promote an increase in academic achievement of students in math and science by enhancing the content knowledge and teaching skills of classroom teachers. Specifically, this is accomplished through the Workshop Institute Programs (WIPs), which involve summer workshops consisting of 80 hours or more of professional development for classroom teachers with at least four follow-up days throughout the course of the school year. The three goals for the Illinois MSP program are: a) to improve teachers’ subject matter knowledge and skills, strengthen the quality of mathematics and science instruction, and promote student academic achievement in math and science; b) to promote strong teaching skills through access to the expertise of mathematicians, scientists, and engineers and their technologies and resources, including integrating reliable scientifically-based researched teaching methods and technologically-based teaching methods into curriculum; and c) to increase the understanding and application of scientifically-based educational research appropriate to mathematics and science teaching and learning.

The Real Numbers workshop was designed to accommodate up to 36 math teachers (currently teaching Algebra I) from Rockford, Belvidere, Harlem, and the surrounding districts. The first workshop, held onsite in Rockford, IL, ran from June 11-22, 2012. The aim of this project was to fully engage teachers and students in critical mathematical and integrated STEM thinking and learning using local and ubiquitous science, technology, and engineering applications which enhance their mathematical reasoning.

The focus of this workshop was to write learning cycles to teach common core in the context of the local industry, focusing on Illinois Pathways for Architecture and Construction, Energy, Health Science, and Manufacturing. The participants visited area businesses and non-profits looking for applications of Common Core State Standards content for Algebra I and/or Math I.

In addition to the workshop, these participating teachers will pilot some of the learning cycles that came out of this workshop in the fall semester. There will be follow-up meetings, and participants will meet again for two weeks in the summer of 2013 to revise and finalize the learning cycles.
Proposals


Publications


Publications Continued


Presentations


CeMaST Fellows

Milner Library
Rick Satchwell

College of Applied Science and Technology
Department of Agriculture: Dave Kopsell & Paul Walker
School of Information Technology: Mary Elaine Califf, Bryan Hosack, & Glen Sagers
Department of Technology: Josh Brown, Kevin Devine, Anu Gokhale, & Chris Merrill

College of Education
Dean’s Office: Robert Lee
Department of Curriculum & Instruction: May Jadallah, Anthony Lorsbach, & Do-Yong Park

College of Arts and Sciences
School of Biological Sciences: Craig Gatto, Elisa Palmer, & Laura Vogel
Department of Chemistry: David Cedeño, Greg Ferrence, Shawn Hitchcock, Marjorie Jones, Craig McLauchlan, Elisha Swanson, & Liza Szczepura
Department of Geography-Geology: John Kostelnick, David Malone, Catherine O’Reilly, Jon Thayn, & Jill Thomas
Department of Mathematics: Olcay Akman, Jae Baek, David Barker, Fuxia Cheng, Craig Cullen, Gary Lewis, Tami Martin, Janet Moore, George Seelinger, Jennifer Tobias, & Matthew Winsor
Department of Philosophy: David Anderson
Department of Physics: David Marx & Ken Wester
Department of Psychology: Steve Croker, Matthew Hesson-McInnis, Rocio Rivadeneyra, & Corinne Zimmerman

Personnel

Director
Dr. William Hunter

Associate Directors
Dr. Jeff Barrett (CAS)
Dr. Ryan Brown (COE)
Dr. Kevin Laudner (CAST)
Dr. George Rutherford (CAS)

Assistant Directors
Dr. Amy Bloom (Outreach)
Dr. Robert Fisher (Urban STEM)
Dr. Darci Harland (Research)