

# 2010 CIESE SUMMER NEWS

## Center for Innovation in Engineering and Science Education

### From the Director

Dear Colleagues,



Some of you may recall Nat King Cole's summer anthem, that celebrated the "lazy, hazy, crazy days of summer." The summer of 2010 at CIESE has been anything but lazy-- but maybe a bit crazy!

Since last fall, CIESE has played a leadership role in garnering nearly \$20 million in federal and state funding to advance K-20 (elementary through graduate) STEM education. As a result of these grants, 20 weeks of summer programs will be conducted at Stevens, across New Jersey and in partner sites throughout the U.S. Combined, these programs will impact approximately 311 K-12 teachers and informal educators, 18,200 K-12

**"CIESE garners nearly \$20 million in federal and state funding to advance K-20 (elementary – graduate) STEM education."**

students and out-of-school youth, 500 university students, and involve collaborations with 19 higher education partners spread throughout the U.S.

Three National Science Foundation grants are currently being implemented: a \$2.5 million *Innovative Technology Experiences for Students and Teachers* (ITEST) "Scale Up" grant to build capacity in partner sites to offer an underwater robotics curriculum for middle and high school youth in classrooms and out-of-school settings; a \$1.4 million *Discovery Research K-12* (DRK-12) grant that is investigating the impact of engineering design on high school chemistry and biology learning; and an \$11.5 million *Math Science Partnership* grant that is building capacity of more than 500 teachers and administrators in 12 diverse partner districts in physical and earth science and engineering. A \$1.7 million NJ Department of Education grant is sponsoring programs for teachers from 19 schools/districts in an intensive, three-year curriculum topic study in science and mathematics. Through a collaboration with the Department of Homeland Security's Center for Maritime, Island, (Continued p. 5)

### July 2010

#### What's Inside:



- New Grants Promote K-12 STEM Education
- STEM Programs for Students and Educators
- 3 Systems Engineering Projects Address Education
- CIESE Partners with DHS Center of Excellence
- Engineering Dominates Top Paying Majors
- Conference & Research Publications
- Three Partner Teachers Honored

### \$13.3 Million in New Grants Promote K-12 STEM Education

In June 2010, CIESE was recognized with a major National Science Foundation grant and a New Jersey Math-Science Partnership grant:

#### PISA<sup>2</sup>: Partnership to Improve Student

#### Achievement in Physical Science: Integrating

**STEM Approaches:** A five-year, \$11.5M National Science Foundation-sponsored program which aims to significantly increase the quantity, quality and diversity of Grade 3-8 physical science teachers.

The partnership includes 12 socio-economically diverse NJ school districts and will impact 400 in-service teachers, 50 STEM undergraduates and 120 school and district administrators. PISA<sup>2</sup> seeks to increase the academic achievement and 21<sup>st</sup> century skills of elementary and middle school students in science and engineering by enhancing the content knowledge, pedagogical content knowledge, and (Continued p. 2)

#### PISA<sup>2</sup> Partner School Districts

Bayonne Board of Education  
Camden City Public Schools\*\*  
Hoboken Public Schools  
Jersey City Public Schools  
Lakewood School District  
Margate City School District  
Morris School District\*\*  
Mustard Seed School (private)  
Princeton Regional Schools  
Red Bank Borough Public Schools  
Saddle Brook School District  
West New York School District

#### IHE Partners

Columbia University/  
Teachers College  
Stevens Institute of Technology\*  
St. Peter's College (School of Education)

#### Other Partners

National Science  
Resources Center (NSRC)  
NJ Department of Education  
Nyre & Associates†

\*Lead Agency \*\*Core Partner  
†Evaluation Partner

attitudes and beliefs about teaching science, technology, engineering, and mathematics (STEM) subjects of teachers. Moreover, the project aims to increase the number of teachers with elementary endorsement with science specialization by offering five new innovative blended graduate courses, combining face-to-face and online components in science and engineering education.

In addition a leadership training and capacity building effort will support school and district administrators as they develop strategic plans for STEM education

**Two Pathways to Teaching for Stevens Students** PISA<sup>2</sup> will make two options explicitly available to Stevens science and engineering students: an 18-credit science education minor, through collaboration with St. Peter's College or Alternate Route Certification.

PISA<sup>2</sup> will also explore the following seven evaluation and research questions:

#### PISA<sup>2</sup> Project Evaluation

1. Does a project which uses scientific inquiry and the engineering design process (EDP) contribute to an increase in teachers' content knowledge of science and engineering?
2. Does a project which uses scientific inquiry and the EDP contribute to an increase in students' content knowledge of science and engineering?
3. Do students improve their 21<sup>st</sup> Century Skills as a result of the program?
4. To what extent do teachers' beliefs and attitudes towards teaching science and engineering change over time?
5. To what extent did the program promote an increase in collaboration and shared vision among partners: University faculty; District and Schools; Administrators; Teachers; Students; Parents?

#### PISA<sup>2</sup> Project Research Questions

1. What are the teachers' conceptions of the 21<sup>st</sup> Century Skills as they apply to teaching and learning?
2. To what extent do they change over time as a result of the instructional interventions?
3. What immediate and contextual factors limit or facilitate a teacher's success in changing classroom practice?

**Curriculum Topic Study to Enhance Achievement in Mathematics & Science (C-TEAMS):** A three-year, \$1.7M NJ Department of Education Math-Science Partnership grant provides vertical teams of 70 teachers from 19 northern New Jersey education agencies with high quality, research-based, classroom-focused professional development designed to increase science and math subject matter knowledge and pedagogical content knowledge. Science and math cohorts, consisting of multi-grade level teacher teams, will form a dynamic and supportive professional learning community to explore key science and math research, standards

and instructional strategies across a wide span of grade levels and apply their new knowledge to development or redesign of classroom curricula. Summer institutes will combine Curriculum Topic Study (CTS) with labs and hands-on activities that provide concrete examples of in-class activities and learning progressions in higher education.

#### C-TEAMS Partners

##### Public School Districts

Bayonne	Morris
Clifton	Paramus
Hackensack	Saddle Brook
Hawthorne	Secaucus
Hillsborough	Weehawken
Jersey City	West Milford
Keansburg	

##### Nonpublic School Districts

All Saints Academy and Marist High School, Bayonne  
 Rising Star Academy, St. Augustine's School, and St. Francis Academy, Union City  
 St. Nicholas School, Jersey City

##### Higher Education Institutions

Stevens Institute of Technology  
 St. Peter's College

## STEM Programs for Students and Educators

### 2010 Energy and Engineering Institute

Twenty middle school teachers (grades 6-8) will participate in a PSE&G-sponsored 2010 Energy and Engineering Institute slated for August 9 -10, 2010. The two-day institute will blend middle school science concepts of renewable energy with hands-on engineering design to raise awareness of the challenge to provide sustainable energy resources to meet growing world demand. PSE&G support provides teacher scholarships and classroom materials to help plant the seeds for creative solutions to our energy needs in the next generation of scientists, engineers and energy consumers.



### Honeywell Student Innovation Day

Sixty students from Jersey City schools participated in the third annual Honeywell-sponsored Student Innovation Day on June 2, 2010. This event brought together middle school students (grades 6-8) to generate excitement about science, technology, engineering and mathematics learning by encouraging imaginative thinking, innovative use of technologies and exploration of STEM career opportunities.



## Three Systems Engineering Projects Address Middle School through Graduate Education

### Expanded Systems & Global Engineering Courses (SAGE)

#### Free Online Professional Development

Five free online courses have been developed to prepare teachers to implement the SAGE instructional modules.



These courses are:

- Introduction to Core Concepts of Systems Engineering
- Reverse Engineering
- Home Lighting in Developing Countries
- Biodynamic Farming
- Water Purification

In each of five SAGE curriculum modules, students participate as part of a geographically-distributed design team and develop solutions to relevant social challenges of interest to students worldwide. Each module emphasizes conceptual knowledge and 21st century skills, including systems thinking, teamwork, effective communication, and problem-solving, as well as engineering design.

CIESE offers the Systems and Global Engineering program, funded by the Edison Venture Fund and in cooperation with the NJ Technology Education Association, to introduce systems engineering and globally-distributed design to high school students around the world.

For more information about the SAGE project, course schedule, or how to register to participate, please visit: <http://www.stevens.edu/ciese/sage>.

### WaterBotics Program Rolls Out In Dayton and Texas

This summer middle and high school age kids and formal and informal educators will participate in camps and workshops using underwater robotics as the vehicle to learn and have fun.



WaterBotics is a research-based underwater robotics curriculum aimed at engaging middle and high school youth in intensive science, engineering, and computer experiences and development of 21st century skills such as problem-solving and teamwork. Supported

by a \$2.5 grant from the National Science Foundation, the curriculum has documented increased student interest in STEM careers as well as increased enjoyment and learning in science, engineering, and computer programming.

The WaterBotics program provides youth with intensive, experiential learning opportunities in a challenge-based format. Students design, construct, program, and test remotely-operated vehicles (ROVs) to perform a series of increasingly complex challenges in an underwater environment. Addressing national and state educational standards in science and technology education, WaterBotics can be used in school settings or informal education programs.

Partners at Sinclair Community College in Dayton, Ohio and the Texas Girls Collaborative Project at the University of Texas at Austin are conducting summer camps and educator institutes this summer. For more information about the project, go to [www.stevens.edu/ciese/waterbotics](http://www.stevens.edu/ciese/waterbotics)

### Capstone Project Aims to Increase Systems Engineering Learning and Career Interest

A 45% growth in system engineering (SE) jobs is expected in the next decade. A critical challenge facing the US Department of Defense (DoD) and related industries is development of systems engineering talent for current and future workforce needs. New academic and career pathways are needed to build the talent base required.

#### SE Capstone Participants

Auburn University  
Missouri University of Science and Technology  
Penn State University  
Southern Methodist University  
Stevens Institute of Technology  
University of Maryland College Park  
University of Virginia  
Wayne State University  
Air Force Institute of Technology (AFIT)  
Naval Postgraduate School (NPS)

To help meet this challenge, CIESE is leading a \$2.5 million DoD research effort in collaboration with the Systems Engineering Research Center (SERC) and 10 universities. This project is researching strategies and practices to optimize systems engineering learning and career interest in the context of capstone courses during the 2010-2011 academic year.

## CIESE Partners with DHS Center of Excellence for Middle and High School Program

As part of the education and outreach initiative of a Department of Homeland Security-sponsored National Center for Secure & Resilient Maritime Commerce (CSR) based at Stevens, CIESE will be conducting a one-week intensive teacher workshop August 2-6, 2010. This workshop will build teachers' capabilities to use autonomous underwater vehicles and detection technologies to engage students in engineering design and problem-solving activities. The mission of the CSR is to provide for the safe and secure use of our nation's maritime domain (including island and extreme environments), and a resilient marine transportation system, through advancement of the relevant sciences and development of the current and prospective maritime workforce. Twenty middle and high school teachers will explore technology applications, research interests, and careers related to the CSR.



## Engineering Dominates Top Paying College Majors

A new study lists the 10 college majors that will net students the most income after graduation. Seven of the top spots are taken up by engineering fields, with economics, physics and computer science filling the three remaining slots. Of the 10 majors listed, Chemical Engineering has the biggest immediate payoff, with a starting median salary of \$65,700/year. But it's Aerospace Engineering that pays off better in the long run, with a median mid-career salary of \$109K/year <sup>1</sup>.



## Conferences and Research Publications

One of CIESE's papers for the Partnership to Improve Student Achievement (PISA) program, "*Partnership to Improve Student Achievement in Engineering and Science Education: Lesson Learned in Year One*" by Macalalag, Brockway, McKay, and McGrath was chosen to receive the 2010 American Society for Engineering Education (ASEE) Best Zone Paper Award at the

annual conference of the American Society for Engineering Education (ASEE) held in Louisville, KY. Additionally, a second paper for the PISA program, "*Promoting 21st Century Skills through Science and Engineering Education*" by Aviles and Macalalag was selected as the elementary school winner of the ASEE Best Practices in K-12 Engineering Panel held at the 2010 annual conference.



CIESE staff presented the following papers at 2010 national conferences.

- Macalalag, A.Z., Lowes, S., Tirthali, D., McKay, M., & McGrath, E. (2010). *Teacher Professional Development in Grades 3-5: Fostering Teachers' and Students' Content Knowledge in Science and Engineering*. American Society for Engineering Education Annual Conference, Louisville, KY, June 2010.
- Peterson, K., McGrath, E. (2010) *Build IT Scale Up Project*, National Afterschool Association, April 2010, Washington, DC
- Macalalag, A.Z., Lowes, S., Guo, K., Tirthali, D., McKay, M., & McGrath, E. (2010). *Advancing Science and Engineering in Elementary Schools: Fostering Teachers' Knowledge and Scientific Inquiry*. National Association for Research in Science Teaching Annual Conference, Philadelphia, PA, March 2010.

CIESE staff presented at conferences including: National Association of Science Teaching Annual Conference in Philadelphia, PA, *Connecting Science Past to Science Future*, March 18 – 20, 2010:

- Shields, C, *K-3 Engineering Activities and K-5 Collaborative and Real Time Data Projects*
- Macalalag, A, *Science and Engineering Partnerships in Grades 3-5*
- Bartus, G, *Earth Science and Engineering Connections*

An article by CIESE staff was published in the International Technology and Education Engineering Association publication, *Technology Teacher*:

- Harms, H., Janosz, D., & Maietta, S. (2010). The Systems and Global Engineering Project. *The Technology Teacher*, March 2010, 69(6), 25-27

<sup>1</sup> Best Undergrad College Degrees by Salary (Payscale.com)

## Three Partner Teachers Honored

The following CIESE partner teachers received awards and recognition this year:

**Angela Kadian** from Woodrow Wilson School in Bayonne received the Technology Education Association of New Jersey's 2010 Elementary School Teacher Excellence Award. Each year the New Jersey Technology Education Association recognizes outstanding teachers in the field of Technology Education and honored her at the NJTEA Awards Banquet on May 13, 2010



**Marilyn Ortiz** from Webb School in Jersey City was awarded a Toyota Tapestry mini-grant of \$2,500. The money will be used to purchase materials to promote environmental engineering. Next year's 4<sup>th</sup> & 5<sup>th</sup> grade students will conduct two environmental engineering design projects (building a water filter and windmill); participate in an Internet-based project called Bucket Buddies, and compare data with other schools from around the world.



**Marlene Aviles** from Webb School in Jersey City received the American Society for Engineering Education, Best Practices in Science and Engineering in Elementary School award at the annual conference in Louisville, KY in June 2010.



### From the Director *Continued from page 1*

and Port Security, based at Stevens, CIESE is exploring the use of autonomous underwater robotics and detection technologies in middle and high school classrooms. The PSE&G-sponsored Energy & Engineering Institute is promoting teachers' investigation of the science and engineering of energy production for use in middle school classrooms.

In addition, a program in partnership with the Systems Engineering Research Center (SERC) and sponsored by the Department of Defense is working with 14 institutions of higher education throughout the U.S. to understand how curricula and coursework can contribute to increased learning and career interest in systems engineering. The Systems

and Global Engineering (SAGE) project, sponsored by the Edison Venture Fund, is providing online professional development to help teachers integrate systems engineering projects into high school science and technology classrooms.



I am pleased to note that a CIESE paper won the "Best Zone Paper" at the 2010 ASEE conference last month, and that, for two years in a row (2009, 2010), CIESE submissions were selected for the "Best Practices in K-12 Engineering Education" program of ASEE.

This is an exciting time at CIESE, both because of the variety of STEM education programs and research being conducted, as well as the diverse collaborations and partnerships that have formed. We are enriched by the contributions of more than a dozen Stevens faculty involved in our current programs, including faculty from Physics, Materials Science, Chemistry/Chemical Biology, Ocean Engineering, Mechanical Engineering, Systems Engineering, Electrical Engineering and Computer Science, Mathematics, and others, and by the synergistic partnerships with external organizations such as the National Girls Collaborative Project, the League for Innovation in the Community College, Teachers College at Columbia University, the University of Texas at Austin, Sinclair Community College, St. Peter's College, Montclair State University, Evaluation and Research Associates, Portland State University, the Museum of Science, Boston, the National Science Resources Center at the Smithsonian Institution, and others.

We look forward to updating you on developments related to these and other programs! Have a great summer!

A handwritten signature in black ink that reads "Beth McGrath".

Beth McGrath  
Director

### Information

For additional information about Stevens Center for Innovation in Engineering and Science Education (CIESE), please call 201-216-5375, or visit our website: [www.stevens.edu/ciese](http://www.stevens.edu/ciese).

## TOP STEM WORKSHOPS

The top STEM workshop list provides a roster of popular school and in-district professional development workshops that are available through CIESE

### Elementary Teachers Workshops

- Science & Engineering Connections  
Engineering is Elementary curriculum:
  - Weather            - Electricity
  - Life Cycles        - Forces
- Designing an Engineering Lesson
- Science Inquiry in Grades 3-8
- Using Children's Literature to Introduce the Engineering Design Process (K-2)

### Middle School Teacher Workshops

- Design Squad:
  - It's Electric        - Cars, Cars, Cars
  - Kick Start         - On the Moon
- Building Math:
  - Stranded           - Everest Trek

For a copy of the PD Catalog, go to  
<http://www.stevens.edu/ciese/pd.html>

### Middle School & High School Teacher Workshops

- Technology Tools:
  - Web 2.0 Tools
  - Google Applications –
- Science & Engineering Connections:
  - Earth Science & Engineering Connections:
    - Earthquakes
  - Physical Science & Engineering Connections:
    - Properties of Water & Distance, Rate, Time
- Finding and Integrating STEM Activities in the Classroom
- KidWind
- Designing an Engineering Lesson

### High School Teacher Workshops

- Engineering the Future
  - Design a Building of the Future
- System and Global Engineering
- Reverse Engineering

Center for Innovation in Engineering &  
Science Education (CIESE)  
Stevens Institute of Technology  
Castle Point on Hudson  
Hoboken, NJ 07030  
201.216.5375 ▪ Fax 201.216.8069  
[www.stevens.edu/ciese](http://www.stevens.edu/ciese)