Developing STEM Talent for Work and Citizenship
The Future is ours to create.

Our mission ignites our work: To inspire, nurture and educate leaders for tomorrow’s technology-centric environment while contributing to the solutions of the most challenging problems of our time.

**STEM Education:**
Our nation’s need for an expanded technical workforce creates increased demand for break-the-mold approaches to STEM (science, technology, engineering and mathematics) teaching and learning from elementary through graduate education. The Center for Innovation in Engineering and Science Education (CIESE), with recognition from the White House, will play a leadership role.
What We Do

- Build teaching expertise through professional development
- Support student engagement through curriculum development
- Investigate teaching and learning questions through education research

25 Years of Support for STEM Literacy at Stevens Institute of Technology
Engaging students in STEM study through:

- Use of software in middle & high school mathematics
- Use of unique & compelling Internet projects and PD to improve K-12 science & mathematics
- K-12 engineering and STEM education research
  Integration with Stevens faculty research and undergraduate T & L
International Programs

- Afghanistan
- Bangladesh
- Costa Rica
- Greece
- Dominican Republic
- Ecuador
- India
- Nepal
- Peru
What Drives Our Work:
Momentum for Building 21st Century
STEM Workplace Talent and Citizen Competencies:

- Need for broad STEM literacy
- Uneven progress
- Diversity
- Globalization and competition
- Rapid change
- Growth in learning sciences
- Gap between theoretical and practice knowledge
- Digital technology advances
- Gap between what we can do and what we should do
- Need for systemic solutions
What Informs Our Work:

**Learning is:**
- Active
- Social
- Built on prior knowledge

**Science literacy:**
- Is for everyone
- Includes engineering
- Means doing science & engineering

**21st century success demands:**
- Problem solvers, critical thinkers, collaborator, who continue to learn.
- Applying
- Flexibility

**Universities should:**
- Shift to evidence-based teaching
- Invest in and promote disciplinary education research
Current Major Projects

- **PISA²**
  - Grades 3-8 Science and Engineering Professional Development

- **WaterBotics®**
  - Engineering Design Curriculum for Middle and High School Students

- **NJ PRIME**
  - Grades K-5 Mathematics Professional Development

- **Project Infuse**
  - Engineering Infused HS Biology Curriculum and Professional Development
• $11.5M NSF Mathematics & Science Partnership Program
• Engages over 300 grades 3-8 teachers from 14 New Jersey school districts
• Enhances teachers’ content knowledge and practice in science and engineering
• Graduate courses & PD led by Stevens faculty and CIESE science and engineering teaching experts

• Research foci: Impact on teacher knowledge and practice; students’ science and engineering knowledge; creativity and critical thinking skills
• Instructional foci: Modeling; evidence-based explanation; engineering design
- Teachers’ content knowledge increased from pre- to post-test in graduate-level science courses ranged from 8.7 to 24.9 % points.
- Gains for elementary teachers who completed the 5-course sequence gains ranged from 9.6 to 29.4 percentage points.

Student results on a test of science content targeted by the program also demonstrated statistically significant gains at both the elementary level (20.1 percentage points) and at the middle-school level (5.9 percentage points).
• MS & HS youth collaborate to plan, design, program and iterate underwater LEGO® robots
• 20-30 hour curriculum for in-class or out-of-school programs
• $2.5 million NSF scale-up grant with national partners targeting girls & underrepresented minorities

Research Foci: Impact on students, fidelity of implementation, and scale-up and sustainability efforts.
Instructional Foci: Engineering design, computer programming, collaboration & communication, STEM interest, engagement and career awareness
Implemented with over 2,300 youth in 8 states. Data collected from over 1,500 youth indicate:

- 53% female; 47% male
- 51% in summer camps; 49% in classrooms

- Informal learning sites had higher student ratings for enjoyment and learning, and a higher percentage of students expressed interest in science and engineering.

- Both formal and informal student post-test scores increased. Gain scores for girls were greater than for boys.
• 3-Yr NJ Dept. of Education MSP Program
• Provides 68 K-5 teachers from 13 high needs schools with PD to strengthen their math content and teaching expertise
• Teachers learn to engage students in deeper conceptual understanding, critical thinking, and problem-solving as emphasized by CCSS – Mathematics
• Participants will eventually serve as math teacher leaders in their school or district.

Research Foci: Growth of teachers’ mathematics understanding and their mathematics knowledge for teaching; confidence and leadership in math teaching; student achievement in mathematics

Instructional Foci: K-5 CCSS-M content and practices in topic areas of Number & Operations and Algebraic Thinking; effective PLC practices.
In Year 1:

- 68 elementary teachers provided 105 hours of mathematics-focused PD
- Teachers engage in 50 hours of school-based PLC meetings to examine student learning
- Over 1,800 elementary students reached
High school biology and physics teachers learn to infuse engineering design into their teaching
5-yr, $3 Million NSF project involves five universities and 2 cohorts of NJ teachers
Goals are to study how HS science teachers learn engineering concepts and how they introduce those concepts in the classroom.

Research Foci: Teachers’ content knowledge and approaches to innovation and engineering design practices
Instructional Foci: Engineering design, modeling, analysis, systems and communication & collaboration
• Links engineering and artistic design, creativity and innovation, and collaboration
• Middle school science and art teachers strengthen their knowledge of engineering and engage students in technological and artistic design
• Supports a professional learning community with art and engineering resources, lesson plans, and project-based learning activities

Research Foci: Teachers’ attitudes and behaviors regarding creativity, innovation and engineering design practices. Instructional Foci: Art and engineering integration
Engage Students in....

- Scientific Investigation and
- Engineering Design

Through....

- Problem-based Learning
- Authentic Learning Experiences
- Real Time Scientific Data
- Tele-collaborative Investigations

And learn....

- Scientific and Engineering Practices
- Cross Cutting Concepts
- Science & Engineering Core Disciplinary Ideas
• Over $50M in external support; $27M since 2004 (K-12 engineering & science focus)
• More than 60 papers on K-12 engineering & science since 2004
• Collaborations in 27 states and 9 countries
• Presidential Award in 2011
• 2 National Academy of Engineering invited talks
• More than 35,000 educators and hundreds of thousands of students in over 35 countries
Jan. 27, 2011
Presidential Award for Excellence
In Mathematics Science and Engineering Mentoring

Recognition

CIESE
CENTER FOR INNOVATION IN ENGINEERING AND SCIENCE EDUCATION
For More Info

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