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National Engineers Week is Feb. 19-25: Stevens Pioneers National Movement to Bring Engineering to K-12 Schools

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In a Jersey City middle school science classroom, teacher Albert Padilla oversees groups of students as they sketch diagrams and designs. They have just learned that the plastic rings that commonly hold soda cans together can be hazardous to animals. Now they are surrounded copier paper, duct tape, wax paper, string, paint stirrers and rubber bands – the materials they will use to create an animal-safe soda container. As they brainstorm what design will be the sturdiest, most convenient and easiest to carry, they discuss concepts they've learned about physics, math and earth science. Finally, they start to build, testing and redesigning prototypes until they come up with the optimized design.

As the nation celebrates [Engineers Week](#), Padilla's classroom activity is part of a larger effort that is happening in New Jersey and across the nation to introduce engineering education into K-12 classrooms. The movement is propelled by national demand for more science, technology, engineering and mathematics (STEM) graduates to drive research and innovation as well as the increased prominence of engineering and design in the Next Generation Science Standards, to be released early in 2012.

As educators realize the promise of hands-on engineering lessons to develop 21st century skills and boost engagement in children as young as kindergarten, countless K-12 science, math and even language arts classrooms at every level are incorporating engineering lessons into their curriculum – often with the help of engineering faculty at the university level.

[The Center for Innovation in Engineering and Science Education \(CIESE\)](#) at Stevens is one of the pioneers, leading an ambitious five-year, \$11.5 million National Science Foundation (NSF) partnership grant program

called, Partnership to Improve Student Achievement in Physical Science: Integrating STEM Approaches (PISA2). PISA2 is a consortium of Stevens, 12 diverse school districts across New Jersey, St. Peter's College, the National Science Resources Center, and the Education Development Center.

PISA2 is designed to increase teacher, administrator and district capacity to deliver high-quality STEM programs, with emphasis in Grades 3-8, ultimately with the goal of increasing student interest, engagement, achievement and persistence in science and engineering. With only 4 percent of the population working in science and engineering careers, efforts such as PISA2 that aim to pique the interest of young students in science and engineering and sustain that interest through college and careers are seen as a critical component of increasing our nation's STEM and innovation capacity.

Since 2010, PISA2 has engaged 42 grade 3-8 New Jersey science teachers like Padilla in graduate-level courses in physical and earth sciences.

The five-course graduate certificate program for teachers present physical and earth science content through the lens of contemporary societal challenges hypothesized to stimulate teachers' greater interest in science and engineering. Overarching themes such as global climate change and energy production and consumption, their interrelationships, and the potential engineering solutions to these critical issues, are the subject of the five courses.

"Teachers participate both as scientists and citizens in broadening and deepening their own understanding of the science and engineering foundations underlying these pervasive and complex contemporary topics," said Beth McGrath, executive director of CIESE and project director of the PISA2 program. "They engage in scholarship by then conceptualizing how young children grasp important concepts in science and engineering and constantly improving their practice."

In addition to improving students' conceptual understanding of science and engineering content, a goal of the PISA2 project is to promote students' 21st century skills, such as critical thinking, problem-solving, innovation and creativity. For example, teachers in the Energy Production and Consumption Course create a plan for improving the energy efficiency of their homes and design a lesson for their students to teach energy concepts.

Teachers also attend professional development workshops to enhance their repertoire of engineering lessons and are supported by monthly classroom visits by CIESE staff. For example, one workshop teaches teachers the engineering design process by engaging them in an activity to design a spacecraft with a shock absorber that would protect a marshmallow astronaut in a landing.

The approaches employed in PISA2 have proven highly effective at increasing participating teachers' content knowledge in physical and earth sciences, improving their preparedness in delivering inquiry-based science and engineering lessons, and enhancing their ability to design learning environments that foster 21st century skills. Ultimately, these skills have been shown to significantly impact students' science learning and their interest and engagement in science classes.

"PISA2 is a model teacher professional development program for cultivating 21st century skills in K-12 science and engineering content and classroom activities," said Augusto Macalalag Jr., Assistant Director of STEM Education Research at CIESE. "This is a replicable strategy to support elementary and middle schools as they adapt to new K-12 science standards to be released in a few months, which will include engineering."

The CIESE partnership with Padilla's classroom was recently recognized as exemplary by its selection to the K-12 & University Partnerships Best Practices Panel at the 2012 American Society for Engineering Education (ASEE) Annual Conference and Exposition on June 11, 2012 in San Antonio, Texas. Macalalag and Padilla will co-present on the panel, which will also include winning partnerships at the elementary and high school level.

"We are proud that Stevens, CIESE and PISA2 are being acknowledged as innovators and leaders at helping K-12 education leaders strengthen STEM programs in their districts, so future generations will be equipped with the STEM foundations and 21st century skills necessary to compete in our global economy," said McGrath.

Learn more about how CIESE is advancing engineering education at the K-12 level at <http://www.stevens.edu/ciese>.