CEEMS MSP Launches STEM Education into 21st Century

By: Lauren Koch

UC, in partnership with 14 Ohio school districts, is leading the way in STEM education with the Cincinnati Engineering Enhanced Mathematics and Science Program (CEEMS). This transformative project will elevate the current STEM education system throughout the tri-state, equipping teachers as math and science learning leaders.

“We are excited to be a part of this project and to work with such diverse partners,” Says Eric Thomas, director of Cincinnati Public Schools Office of Innovation and Grant Development. “This collaboration will allow teachers to become learning leaders, truly moving the way we view STEM education into the 21st century. The CEEMS program will provide opportunities for students to really achieve in a big way.”

The recent CEEMS program launching celebration and reception was held at the University of Cincinnati on Nov. 16 to celebrate the National Science Foundation $9.2 million grant (over five years) and to set the stage for a big impact on STEM education.

For the first time, teachers and students will have training in courses that bring engineering and technology into the high school classroom as part of a school’s curriculum. Acting as an integral part of everyday math and science education in order to prepare students for the challenges and opportunities in technology based careers.

As a part of the NSF Targeted Math and Science Partnership, CEEMS MSP reaches beyond UC to inspire and educate high school teachers and students from across the Ohio region. CEEMS is committed to reach a total of 1,925 teachers who impact 38,500 students from 7th-12th grades over the five years of the grant.

“NSF’s grant in support of our CEEMS initiative is one of the largest received by the university this year, and I believe the grant affirms our leadership position in the STEM disciplines,” states UC Provost and Senior Vice President, Santa Jeremy Ono. “Interdisciplinary projects of this scope not only showcase our wide range of excellence, spanning engineering, the sciences and education, but CEEMS also expands access for tri-state teachers and students to our award winning faculty and facilities.”
This collaborative endeavor encompasses 14 Core Partner school districts: Cincinnati Public Schools, Oak Hills Local School District, Princeton City Schools, Norwood City Schools, Winton Woods City School District, and the Clermont County STEM Consortium of nine school districts. The UC team for CEEMS is made up of the university’s College of Engineering and Applied Science (CEAS), the College of Education, Criminal Justice and Human Services (CECH) and the McMicken College of Arts and Sciences.

(From Princeton City Schools: Steve Moore (President of the Board of Education), Amy Crouse (Director Curriculum PreK-12), Gary Pack (Superintendent), Christian Lohmeirer (student), Adam Brooks (student), and Brian Lien, Technology and Engineering teacher.

"STEM education allows students to use problem solving, scientific method, inquiry based learning, and current technology, synchronously to be innovators and leaders in this high-tech world. Specifically at CPS, we expect increased student math and science achievement due to increased teacher content knowledge ..."

Mary Ronan, CPS Superintendent

(L-R) Oak Hills High School sent Mitch Bishop (student), Dan Boles (Chemistry and Pre-engineering teacher), with Valerie Ahren (student – her bridge shown later).

CEEMS is a program designed to meet the growing need for engineering-educated teachers. Its goal is to equip teachers with the skills needed to provide students with opportunities to reach and surpass recently revised Ohio State Science Standards in addition to equipping students with a set of universal skills.

“The CEEMS project is an outstanding example of the colleges’ and university’s commitment to providing the highest quality engineering education and collaborative outreach with our community. Past efforts have established a solid base of interdisciplinary and community ties without which this grant and our vision would not be possible,” states Carlo Montemagno dean of the College of Engineering and Applied Science (CEAS).

CEEMS is in many ways the culmination of 10 years of previous planning and programs that have made southwest Ohio a national leader in STEM education. Among these programs are the NSF GK-
12 Fellows Project, NSF Research Experiences for Teachers (RET), and the Woodrow Wilson Ohio Teaching Fellowship.

The **NSF GK-12 Fellows Project** supports fellowships and training for graduate students in STEM education. Each year since 2006, the NSF RET project supports twelve teachers from the greater Cincinnati area to work for eight weeks in the summer with engineering faculty members on research projects. The teachers then take their experiences back to their own classrooms. The **Woodrow Wilson Ohio Teaching Fellowship** seeks to recruit, prepare and retain effective teachers for schools and students who are in desperate need.

In sharing the collective vision Dean Montemagno declared, “Today, we envision that as the curriculum develops through this program it will emerge as the national model for STEM education, so that, our community colleges and high schools can directly feed students into our engineering and technology programs seamlessly with much of their first and even second years already completed.”

CEEMS efforts are centered in “real world application with direct connections to engineering”. CEEMS offers four professional development pathways for teacher preparedness:

- Masters in Curriculum and Instruction (CI) degree with Engineering Education (MCIEE) specialization,
- Summer Institute for Teachers (SIT),
- Education Pathway with Licensure for Engineering (EPLE) majors,
- Engineering Education Pathway for Career Changers (EEPCC).

The key to these four pathways are eight new engineering and science based courses, including five engineering courses: (1) Engineering Foundations, (2) Applications of Technology, (3) Engineering Applications of Mathematics, (4) Engineering Models, (5) Engineering Energy Systems, and three science courses: (1) Modeling and Applications (M&A) in Physical Sciences, (2) M&A in Biological Sciences, (3) M&A in Earth Systems. The engineering courses are to be taught through CEAS and the science courses through A&S.

Classes are divided into four core classes and four electives. **Engineering foundations** will be a core course that introduces students to the scope of engineering disciplines, basic foundations of engineering science, and engineering design. Working in teams, students will implement the design process from the need to the
prototype in an open ended environment. In **applications of technology**, another core course, problems will be presented that allow students to define, design, build and test their solutions.

Another core course being offered is **engineering applications of mathematics**. In this course, students will be introduced to salient math topics presented within the context of engineering and reinforced through hands on lab or computer simulation. Rounding out the core classes is **modeling and applications in physical sciences**, a course built to understand the importance of modeling and math in discovering principals of physics and chemistry. This course will integrate math and physical science and lab modules to address current areas of societal interest.

The first of two engineering electives offered is **engineering models**. This class will connect algebra, trigonometry and calculus to engineering applications. **Engineering energy systems** will use thermodynamics, mass and energy balances to evaluate energy supply systems and determine their efficiencies.

**Modeling and applications in biological sciences** will show applications of math in biology in the contest of modern life and science topics, including healthcare system, political decisions, and environmental concerns. **Modeling and applications in earth systems** will be a course that studies the complexity and interaction among natural systems that shape our world.

The objective is for CEEMS to have a positive effect on the tri-state by building a collaborative, sustainable, education licensure and degree-granting infrastructure for STEM that fosters innovative and fresh teaching techniques on a continuing basis.