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Engineering Success: Prince George's County High School Alumni Return to Redesign Classes

Image Title: Graduates of Eleanor Roosevelt High School's science and technology program redesigned the engineering curriculum this summer. Top: A.J. Cressman, Ankit Chaudhari, Kartik Vadlamani, Chris Giler, Thomas Schwenn, and Loic Tchokouani. bottom: Nick Chornay, Danielle Gordon, Charles Nguyen, Blossom Tewelde, and Joseph Woodworth. - Debra Felix

This summer, A.J. Cressman went back to high school. That might seem unusual for a college junior and physics major at Caltech. But Cressman was given a mission: help create the best prepared future engineers in the country at Eleanor Roosevelt High School.

Cressman joined nine fellow graduates of the elite science and technology magnet program every day for six weeks to create top-flight engineering coursesfor high school students. The class at the Greenbelt, Md., school will teach the latest in computer programming and drafting with software used by college professors and professional engineers. And since engineering teachers

can be hard to find, the curriculum is designed to be taught by a non-expert.

“This is rigorous. They are going to learn about physics, they are going to learn about design. They are going to learn to think for themselves,” says Cressman, who helped lead the group of 10 college students and one high school senior. The students' summer work was funded in part by a grant from the Howard Hughes Medical Institute.

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Eleanor Roosevelt's science and technology magnet program is in high demand in the county because of its high standards and good results. Last year, its Advanced Placement program produced the largest number of African American students in the U.S. who successfully scored 3 or higher on the AP Physics B and AP Chemistry exams. In 2007 one of its students was a semi-finalist in the Intel International Science and Engineering Fair.

All freshman in the science and technology magnet program are already required to take two introductory engineering classes, but the curricula for those classes were originally designed in 1976. “There has been some revamping through the years, but we knew we needed a major overhaul. Things have changed so much,” explains Jane Hemelt, coordinator of the science and technology program, which serves about 900 of the school's 2,700 students. The problem was that there wasn't an easy way to get the expertise to fix it.

Hemelt talked about the problem with Rocco Mennella, a mathematics professor at Prince George's Community College and Catholic University who teaches science and math at Roosevelt. For several years, Mennella had been recruiting Roosevelt graduates as tutors for his summer precalculus class, and he told Hemelt that his recruits—who were science, math, and engineering majors—might serve double duty by redesigning the engineering curriculum.

Mennella's college recruits came from Caltech, MIT, Brown, Johns Hopkins, Georgia Tech, and the University of Maryland, where they have been exposed to some of the best science and engineering teachers in the country. In addition, Cressman contacted about 80 engineering professors at universities and colleges around the country to find out what they would like their incoming students to know; almost 50 responded.

Armed with that list and their own ideas, Cressman and his fellow Roosevelt graduates spent the first few days brainstorming. “I had some ideas. Then I realized that the best thing to do was to junk my ideas and let them do it,” Mennella says. The students spent four hours a day or more working on the curriculum, filling each chalkboard in the windowless classroom that served as their brainstorming center. Before long, the chalkboards were full of ideas about what the students should know and how they should learn it. For example, all agreed that the classes should focus on the practical aspects of engineering, including computer-aided design and computer programming, while exposing the high school students to electrical, civil, and mechanical engineering. But the curriculum designers also wanted their younger peers to have fun while learning, so they put in many hours on computers creating lessons that would challenge students to redesign the Taj Mahal, build an SUV, or guide a robot.

They also injected a hefty dose of reality—the classes were designed to include as much physics and math as possible. Another important consideration was ensuring the material wouldn't be out of date in a few years. Among the more difficult decisions was which computer programming language to teach, since there are so many choices and they evolve all the time. The students eventually settled on Python, a ubiquitous programming language that is prized for its readability. Besides, MIT's introductory computer science and engineering courses are using it, which is where sophomore electrical engineering major Danielle Gordon first learned the language. “It teaches you the basic structure and you can relate it to a lot of programs. We wanted to do robot interfaces also, and Python is good for that,” Gordon says.

Within a few weeks, the college students had so many good ideas that they went beyond redesigning the two mandatory classes—Foundations of Engineering 1 and 2—to create several new upper level electives. Chris Giler, a sophomore at the University of Maryland, worked with several other students to design an elective engineering drafting class that combines traditional pen and paper drawing with computer-aided design in Pro/Desktop. The final project will allow students to design whatever they want—an airplane, a dump truck, a robot—as long as it's complicated. “In college, they do a lot of drawing like this,” says Giler, a mechanical engineering and math major. “I think it will be good preparation for college, especially for mechanical and architectural engineers.”

Mennella's one request was that they design the curriculum as modules that could be taught by teachers who are not engineering experts, since few have the breath of knowledge covered in each course. For example, technical education teachers will know the design aspects but probably not the computer programming. And there is one other advantage to this approach. “You don't need a textbook. Technology is changing so rapidly that it will be easy for us to take a module out, plug a module in, and constantly stay up to date,” Mennella says.

Once they had designed the step-by-step lessons for the introductory classes, the graduates tested them out on students who had not taken any programming classes before, including a biology major and a current high school student. The students came back with suggestions that made the lessons even more complete. “You don't realize how much you have learned until you are talking to somebody who has never learned any of it before,” said Joseph Woodworth, a sophomore math major at the University of Maryland.

Eleanor Roosevelt High School will test some of the modules as part of other classes this fall, which will reach 30 students or more, and the team hopes to roll out the other classes full time in coming years. The Prince George's school district's other two science magnet schools, Oxon Hill and Charles Flowers, also plan to use the curriculum. But Mennella and Hemelt hope it will spread even wider, including to schools that don't specialize in science and math. Those schools might just use parts of the curriculum, or spread a semester-long class out over a year. “Who knows, this could become a model for the state and maybe a model for the country,” Hemelt says.