ROWAN UNIVERSITY COLLEGE OF ENGINEERING

Engineering News

Fall 2010
Volume XII • Issue I

DEAN'S MESSAGE

Rowan Engineering contributes to new knowledge in frontiers of every imaginable dimension, from our understanding of nanoscale materials to (virtually) exploring brave new universes. These are threaded by a common goal of making a positive societal impact in today's world. Community outreach efforts such as those in Engineering Innovators Without Borders™ serve as an illustrative example. Our K-12 outreach activities inspire young minds to pursue engineering as a career, so that a pipeline of talented engineers can be developed.

I hope you enjoy reading this newsletter, which highlights our accomplishments. Please contact us if there are opportunities that you would like to explore together.

Last but not least, Dianne Dorland has returned to the Chemical Engineering faculty to focus on her passion for teaching our students. During her tenure as dean, her leadership and dedication in the first 10 years of the new millennium were instrumental in raising Rowan Engineering's profile as a recognized leader in engineering education. Let's thank her for her contributions and for paving the path into the future.

Steven Chin

Dr. Steven Chin
Interim Dean

Rowan Engineering Teams Are Talking About Regeneration

What do a disease study database, hydrogel injections and flatworms have in common?

For chemical engineering assistant professors Dr. Mary Staehle and Dr. Jennifer Vernengo, who focus their research on biomedical engineering, all are components for studying regeneration.

Biomedical engineering, the fastest-growing engineering discipline, is "the intersection of engineering and biology," Vernengo explained. By applying engineering approaches to biology, students cultivate a valuable interdisciplinary skill set with the knowledge and experience to apply their skills to other non-traditional engineering problems.

Dr. Mary Staehle and her students are studying the planaria flatworm to gain insight into the process of regeneration.

In two biomedical engineering clinics begun last year, Vernengo and her students research the possibility of using injections of a substance called hydrogel to treat or even reverse damage from intervertebral disc degeneration.

Vernengo is also partnering with Cooper University Hospital's Dr. Robert Ostrum to design a biodegradable patch that doctors can apply to surgery sites inside the body to prevent infection. Her team hopes to have a prototype ready by the end of this semester.

Students working in Staehle's "Neurodegenerative Diseases" clinic are compiling a database of information on neurodegenerative diseases — diseases characterized by loss of brain mass or function — and analyzing it to find any common molecular patterns. In "Neuroregeneration in Planaria," Staehle and her students observe the planaria flatworm, known for its remarkable ability to regenerate, to gain insight into the process of regeneration.

The goal is "not to *make* tissue regrow," Staehle said, "but rather to engineer ways to *promote* regrowth." Vernengo and Staehle see now as the perfect time for students to consider biomedical engineering.

The creation of Cooper Medical School of Rowan University will provide research teams with resources that would have been inaccessible in the past.

Regeneration is far from the only subject of biomedical engineering research. "There's a lot of engineering in the body," Staehle said, "and there's a lot nature can teach us about engineering. The body is arguably the most complex and interesting machine that there is."

Rowan University

Students Ignite New Technological Potential

With a small flickering flame, Dr. Smitesh Bakrania, assistant professor of mechanical engineering, and undergraduate students hope to give life to new technological solutions.

Students are synthesizing nanometer-scale particles within the flames, which can be used in a range of applications. Although nanoparticles usually are synthesized in a chemical solution, the process requires repeated chemical reactions to control their size and shape. "It involves typically four to five steps before you get to your nanoparticles," Bakrania said. "We're doing it in a flame, so it happens in an instant."

These nanoparticles may become essential components in more affordable technology. For example, another team of students will be using them to create dye-sensitized solar cells that are four to five times less expensive than traditional solar cells. "The trick is to make solar cells cheap so they're more affordable, but the challenge is that these cells are less efficient than what you can buy in the market right now," Bakrania said. "They're not competitive right now, but a lot of researchers are interested in trying to improve the efficiency, and that's what I'm working on as well."

In their project titled "Platinum Nanoparticle Catalysis," students are using nanoparticles in chemical catalysis. Researchers believe that nanoparticles ultimately could be used to build less expensive catalytic converters for vehicles.

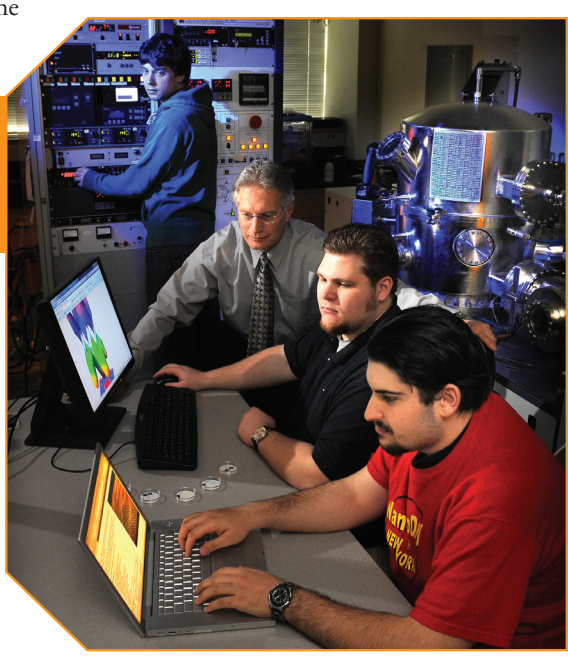
Close to 20 undergraduate students have participated in these nanotechnology-related clinic projects, and Bakrania is proud of their progress. "To me it's actually fascinating because some of this is graduate-level work," he said. "But when they accomplish all this as undergraduates with limited guidance from me, it's pretty impressive."

Dr. Smitesh Bakrania discusses nanoparticle synthesis with students **Thomas Barkley** and **Jenna Vastano.**

Electrical Engineering Professor Explores New Frontiers in Materials

Using very high-resolution microscopes, Dr. Robert Krchnavek spends a large portion of his time peering at miniscule particles smaller than the eye can see. But these nanoscale materials — many times smaller than a red blood cell — could have an immense impact on humanity.

During the last 40 years, the field of electronics has been dominated by silicon, silicon dioxide and aluminum. Roughly every 18 to 24 months, the number of integrated circuits placed on a square centimeter of silicon has doubled, simultaneously shrinking the size and cost of electronic devices.



Dr. Robert Krchnavek works with students **Chris Platt, Matthew Plummer** and **Douglas Fuscia** (left to right).

"The problem that we've seen, though, is that triad of silicon, silicon dioxide and aluminum is starting to fall apart," said Krchnavek, associate professor of electrical and computer engineering. In the next decade, silicon will not be able to continue shrinking, compelling researchers to find a new material to replace it.

Researchers are investigating a possible candidate — graphene — a 1-atom-thick layer of graphite. "The properties of graphene are remarkable," he said. "There are some estimates that it's 100 times faster than silicon. The smallest transistor ever made to date has been in graphene — 1 atom thick and 10 atoms across."

If graphene proves to be the material of the future in making powerful microprocessors, it could lead to increasingly greater computer functionality. "My group is working feverishly to develop a technique to put down graphene, although it's very challenging work," he said. "A high-quality film of graphene deposited over a reasonably large area would be a very significant breakthrough in being able to push graphene toward that next material that's going to replace silicon."

This research has potential short- and long-term rewards. Students engaged in this project are seeking answers to complex problems while gaining valuable experience. Alumnus Michael Campolongo (ECE '05), who is currently a Ph.D. candidate at Cornell University, shared with Krchnavek that he has been able to use many of the techniques he learned while at Rowan. "His work at Rowan helped him to stand out since few of the applicants seeking positions in his lab had this sort of prior experience," Krchnavek said. "And our students work on machines that most students never see until they go through a doctoral program."

On a global scale, super-powered electronics resulting from this kind of research could unlock solutions to many modern-day challenges. Researchers may be able to forecast devastating weather events more precisely or solve other computationally challenging problems. Furthermore, scientists may be able to use smaller electronics to produce ground-breaking medical devices, such as an artificial eye to restore sight or a prosthetic limb that responds to brain impulses.

"The ability to continue to develop computing power where you get more functionality for less money is going to have impact well beyond the next awesome cell phone. It will have a huge impact on life," Krchnavek said.

Discovery Science Channel Features Rowan Technology

Thanks to the magic of television, characters of the popular series *Star Trek: The Next Generation* whisked themselves to virtual locations without leaving the confines of a space-age marvel known as the Holodeck, a chamber on the *U.S.S. Enterprise*.

A far-fetched notion? Not for users of the Cave Automatic Virtual Environment (CAVE®), a 10 by 10 by 10-foot immersive, interactive virtual environment at Rowan University. In fact, the CAVE® recently attracted a production crew from the Discovery Science Channel to film the technology for a November episode of *Sci-Fi Science: Physics of the Impossible* featuring Holodecks. The program, hosted by Dr. Michio Kaku, reports on emerging technology that closely resembles science fiction creations.

"They were looking into currently available technologies allowing them to replicate a Holodeck from *Star Trek* now," said George Lecakes (MSE '09), a graduate student at Rowan University. "And the first piece of the puzzle is the ability to walk into an empty box and be transported into another universe or world, which is exactly what the CAVE® is virtually capable of doing."

The visitors were impressed by the CAVE®, a technology not available at any other college or university in the state. "For instance, we loaded up a dinosaur setting for Dr. Kaku, and he marveled at how we could get so close to dinosaurs and feel like we were really there — almost," said Lecakes. "The illusion is broken once you try to touch something. But up to that point, when you try to touch it, you feel like you really can."

The College of Engineering uses CAVE® technology for advanced scientific visualization in projects sponsored by organizations such as NASA, the U.S. Navy and the City of Camden.

Dr. Shreekanth Mandayam, professor and chair of Electrical and Computer Engineering, explained that the program showcased the technology of Rowan University College of Engineering on an international stage. "This is a fantastic opportunity for the technology developed and used by faculty, students and staff at Rowan University to gain international exposure in a popular science setting," he said.

Dr. Michio Kaku and his film crew recently visited the CAVE® at Rowan University.

Students Devise Vital Device

In some developing countries where good food is precious, plucking fruit from towering palm trees is critical for nourishment, but it's a dangerous endeavor.

Learning this, Rowan Engineering students, who had already created a pedal-powered grain crusher for the developing world in previous clinics as part of Engineering Innovators Without Borders™ (EIWB), sought ways to help.

"There are lots of deaths associated with climbing the trees," said Dr. Beena Sukumaran, professor and chair of Civil and Environmental Engineering and EIWB founder. "People are also gravitating away from it because of the dangers."

Taking the lead, students began designing the device, analyzing it for safety, building it and testing it in the field. "They have a tree behind Rowan Hall that is rather thin and somewhat resembles a palm tree," Sukumaran said. "The students try to climb that, which helps them realize some of the flaws in their design. Then they come back and revise it and go through the whole process again. They're in their third revision and they're quite happy with it."

Students hope to pilot the tree climber during a future Engineers Without Borders™ trip to The Gambia so people there can test it and provide feedback. "That's extremely important," she said. "Local people may have certain preferences, and only certain materials may be available. We may not have taken that into account. But for a tree climber like this, they're just using steel materials with easily obtainable connections, so it should be pretty easy to build anywhere in the world with minimal tools. The device will make the process of tree climbing much safer."

EIWB efforts continue at the College to create devices to help people in developing countries. For example, Sukumaran explained, ongoing projects include the development of peanut shell briquettes for fuel, led by Dr. Jess Everett, professor of civil and environmental engineering, and the design of a rope pump, led by Dr. Jennifer Kadlowec, associate professor of mechanical engineering. Sukumaran also hopes to someday help other colleges and universities establish EIWB chapters.

"This initiative is extremely important because faculty and students are developing products that benefit people living in these countries," Sukumaran said. "Moreover, people who live in poverty can produce these products, enabling them to become small-scale manufacturers and entrepreneurs. Therefore, these products improve their quality of life and their economic situation."

Student **Evan Forosisky** tests the tree-climbing device he and classmates designed, as **Dr. Beena Sukumaran** (second from left) and students **Stephen Schwandt, Michael Panko, Mark Zielinski** and **Christopher Marra** (left to right) observe.

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In July, high school students learned about opportunities in engineering while touring PSEG Nuclear in Hancocks Bridge as part of RISE (Rowan's Introduction for Students to Engineering).

Chemical Engineering Maintains Its #2 National Ranking

"We're No. 2" might not exactly be a cheerleader's favorite chant at a playoff football game, but for the Chemical Engineering program at Rowan University those words sound pretty good — again.

U.S. News & World Report this year once more placed Rowan's Chemical Engineering program at second in the nation among colleges that primarily offer bachelor's and master's degrees.

This is not surprising for one of the newest chemical engineering programs in the country.

U.S. News & World Report, in its annual "America's Best Colleges" issue, placed Chemical Engineering sixth or higher since 2002, just two years after Rowan graduated its first engineering students. In all but the first two years of Rowan Engineering's existence, the publication ranked Rowan's Chemical Engineering program first among public institutions. In 2010 and 2009, the publication placed the program at No. 2 in the nation among public and private schools.

"This is a wonderful reflection on our faculty and our students," said Dr. Robert Hesketh, chair. "The *U.S. News* ranking is not the whole picture, of course. Our faculty and students are consistently recognized for their research and publications, and many of our professors are leaders in such important organizations as the American Institute of Chemical Engineers and American Society for Engineering Education. This all contributes to an outstanding program."

Engineering News
Volume XII, Issue I • Fall 2010

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Engineering News is published twice annually by the College of Engineering to highlight the achievements of its faculty, staff and students. We welcome comments and suggestions. Send correspondence and inquiries to:
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