Achieving Princeton’s vision for engineering

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Small changes can have big effects

Nearly every time I walk through the terrific new café that brightens the EQQuad, I see students, faculty and staff from all parts of the quadrangle sharing a table, having a coffee, or just chatting in the checkout line. And when I pop in there myself for a bite to eat or a shot of caffeine, I run into someone I probably would not have seen that day, often someone from an entirely different part of campus. Those are the intangible benefits that we all hoped would come from building the café.

In this issue of the EQQuad News, you’ll read about some of the major initiatives we’re putting in place to bring our vision for Princeton Engineering to reality—big, exciting efforts that have taken lots of planning and require major investments. But my trips through the EQQuad Café remind me of our many smaller steps that are having big effects. Recently, for example, we worked with the University administration to remove barriers to hosting visiting faculty and students. Each department can now host multiple visitors at nominal cost; we have a new nonpaid category for visiting researchers who are retired; and the institutional charge has been waived for visitors from nonprofit institutions.

Beginning next year, Ph.D. students who take longer than the assigned four or five year period for their degree will be able to enroll for two further years at marginal-cost tuition. This will eliminate the problems with loans and visas currently faced by such students and will smooth the way for faculty to focus on research and teaching.

Our new EMP integrated freshman course, which you’ll read about in this issue, is exposing students to hands-on, interdisciplinary engineering projects from the very start of their four years. We are now in our second year of offering our 1-YES seminar series of talks for freshmen, and I was in my second year of going to the residential college dining rooms to have dinner with every one of our incoming freshmen in small groups. These efforts are receiving an enthusiastic response.

I would put all these steps in the broad category of “creating a great environment for research and learning.” They are helping us build on the momentum that grew out of our strategic vision and are preparing us to take full advantage of the bigger efforts that are taking shape. If you haven’t already done so, I encourage you to make a few visits to the EQQuad Café and sense the vibrancy of this place for yourself. Maybe you’ll strike up a little conversation that will lead to something big.
Princeton engineer Claire Gmachl has been selected as a 2005 MacArthur Fellow for her research on highly versatile lasers that could be used in fields ranging from environmental monitoring to medical diagnostics and homeland security.

The John D. and Catherine T. MacArthur Foundation announced Sept. 20 that Gmachl is among 25 scholars, scientists and artists who each will receive $500,000 in unrestricted support over the next five years. The awards, known informally as "genius grants," are given to people from a broad range of fields who "demonstrate exceptional creativity and promise."

Gmachl is the third Princeton scientist or engineer, all women, to have won a MacArthur Fellowship in the last four years. Bonnie Bassler, a professor of molecular biology, won in 2002, and Naomi Leonard, a professor of mechanical and aerospace engineering, won in 2004.

Gmachl, a native of Austria, earned her Ph.D. in 1995 from the Technical University of Vienna. She came to Princeton University in 2003 after working for eight years on the research and technical staffs of Bell Laboratories, where she joined the group that built the first quantum cascade laser. Her current research, supported primarily by grants from the Defense Advanced Research Projects Agency and the National Science Foundation, is aimed at improving the performance and development of new types of quantum cascade lasers and at understanding the basic physics behind the materials and structures used in the lasers.

"Claire is an amazing person," said Princeton Engineering dean Maria Klawe. "She has a deep understanding of basic physics, but also can translate that knowledge into technology that will have a major impact on many areas of society. She is an inspiration to any student who wants to work in engineering, be creative and make a difference."

Among many potential uses, quantum cascade lasers could detect trace gases in people’s breath to reveal the presence of lung, kidney, liver and other disorders. They also could be used to monitor smoke-stack or tailpipe emissions and many other environmental factors. Military researchers are interested in the technology for detecting explosives or chemical weapons.

"What fascinates me about this work is that we are making designer materials," Gmachl said. "By being creative, you can trick these new materials into doing something that is not available in nature."

Gmachl said the new laser devices offer so much flexibility that even some of the most far-fetched ideas proposed in her lab have been made to work. Finding funding to pursue such ideas, however, is not easy, and that is why Gmachl plans to use the MacArthur award to support "some really far-out projects" that she has not yet tried or even proposed.

"I am extremely happy to have this support," said Gmachl, who learned of the award while she was at a conference on Cape Cod. "I am very thankful to my peers and my research group, which works so hard with me. Without this support team, there is no way to win such an award."

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Princeton professor of electrical engineering Hisashi Kobayashi has received the 2005 Technology Award of the Eduard Rhein Foundation for his role in inventing techniques that allowed dramatic increases in the storage capacity of computer hard disks.

Kobayashi, who is Princeton’s Sherman Fairchild University Professor of Electrical Engineering and Computer Science, will share the award with Francois Dolivo and Evangelos Eleftheriou of the IBM Zurich Research Laboratory.

The Rhein Foundation presented the award, which is one of the highest honors in the field of information technology, at a ceremony at the Deutsch Museum in Munich, Germany, on Oct. 15.

The award honors Kobayashi for the conception and analysis of a data storage technique now known as PRML, which he published in 1970 and 1971. The PRML method allows more data to be stored on computer hard disks than the conventional recording method and retrieves stored data with fewer errors. During the following 20 years, Dolivo and colleagues perfected Kobayashi’s ideas, allowing IBM to introduce a hard disk drive using PRML in 1990 and leading to a number of years in which storage capacity increased by about 50 percent each year. This technology is now widely adopted as the industry standard in personal computers and MP3 players such as the iPod. Eleftheriou is recognized for the invention of further improvements that have been applied to IBM disk-drive products since 2000.

Kobayashi received his Ph.D. from Princeton in 1967 and went to work as a research staff member at IBM’s Thomas Watson Research Center, where he conducted his seminal research on data storage techniques. After a distinguished career at IBM, Kobayashi returned to Princeton in 1986 as dean of the School of Engineering and Applied Science. He served as dean through 1991, when he assumed full-time teaching and research duties in the Department of Electrical Engineering.

The Eduard Rhein Foundation has honored outstanding achievements in technology since 1979. Recipients of its Basic Research or Technology Award have included the leading figures in fields of computers and communications, such as Claude Shannon, the father of modern information technology, and Tim Berners-Lee, who created the World Wide Web. Another Princeton professor, Ingrid Daubechies of mathematics, received the 2000 Basic Research Award. – SS
Princeton engineers recently revealed an inexpensive technique that could shrink computer chips by 30-fold—a trick that would bump the memory capacity of an iPod nano from 1,000 to 30,000 songs.

Reporting in the August issue of the journal Nanotechnology, Stephen Chou and colleagues described how they created complex patterns similar to those on computer chips by pressing a minute mold into plastic. The technique is faster and less expensive than conventional methods and produced elements of a memory circuit that were squeezed to a density of 25 million per square millimeter.

The basis for the discovery is a technique called nanoimprint, which Chou invented in 1995. The conventional method for making densely packed circuits is to carve the circuit elements out of silicon with a beam of electrons. Chou’s technique requires the same laborious technique to make an initial mold, but then uses the mold to stamp out limitless copies.

In recent years, Chou has reported the creation of ever-smaller dots and lines made by nanoimprint, but until now no one has used the technique to produce the more complex arrangement of shapes needed for actual circuits.

“Making a straight line is one thing, but making a complicated pattern is something else entirely,” said Chou. The key to the latest advance, said Chou, was using a different plastic and inventing a new chemical process to use in conjunction with the electron beam to make the mold. Once the mold is made and its pattern is pressed into plastic, a routine chemical process is used to convert the pattern into metal lines on a quartz backing, which becomes the basis of a circuit.

Chou, who is Princeton’s Joseph C. Elgin Professor of Engineering, co-wrote the paper with electrical engineering professor Stephen Lyon, former graduate students Michael Austin and Wei Zhang, and post-doctoral fellows Haining Ge and Daniel Wasserman. The work was funded in part by the Defense Advanced Research Projects Agency and the Office of Naval Research.

In the same paper, the researchers also reported making straight lines that were spaced just 12 nanometers (billionths of a meter) apart, which is 2 nanometers, or 17 percent, less than their previous record. “That is significant, because we are down to the regime where 1 nanometer is a huge improvement,” Chou said.

In addition, the researchers showed that they could make patterns with 10 times less fluctuation in size than can be accomplished with current techniques.

The semiconductor manufacturing industry has adopted nanoimprint as part of its “international road map” for continued advances in the size and cost of electronic components. The industry’s goal is to begin using nanoimprint in 2010, Chou said.

“Memory used to be so expensive, but now it’s cheap enough to put in an iPod,” said Chou. “Think about it: What if you could reduce that by another factor of 100? Nanoimprint is the only technology that can reduce the size and the cost.” — SS
On Oct. 6, the Princeton Institute for the Science and Technology of Materials (PRISM) hosted a videoconference with the institute’s long-time industrial partner Greg Olsen, who was on board the International Space Station. Olsen, the founder and chairman of Sensors Unlimited, was the third private citizen to go into space and traveled under contract with the Russian Federal Space Agency. During an eight-day stay on the space station, Olsen conducted experiments for the European Space Agency and spoke to children back on Earth about the importance of science and technology.

After some technical difficulties in establishing an audio connection between Princeton and space, Olsen spoke to a packed audience in Bowen Hall, including a local Boy Scout troop. “This is what we’re all about: technology,” Olsen said. “One of the things I’ve learned out in space is how limited technology really is, and how much more remains to be done and how many opportunities there are.”

PRISM and its predecessor organization, the Princeton Center for Optoelectronic Materials, has worked closely with Olsen and Sensors Unlimited for more than a decade. Using technology partly developed at Princeton, the company produces cameras and sensors for near-infrared light, with applications ranging from industrial processes monitoring to military surveillance. But in space Olsen conducted some medical experiments and enjoyed the ride. “The best part for me is just floating in the air and looking out the window,” he said. – SS

Olsen in Space

‘Art of Science’ dazzles judges

Art in laboratories? Science on an easel? The Art of Science exhibit, which is currently on display in the Friend Center for Engineering Education, proves both are possible.

The exhibit features the top 55 entries in a contest celebrating the mutual inspirations between art and science at Princeton. From a horsehead nebula to a submicrometer piece of dust that bears an uncanny resemblance to a dog, the gallery encompasses a wide range of scientific phenomena.

“We were almost overwhelmed by the number of high-quality entries in the competition,” said Dean of the Faculty David Dobkin, who is a computer scientist. “The most interesting entries had an artistic sense to them, but also represented scientific ideas across a broad range of disciplines.”

“The images present an interesting lens into the world that scientists look at every day,” he added. “Anyone attending the exhibition will be amazed by the variety of work they will see.”

The exhibit will remain on display in the Friend Center until next year’s Art of Science competition, which will open in early May. The deadline for entries for the 2006 competition will be late March. The current exhibit pieces can be viewed online at www.princeton.edu/~artofsci/gallery/.

Nearly 100 individuals across 15 humanities, social sciences, sciences and engineering fields entered the contest, which was sponsored in part by the School of Engineering and Applied Science. The contest was organized by visual arts lecturer Andrew Moore, computer science graduate student Alex Holderman, comparative literature graduate student Kati Lovasz and computer science professor Adam Finkelstein. The judges were Dobkin, President Shirley M. Tilghman, professor of the Council of the Humanities and visual arts Emmet Gowin and comparative literature professor Thomas Hare.

The values of the three monetary prizes—$250 for first place, $154.50 for second place, and $95.50 for third place—were determined according to the golden ratio, a mathematical constant found in nature and used in art to proportion nautilus-like “golden spirals.”

Elizabeth Landau

First prize in the Art of Science competition went to Elle Starkman and Andrew Post-Zwicker of the Princeton Plasma Physics Laboratory for “Plasma Table,” which depicts a dust cloud of silicon microspheres that were illuminated by laser light and suspended in a plasma.

Second prize went to Anton Darhuber, Benjamin Fischer and Sandra Troian of the School of Engineering for “Driven,” which depicts patterns that formed when a surfactant was spread over a thin liquid film on a silicon wafer.

Stephen Pratt of ecology and evolutionary biology took third place for “Individually Marked Ants,” a portrait of ants marked with dabs of paint so their movements could be studied.

Online at the ACS website, the exhibit features an exhibition catalog that is filled with both scientific descriptions and artist commentaries. The exhibit is also being featured in the journal Science, which will publish an article about the exhibit in coming weeks. The catalog can be downloaded from www.princeton.edu/~artofsci/catalog/.

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Elizabeth Landau
Today's college students are poised to influence a "golden age" of technology that will change the way billions of people worldwide communicate, work and play, Microsoft Corp. founder Bill Gates told Princeton University students Friday, Oct. 14.

Gates spoke to an audience of 800 people in Richardson Auditorium as part of a college tour to share his views on new frontiers in technology. During his visit, Gates also received an award from students and met with engineering school faculty members, who briefed him on Princeton's innovations in computer science education.

"It's really young people coming into this field, who look at things in a new way or are willing to innovate and drive the breakthroughs, who will be at the forefront of making this happen. The time frame right now is the golden age," said Gates, who serves as Microsoft's chairman and chief software architect.

Gates, who was of college age when he co-founded Microsoft with Paul Allen, said they envisioned developing software that would make it easier for people to use personal computers at work and at home, with a greater ability to connect with others around the world.

"Today we have a billion personal computers in use. We really won't have achieved that original vision that goes back 30 years ago unless we have 6 billion personal computers and devices of all sizes working together in this great way," he said. "Over the course of this decade, most of that absolutely will be achieved."

While his talk centered on technology, faculty members who spent an hour with him earlier in the day focused their conversation on Princeton’s many initiatives in undergraduate education.

"The thing he was most impressed with at Princeton was how we present an interdisciplinary view of computer science to students very early," said Larry Peterson, chair of the computer science department. "Students are being exposed to topics across discipline boundaries long before they specialize in a particular subject."

Participants in the meeting included President Shirley M. Tilghman, engineering dean Maria Klawe and faculty members of the Department of Computer Science. They discussed two integrated series of first-year courses that combine computer science and engineering with math, physics, biology and chemistry, as well as a freshman computer science course that emphasizes real applications of computer science.

Peterson said the faculty talked with Gates "not only about how we teach computer science to science and engineering students but also how we interact with students who are studying the social sciences and public policy and those in the arts and the humanities."

During the meeting Gates expressed concern about how computer science as a discipline can draw in new people, given that the number of students studying computer science is declining.

"The big paradox is that the computer science revolution is just unfolding—it’s never been so exciting," observed Bernard Chazelle, one of the members of the computer science faculty who met with Gates. "The question is, Why is there this decline when it’s never been more exciting?"

"He was very impressed with the opportunities that Gates presented. "He was forward-thinking and brought up how he wanted to get technology out to everyone, not just to the privileged," Moore said.

"The message that made me think, as a student in engineering, is how we cannot just make technology, but improve technology that will help people in society as a whole," she added. "We need to think about the problems he raised, such as world health and sanitation—not just the problems that are cool and fun—and how we are going to really help people."

In addition to his work with Microsoft, Gates established the Bill and Melinda Gates Foundation, which has committed billions of dollars to organizations working in global health and education. The foundation also established the Gates Millennium Scholars Program, which provides scholarships to undergraduate and graduate students from minority backgrounds.

For these efforts, Gates was presented with the second annual Crystal Tiger Award, given by Princeton undergraduates to an individual who has had a transformative impact on the world. Former U.S. Secretary of State Colin Powell received the inaugural award in February 2004. – Eric Quitiones

Gates also emphasized the need to look beyond a narrow view of computer science during a question-and-answer session with students following his talk. He emphasized the importance of promoting education and tackling issues of poverty, infrastructure and health in developing countries and stressed the need to address the societal impact of technological advances.

"It’s very important that this discussion about what technology is going to do be broadly known, so that it’s not just the engineers deciding how we will apply these things," Gates said.

Following his address, senior Sarah Moore, a chemical engineering major, said she was impressed with some of the new technology that Gates presented. "He was forward-thinking and brought up how he wanted to get technology out to everyone, not just to the privileged," Moore said.

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Gates discusses teaching and technology

On July 18, Dean Maria Klawe and Microsoft chairman Bill Gates engaged in a 45-minute dialogue about the field of computer science before an audience of 400 academic researchers and other invited guests at Microsoft Research's 2005 Faculty Summit. The conversation, in an informal question-and-answer format, explored issues ranging from the perception among young people of the field of computer science to the level of government funding for research. A Webcast and transcript are available at http://research.microsoft.com/workshops/FS2005/webcast.aspx

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Live on stage, Gates and Klawe hold power chat
With the adoption of its strategic vision statement in 2004, Princeton’s School of Engineering and Applied Science set ambitious goals for leadership in teaching and research. The document, called “Engineering for a Better World: The Princeton Vision,” described an agenda for capitalizing on Princeton’s strengths to reach beyond pure technical achievement and to educate leaders and solve problems for a truly global, technology-steeped society.

Princeton Engineering has moved rapidly in the last 18 months to bring this vision to reality. The following pages describe important steps in the core areas of its plan—establishing leadership in engineering education; creating an environment for high-impact interdisciplinary research; and building centers of excellence in focused research areas. Each of these advances is helping Princeton produce the leaders and breakthroughs that will make the world a better place. For continuing news and updates about Princeton Engineering, visit www.princeton.edu/engineering.

Innovation in education
Center prepares students for leadership in a technological age

Responding to a national need to rethink the teaching of engineering, Princeton University has created the Center for Innovation in Engineering Education (CIEE), an initiative to better prepare all students—both engineers and non-engineers—to be leaders in an increasingly complex, technology-driven society.

The center is creating new courses and strengthening existing ones that go beyond purely technical subjects to provide students a broader understanding of the global economic, environmental and cultural forces that shape and are shaped by technology. At the same time, the center is improving students’ technical education by exposing them to real engineering projects throughout their four years, through internships, entrepreneurial opportunities and multidisciplinary courses.

“Our plan is to set a new standard for engineering education,” said H. Vincent Poor, the director of the center and Princeton’s Michael Henry Strater University Professor of Electrical Engineering. “We want to inject more engineering into the liberal arts, and inject more of the liberal arts into engineering.”

“Engineering and applied science are going to play a key role in determining what happens to the world during the next 25 years,” said Maria Klawe, dean of Princeton’s School of Engineering and Applied Science. “The difference between technology that makes the world a better place and technology that creates additional problems will depend on our ability as a society to educate leaders who are well-versed in both technical and nontechnical fields.”

Continued on page 12
“Everyone receiving a first-rate education—everyone who wants to make a positive difference—has to understand the technologies that are going to affect the future of the world, as well as the public policy and other societal choices that are to be made in concert with technological developments,” said Vincent Poor, director of the Center for Innovation in Engineering Education.

Preparing students, continued

The creation of the center is one of the key initiatives to emerge from the engineering school’s strategic plan, “Engineering for a Better World: The Princeton Vision,” which it adopted in May 2004. Poor was appointed director of the center in February 2005, and its first curriculum innovations began this fall.

The center’s initial projects are to:

• introduce, starting this fall, a freshman curriculum that combines math, physics and hands-on engineering into an integrated series of courses;
• expand the engineering school’s already strong offering of interdisciplinary courses that attract humanities majors and other non-engineers; the goal is for more than 90 percent of all Princeton students to take at least one engineering course during their four years;
• build more exposure to engineering practice into the undergraduate experience by fostering internships and creating more classes that promote leadership, teamwork, product design and communications;
• emphasize invention and entrepreneurship by challenging students to address specific societal needs and pursue commercial opportunities.

In all these efforts, the center will seek to attract students from a wide variety of backgrounds and bring an international and interdisciplinary perspective to their education.

William Wulf, president of the National Academy of Engineering, said the center’s agenda addresses important issues confronting the U.S. engineering profession, including the need to expose students to real engineering problems in all four years. “If there were one thing I would change in all engineering curricula, it would be exactly that—giving students more experience with the practice of engineering,” Wulf said. (See interview on p.15.)

The center’s plan to foster connections between engineers and non-engineers also is crucial, Wulf said. “As engineers, we create solutions to human problems. We do it within a set of constraints that are not just issues of size, weight and power consumption. If you ignore the human dimension, you are not going to get as good a solution.”

New curriculum choices

The center’s efforts began this fall with the introduction of a course called EMP, which combines engineering, math and physics. In conventional engineering programs, students spend their first year taking required foundational courses that provide little exposure to real engineering problems. The new Princeton course, which involves 10 faculty members from seven departments, addresses the fundamentals in tandem with hands-on projects that show students where their preparations are leading. Labs, for example, deal with problems of energy consumption, robotic sensing and digital image transmission.

“The idea here is to integrate the subjects so students see the connections,” said Poor. “They can transfer something they learned in math to physics, and back and forth. Those ideas will then improve their engineering work, which, coming full circle, will motivate and deepen their understanding of math and physics.”

The center is starting from a solid base in its effort to reach beyond students majoring in engineering. With nearly two-thirds of all Princeton students already taking at least one engineering class, a goal of 90 percent is ambitious but attainable once the school introduces more interdisciplinary courses, according to Poor.

“Everyone receiving a first-rate education—everyone who wants to make a positive difference—has to understand the technologies that are going to affect the future of the world, as well as the public policy and other societal choices that are to be made in concert with technological developments,” he said.

The center also will broaden the education of engineering students by working with businesses to create summer internships, which will expose students to the real applications of their learning and allow them to bring new perspectives back to the classroom.

At the same time, some Princeton engineering classes will adopt more elements of the business world, with a particular focus on invention and entrepreneurship. The center will build on the success of courses such as “High-Tech Entrepreneurship,” led by longtime entrepreneur and former Harvard Business School professor Ed Zschau. For example, Daniel Nosenchuck, a professor of mechanical and aerospace engineering, has created a course in which teams of engineering majors and humanities majors will work together to analyze markets and design products, which will be judged and possibly adopted by executives from major consumer products companies.

Taken together, the center’s initiatives are intended to advance another major goal: increasing the diversity of engineering students. Among the many cultural barriers and stereotypes that have limited the diversity of the pool of people who chose careers in engineering, a persistent problem simply has been the way engineering is taught, said Klawe. “We lose students who have outstanding technical skills but are not willing to devote their entire educations to the study of technology for its own sake,” she said. “These students want to use their skills to make a difference in the world. The Center for Innovation in Engineering Education will help them do that.”

Freshman engineering students were given the option this year of applying to enroll in EGR 191, the first in a newly developed series of courses that integrate engineering, math and physics in a single structure. In their applications for the course, which had a pilot enrollment of 40 students, the freshmen expressed eagerness to combine knowledge from many areas and make a positive difference. They also liked the first semester lab that culminated in launching a water-propelled rocket. Here are excerpts from some of their applications for the course.

“I love engineering because it is not just the study of a science; it is the integration of many different subject areas that when fused together can be used to make a significant contribution to the world.”
— Nicole Clarke

“I am a natural, intuitive physics student, so all traditional methods (i.e., plug these values into a given equation, over and over) completely bore me. I really want to apply higher-level physics and calculus to actual engineering problems, and I want to see how the basics come together … Besides, who doesn’t want to design rockets? I have been building them and shooting them off in cornfields since I can remember!”
— Nicolas Frey

“My goal for studying engineering is to develop a nanorobot which would roam about human blood vessels to detect and cure diseases…. In addition to multivariable calculus and physics, which will be the actual tool for designing the nanorobot, this special engineering course will allow me to experience and learn the mindset of an engineer.”
— Jiyong Kwak

“These three areas of science will have to be integrated eventually one way or another. The idea of doing that from the very start sounds pretty perfect.”
— Metodi Blagoev Zlatinov

“I spent the last two years at a small, project- and research-based high school that was focused on integrating math, science, technology, and engineering, and I absolutely loved the program…. Learning to integrate and apply these skills is much more useful than learning math and physics individually, particularly for an engineering major.”
— Rachel Johnson
In May 2004, the same month that Princeton announced its strategic vision for engineering, the National Academy of Engineering (NAE) released “The Engineer of 2020: Visions of Engineering in the New Century.” This major report takes a broad look at the knowledge and talents that will be demanded of engineers in the coming decades. The two visions have important themes in common, according to John Mulvey, a Princeton professor of operations research and financial engineering who served on the Engineer of 2020 steering committee. Both seek to expand the definition of engineering, emphasizing leadership, a strong grounding in the liberal arts and the ability to think creatively in more than one discipline.

“At a formative age you have to learn how people from different disciplines approach problems, and that is what you get from a liberal arts education,” Mulvey said.

The National Academy of Engineering has now followed the 2020 report with “Educating the Engineer of 2020: Adapting Engineering Education to a New Century.” At the same time, Princeton has implemented a cornerstone of its vision with the creation of the Center for Innovation in Engineering Education (see story p.12). The EQuad News recently spoke with William Wulf, president of the NAE about Princeton’s initiatives and his vision for engineering education. Wulf has been president of the NAE since 1997. He is currently on leave from the University of Virginia, where he is a university professor and AT&T Professor of Computer Science.

EQuad News: If you had to stop someone on the street and tell them what’s going on in engineering education and what’s needed in the field, what would be at the top of your list?

Wulf: There is a philosophical set of issues and a very pragmatic set of issues—both of which, by the way, are being addressed in your new center. The first is teaching enough technological literacy, enough engineering to the general public that they can be responsible citizens. I set here at a nexus of science, engineering and public policy, and it is just disheartening to realize how many issues, important public policy issues, there are that have a technological dimension and the average citizen is not prepared to even ask the right set of questions. I am on leave from the University of Virginia, which was founded by Thomas Jefferson, who felt passionate about [the university] because he said you couldn’t have democracy without an informed citizenry. I’m afraid we’re the most technologically sophisticated and the most technologically dependent society ever, and yet the vast majority of the people who are supposed to be the stewards of that democracy don’t have a clue.

That’s one dimension of it. The other dimension has to do with how [American-trained engineers] are going to compete in this globalized, flat world as [columnist and author] Thomas Friedman describes it. We’re not going to compete on cost, so we had dam well better compete on quality. If we persist in being only the same on quality and five times the cost, ultimately we are not going to continue to enjoy the quality of life that engineering and technology has brought us over the last century.

So what can we do to make our engineering different and better?

I can talk at length about that, but I am very fond of quoting Bob Galvin on this—you know Bob was the CEO of Motorola—and he’s one of my heroes. In many ways, he is the guy who made the U.S. conscious of the need for improving the quality of our products back when we were competing with the Japanese. And at one point Bob said that he had never seen a process that couldn’t be speeded up by a factor of two while simultaneously improving quality, and I think that’s the kind of goal we need to set for engineering education. There’s a lot of stuff that we’re still teaching that is irrelevant to the modern practice of engineering. There is a huge amount known about both the physiology and the psychology of how people learn—we have applied none of that. So both from a curriculum content point of view and a pedagogical point of view I think we could do twice as much, and therefore in effect turn out a bachelor’s student who is at least at the current master’s level, maybe more.

What about Princeton’s goal of educating people who can lead because they not only have strong technical knowledge, but also have a broader perspective and grounding in fields outside science and engineering?

People use different definitions for what engineers do, but as far as I’m concerned what we do is create solutions to human problems. We do it within a set of constraints that are not just issues of size, weight and power consumption. If you ignore the human dimension, you are not going to get as good a solution. This is not soft, fuzzy stuff; it is the essence of engineering. One of the things that people have talked about a lot is the need for engineers to be able to communicate better and that sort of thing, and I think that’s also true. But I think the bigger reason for the human dimensions of engineering has to do with the quality of what you engineer.

The best engineers are not necessarily the best mathematicians, or the best scientists; they are the most creative people. The essential characteristic of a good engineer is creativity.

Going back to my person-on-the-street question: What would you want people to know that they might not currently grasp about engineering as a field?

One of the things that annoys me more than anything else is that there is this stereotype of engineers—the nerd image, the notion that engineers are very narrow. I think that image is just 100 percent wrong. There’s an aerospace engineer from the 1940s and ’50s, a guy by the name of Theodore Von Karman, and he said it beautifully. He was drawing a contrast between science and engineering, and he said that science is about understanding nature, about understanding what is, and engineering is about creating what has never been. The best engineers are not necessarily the best mathematicians, or the best scientists; they are the most creative people. The essential characteristic of a good engineer is creativity. And that is 180 degrees out of synch with the typical stereotype. When they make me king, and I get to flip the switch, that’s the thing I would want to communicate to the general public.

What if you had the same power within the field of engineering itself? Among faculty and students, is there anything they may not fully grasp about their own field?

One of the things that I was very pleased to read in the material about [your new center] was the focus on giving students some experience actually doing engineering in all four years of their degree. If there was one thing I would change first in all engineering curricula, it is exactly that: giving people experience with the practice of engineering. We have let engineering education get very scientific, very analytical, very mathematical, but the truth of the matter is, there’s an awful lot of engineering that gets done with algebra and high school physics, and so giving students more of the experience of what I think is the really fun part of engineering, namely creating solutions to human problems, well, as I say, that’s the first thing I would do.

Thanks very much. We’ll keep you posted as we move forward.

The best engineers are not necessarily the best mathematicians, or the best scientists; they are the most creative people. The essential characteristic of a good engineer is creativity.
Research center to address policy issues caused by technology

by Steven Schultz

Forging ties between technologists and public policy experts, Princeton University is creating a research center to address societal issues such as privacy and security that arise from advances in computer technology.

The Center for Information Technology Policy will bring leading computer scientists and engineers together with economists, sociologists, lawyers and lawmakers to make recommendations on issues ranging from the privacy of medical records to creating fair regulations for Internet phone services.

The University has appointed computer scientist Edward Felten to oversee planning for the center and serve as its first director. Felten, an authority in the area of computer privacy and security, is highly regarded among policy experts for his insights into the broader impacts of computer technology, particularly concerning copyright law. He holds a joint appointment in the Department of Computer Science and the Woodrow Wilson School of Public and International Affairs.

The stakes for how society deals with the regulation of technology are high, said Felten. "Just as technology has pervaded every aspect of our lives, the laws and regulations we pass concerning technology will have major effects on society for decades to come." Important decisions about laws and policy are being made without a thorough understanding of technology, while scientists and engineers often do not think through the societal impacts and regulatory reactions their technologies might cause, Felten said.

"One of the services we can provide is to participate in policy discussions from a technically knowledgeable viewpoint," Felten said. "We can be in the middle and look at both the policy questions and the technology issues in a more sophisticated way."

The center will be organized around 18-month-long focus areas during which Princeton will invite specialists from academia, business, government and nonprofit organizations to study, exchange ideas and make recommendations regarding specific problems and opportunities presented by advances in computer technology. At the end of each project, the center will issue a report and hold a policy briefing in Washington, D.C.

One of the potential focus areas is the proliferation of spam e-mails and phishing attacks (fraudulent e-mails aimed at tricking people into divulging private information). While automated filters currently are fairly effective at screening unwanted e-mails, the war between spammers and ordinary e-mail users is far from over, according to Felten. In the near future, the convergence of telephone systems and the Internet may allow spammers to make cheap telephone calls from countries that are not subject to the National Do-Not-Call Registry, creating a flood of telemarketing calls and a potentially serious burden for phone systems.

Controlling these problems effectively requires an understanding of technology, laws and market incentives, while misguided solutions could compromise privacy and open communication, Felten said. "Our center is well-situated to address the spam problem," he said. "We have a strong computer science team with expertise ranging from theoretical cryptography to system-building, and we have expertise in economics, sociology, ethics and the international aspects of technology."

Among other possible subjects are: computer viruses, worms and spyware; medical privacy; wireless communication regulations; and electronic voting.

"The Center for Information Technology Policy will help to fill an international need for a more thoughtful approach to dealing with the technological revolution that is changing every part of our lives," said Anne-Marie Slaughter, dean of the Woodrow Wilson School of Public and International Affairs.

The need for a bridge between technology and policy is great, said Felten. "We are experiencing an explosion right now in the regulation of technology," he said. "Not only do you see the usual government policymakers, Congress and administrative agencies jumping into these issues, but there’s also a lot more public debate, more advocacy, and there’s an increased amount of academic discussion of these issues."

Princeton sociology professor Paul DiMaggio, who studies the social implications of digital technologies and will be a participant in the center, said this debate is occurring with little communication between specialists. "For the most part, the social scientists don’t understand the technology and the technologists are not having conversations with the social scientists."

"At Princeton, I think we really have the potential to create an integrated center that is informed about both the technology and the policy," DiMaggio said. The center also has an opportunity to train students who will have strong backgrounds in both areas. "I think that is very exciting," DiMaggio said. "The world needs people like that."

After a period of fundraising, which is expected to support the hiring of additional faculty members and the creation of a visiting scholars program, the center is scheduled to begin work on its first focus area in the fall of 2006.

The creation of the center is one of the major outcomes of Princeton Engineering’s strategic plan, which emphasizes the need for interdisciplinary research and a greater understanding of the impact of technology on society.
A conversation with technology policy expert Ed Felten

Computer technology is adding tools, toys and gadgets of all kinds to our lives, but also it has made some complex questions about how society uses technology. Personal privacy, business regulation, national security, economic competitiveness, international relations and social justice are all being cast in a new light as information changes hands with greater speed and in greater quantities.

Ed Felten, professor of computer science, points out, neither technologists nor policymakers are equipped to deal with these issues on their own. The pace and impact of the changes demand that people in these two traditionally isolated areas take notice of each other and begin working together.

To address these issues, Princeton University is creating the Center for Information Technology Policy and has appointed Felten as founding director (see story on p.16). Felten, who joined the Princeton faculty in 1993, has published extensively about Web browser and computer security. He also has become a major voice in debates over computer privacy and digital copyright protection.

EQN: Why is it necessary to make a special effort to address these issues now?

Felten: To start with, there is the increasing pervasiveness of digital technology in all parts of life and the economy. Society is undergoing a transformation that is increasing in scope and pace, and because of that, public policy decisions are getting more complex.

There is this phenomenon that people call convergence: Rather than having different kinds of devices—telephone, television, radio, notebook and so on—there is a movement toward a smaller number of devices that do more things. The personal computer is one example; the cell phone is another. So where you used to have separate regulations for these different devices—one regulatory regime for telephones, one for radios, one for data networks—when you have convergence you now find all kinds of new questions. How will the telephone regulations get applied to computers? There’s a big fight going on right now: How will broadcasting regulations get applied to computers as computers become able to receive broadcasts directly off the air and online distribution starts to replace at least some broadcasting?

You also see this phenomenon in automated trading markets. Stock exchanges are getting computerized and that means that things that used to get done by people yelling at each other on the floor of the exchange are now being done by computer programs. And so to the extent that there was regulation of what those guys did before, that regulation naturally moves to the computer systems that replace trading pits. Securities regulation starts to control certain kinds of technology, and so there’s a sort of culture clash between the worlds of technologists and regulators.

It used to be possible for technologists to go into the lab and do what they thought was good technically. Now they seem to be much more aware that they need to clear what they’re doing with legal, they need to understand the policy situation. And you see big technology companies getting much more involved and engaged in the Washington policy process.

Suddenly there are a lot more options for how technology can work and a lot of design choices. Some people see that as providing more opportunities to regulate, more opportunities to foster whatever outcomes or values they may want.

Don’t these questions work themselves out over time in the marketplace? What is at stake?

There is a mismatch between the speed at which technology changes and the speed at which regulators adapt to technology, so you have lost opportunities. New products can’t exist because they’re illegal for reasons that no longer make sense, or people get away with doing harmful things because the regulators haven’t caught up…

Wait, I can imagine the latter, but can you give an example of the former?

Let’s see, here is an argument that not everyone agrees with, but one example has to do with indecency in broadcasting. There used to be rules that during certain hours of the day programming had to be kid-friendly and that two things have changed in recent years. One is technologies like the V-chip that let parents block certain shows and channels. The other is the rise of all kinds of technologies where people record things at one time and watch them at another, which means that restricting the broadcast of something at a particular time doesn’t necessarily have the efficacy that it used to have. So these technology changes have weakened the case for government zoning TV.

What other opportunities might be lost?

I think economic competitiveness will be an increasing issue in this area. There is certainly the risk of overregulating or regulating poorly, and if you do that it’s definitely an economic drag. It’s a drag on productivity and growth of technology. I think people have an increasing sense that the U.S. is not automatically the leader in technology and that we have to keep earning that leadership. The policy choices that are being made affect competitiveness.

It’s also an issue that these technologies tend to break down borders; they tend to allow organizations and groups to operate across borders, so there’s an increased need for international cooperation as well in talking about all of these positions.

One of the subject areas you are thinking of addressing in the new center is the proliferation of spam e-mail. Is spam more than just an annoyance?

The cost of spam is higher than just the annoyance. People trust e-mails a lot less because they get so much junk. In the wake of Hurricane Katrina, people sent out fraudulent e-mails that appeared to be fund-raising. When you get a request from the actual Red Cross, you’re more likely to throw it away because of the worry that it’s fraudulent. There’s also the related issue of phishing, which is people sending fraudulent e-mails to draw the recipient into revealing pass-words and so on. Many online merchants and banks have given up on using e-mail to get messages to their customers because there are so many fake messages.

Also, spam will spread from e-mail to other communication technologies. You’ll see more spam in the phone system. You thought telemarketing was bad before? There’s been a lot of success in regulating telemarketing with do-not-call lists, but there’s a real concern that the list will break down as the cost of calling internationally gets lower and as the phone system moves away from the centralized control of a few large companies toward more open and Internet-based architecture.

The nighttime scenario is that the phone system breaks down in a flood of spam-like telemarketing, and it’s a plausible outcome. You better be thinking about it because if spammers can make the switch to the phone system and instead of e-mails you get 150 calls a day, that’s pretty bad.

In designing regulations, you always have to be concerned whether you can enforce them. For example, the FCC considered making a do-not-e-mail list just like the do-not-call list, and I worked with them as a consultant on that. They decided, I think correctly, that it didn’t make sense to try to do that because it would be less effective and there would be greater privacy risks.

There’s a technological arms race between filter designers and the spammers, and one of the things we can do with our technical knowledge is look at that arms race and predict where it’s going.

What can Princeton contribute to this overall set of issues?

The tendency has been that people who know a lot about technol- ogy are generally not so involved in the policy process. And many of the people who are involved in policy are trained in law or trained in things other than technology and often don’t have access to the technical nuances that matter. One of the big services we can pro- vide is to participate in policy discussions from a technically know- ledgeable viewpoint. We can be in the middle and look at both the policy questions and the technology issues in a more sophisticated way. We also can educate a new generation of students—whether humanities majors, scientists or engineers—who have some under- standing of each other’s fields and who go on to become leaders who are prepared to anticipate problems before they emerge.
Grant funds technologies for developing regions

The Princeton Institute for International and Regional Studies (PIIRS) has given the School of Engineering a grant to explore new technologies that are appropriate for developing regions.

The grant will fund a lecture series during the current academic year, and in subsequent years will expand to fund graduate fellowships and field work.

“One of the starting realizations for us is how many people are working on these kinds of technologies without knowing about the work that others are doing in the same area,” said Margaret Martonosi, newly appointed associate dean of academic affairs and professor of electrical engineering. “The lecture series will help crystallize a community that is already forming here in the EQaud.”

Martonosi spearheaded the proposal for the grant, along with Michael Celia, chairman of the Department of Civil and Environmental Engineering, and Daniel Rubenstein, chairman of the Department of Ecology and Evolutionary Biology.

The monthly lecture series is still being finalized, but starts in December of Ecology and Evolutionary Biology.

Martonosi noted that efforts to improve water quality, housing, and medical care in the developing world could bring together researchers from many departments.

“This is the kind of effort that spans the whole engineering school,” she said.

Part of the grant will subsidize graduate fellowships for research in technology for the developing world. In addition, funds also can be made available to support field work. The grant covers the academic years from 2006 to 2009.

“So much engineering today assumes a first-world context—stable electricity, ample resources, and clean water,” Martonosi said. “But fundamentally the more interesting research challenge is how to develop solutions that work at low-cost and with little infrastructure. These kinds of problems require tremendous creativity and innovation.”

Martonosi also noted that because of the large populations in some developing regions, effective solutions to engineering problems have great commercial promise. “We at Princeton are not in this to get rich, but it is a flawed assumption to think that commercial entities won’t be interested,” Martonosi said.

Martonosi said she hoped the PIIRS grant would be a starting point and that others are doing in the same area,” said Margaret Martonosi, newly appointed associate dean of academic affairs and professor of electrical engineering. “The lecture series will help crystallize a community that is already forming here in the EQaud.”

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Martonosi said she hoped the PIIRS grant would be a starting point and that the National Science Foundation or private entities ultimately might provide more substantial, long-term funding. “This is a short-term pot of money to get things rolling,” she said. “I would love to see some endowed fellowships to help support this work.” –TR

Princeton Engineering seeks leaders for major initiatives

As part of its new strategic plan, Princeton Engineering is conducting two faculty searches for “transformational hires”—positions that are expected to capitalize on current strengths while leading the school in new directions.

One search is for a faculty position in the general field of nanomaterials, materials and photonics. The other is for a new faculty member to spearhead an important cross-disciplinary initiative in engineering and the life sciences.

The person hired to oversee the life sciences initiative should be “a world-renowned researcher who has the vision, versatility, energy and drive to establish and lead Princeton’s initiatives in this exciting new field,” said dean Maria Klawe.

The initiative will establish research and educational activities that span the six departments of the engineering school and will link to related work in other departments, including molecular biology, evolutionary biology, ecology, chemistry, physics and psychology.

Associate dean Catherine Peters and Margaret Martonosi are co-chairs of a search committee comprised of current professors in engineering and life sciences areas.

Martonosi, professor of electrical engineering, said that the initiative would be different from, but complementary to, Princeton’s Institute for Integrative Genomics. “Where genomics focuses heavily on understanding ‘what is,’ she said, “the initiative will marshal the school’s engineering prowess to imagine what might be.”

New building to house ORFE

The University has hired the award-winning architecture firm of Frederick Fisher & Partners to design a new building for the School of Engineering’s Department of Operations Research and Financial Engineering (ORFE).

The building will provide critical new space for the department, which has grown significantly since it was founded in 1999. It is also an important first step in the engineering school’s vision to add space for interdisciplinary research. Currently the department is housed in the E’ wing of the Engineering Quad.

Construction of the building is tentatively scheduled to start in the spring of 2007 and end in the fall of 2008. The new ORFE building has not yet been named. –TR

In terms of President Shirley M. Tilghman’s vision for “campus neighborhoodhoods,” she said that she saw the building as a “bridge between social sciences and engineering.”

ORFE students, according to Bob Vanderbei, chairman of the department, are typically engineering innovators and entrepreneurs. Some ORFE graduates go on to become leaders in finance, information technology, management consulting, insurance, and operations planning. Others develop tools to improve the performance of complex systems or to manage resources efficiently.

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Engineers Without Borders changes lives in Peru

by Alan S. Brown

Until this past summer, the latrines in the small Peruvian village of Huamanzaña were no more than simple pits. They were magnets for insects, which flew into the open pits and then transferred the germs to the villagers’ food, causing major public health problems.

The outlook for Huamanzaña’s health is now improving, however, through the work of seven engineering students and two anthropology students who founded the Princeton University chapter of the humanitarian group Engineers Without Borders (EWB). The students spent the past year designing and then building a modern latrine—a tin-roofed brick building housing four toilets, a sink, a shower and sanitation plumbing.

The effort culminated in August when the students trekked to Huamanzaña, about 90 minutes’ drive from the nearest developed city along the Pan-American Highway, to pour cement, lay bricks and raise a roof on the covered latrine.

The project is changing lives in the village, but also has changed the lives of the Princeton students. “It was like an epiphany every sunrise,” recalled Sebastien Douville, a senior majoring in mechanical and aerospace engineering. “We breathed the purest air, saw the clearest sky, and spent the most incredible day on Earth doing some incredible things.

McGowan describes the experience as a ‘culture shock.’ He was stunned by both the poverty of the region and the generosity of its people. He returned to Princeton wanting to do more.

McGowan met Douville playing sprint football that fall. Douville, in turn, had met mechanical engineering student Nate Lowrey and chemical engineering major Anshuman Sahoo the year before while taking a course on science, technology and public policy taught by Prof. Frank von Hippel in the Woodrow Wilson School.

Looking to take on engineering problems in undeveloped regions, they were already planning to form an EWB chapter on campus. McGowan’s experiences in Peru catalyzed their thinking.

They began sounding out other engineering students. “As soon as we started talking, everybody else got excited,” Lowrey said. They soon brought in environmental engineering student Bettnia Miguez and chemical engineering majors Lara Ionescu and Ron Weissbard.

The group also recruited two anthropology majors to act as cultural liaisons: Olivi, who had already spent a semester investigating public health in Nicaragua, and Seamus Abshere, who had switched majors from computer science. “Engineers know handwashing is important, but we didn’t know what it would take to change habits,” Lowrey said.

The group could have grown very large very quickly. “We decided to keep it small so we had a manageable team that could work on the long effort to get this off the ground,” Lowrey explained. That decision proved wise, especially when working through logistical issues such as the University’s concerns about the liability of sending students into remote areas.

The students spent much of the fall and winter lining up funding. Sahoo, who coordinated the campaign, secured major grants from the Class of 1969 Community Service Fund, the Princeton Institute of International and Regional Studies and the Global Science Program. The group also picked up numerous smaller contributions to help pay for travel and materials.

The planning

The students decided to start with a simple project. Fortunately, they had one ready-made. While McGowan was working in Santa Rita, northern Peru, he wound up in Santa Rita, an Andean town near Huamanzaña, where an EWB group was building a latrine for a school.

The project was a simple one. The group hoped to learn how to manage a project without being over imposed engineering solutions. In Huamanzaña, for example, residents pushed to add a shower to the latrine. “They have very limited drinking water, so they sometimes bathe in irrigation water that has pesticides in it,” says Olivi. “This will be a lot safer.”

The new latrine in Huamanzaña promises to solve this problem. Its four pedestal toilets have drains with U-shaped traps that lead to a large septic tank. Villagers flush them with a bucket of water, which carries away the waste and also fills the trap. This water barrier blocks insects from entering and keeps odors from leaving. The latrine also has a sink, making it easy to wash bacteria off hands after using the toilet.

By this time, the EWB chapters understood 80 new projects. Every one of them had originally been started by one person. “All of a sudden, everybody else got excited,” Lowrey said. “Slowly but surely, the group began to grow.”

This past year, EWB chapters undertook 80 new projects. Every one of them had originally been started by one person. “All of a sudden, everybody else got excited,” Lowrey said. “Slowly but surely, the group began to grow.”

Santa Rita

Princeton’s involvement with EWB began in 2004, when civil engineering student Sean McGowan, now a senior, began looking for a nontraditional job. “I didn’t want to sit behind a desk all summer,” he said. Instead, thanks to the Class of 1969 Community Service Fund, he wound up in Santa Rita, an Andean town near Huamanzaña, where an EWB group was building a latrine for a school.

McGowan, who speaks some Spanish, originally signed on to help organize community meetings, but given his civil engineering background, he soon found himself pouring cement. He also spent much of his time making sure materials were in the right place at the right time. “There’s no Home Depot down there,” he chuckled.

“Then we did basic paperwork, and I was a lot involved in recruiting people. He returned to Princeton wanting to do more.

The design was straightforward. They would build the latrine with walls of local red clay bricks, a roof frame of native eucalyptus poles and a tin roof. The sink, shower and four pedestal toilets would sit on a slab of hand-mixed concrete. The toilets would flow into a large pit lined with porous brick that would let the decomposed waste seep into the ground.

The new latrine in Huamanzaña promises to solve this problem. Its four pedestal toilets have drains with U-shaped traps that lead to a large septic tank. Villagers flush them with a bucket of water, which carries away the waste and also fills the trap. This water barrier blocks insects from entering and keeps odors from leaving. The latrine also has a sink, making it easy to wash bacteria off hands after using the toilet.

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The group also recruited two anthropology majors to act as cultural liaisons: Olivi, who had already spent a semester investigating public health in Nicaragua, and Seamus Abshere, who had switched majors from computer science. “Engineers know handwashing is important, but we didn’t know what it would take to change habits,” Lowrey said.

The group could have grown very large very quickly. “We decided to keep it small so we had a manageable team that could work on the long effort to get this off the ground,” Lowrey explained. That decision proved wise, especially when working through logistical issues such as the University’s concerns about the liability of sending students into remote areas.

The students spent much of the fall and winter lining up funding. Sahoo, who coordinated the campaign, secured major grants from the Class of 1969 Community Service Fund, the Princeton Institute of International and Regional Studies and the Global Science Program. The group also picked up numerous smaller contributions to help pay for travel and materials.

The planning

The students decided to start with a simple project. Fortunately, they had one ready-made. While McGowan was working in Santa Rita, representatives from Huamanzaña had approached EWB about building a latrine for their school, similar to the one McGowan had helped build in Santa Rita. By building on an existing design, the group hoped to learn how to manage a project without being overwhelmed by the region’s isolation and their lack of experience.

The design was straightforward. They would build the latrine with walls of local red clay bricks, a roof frame of native eucalyptus poles and a tin roof. The sink, shower and four pedestal toilets would sit on a slab of hand-mixed concrete. The toilets would flow into a large pit lined with porous brick that would let the decomposed waste seep into the ground.

Continued on page 24
The engineering I studied in school gave me a good foundation, but until I put it into practice I had no idea how complex a project could be,” said civil engineering student Sean McGowan.

Similar latrines are found the world over, yet in remote Huamanzaña the design posed complex challenges. Not only were supplies and equipment limited, but the community lives above a desert and has limited access to fresh water.

By March, the students were ready to present their design to EWB’s technical review board. It was turned down. “They have very high standards and we were just unprepared,” Douville said. “But they showed us what we needed to change. They told us that if we made the changes, we could reapply in two months.”

Many of those changes involved engineering calculations based on information—soil conditions, topography, water supply—that could only be gathered in Huamanzaña, which the group had not yet visited. “We didn’t know where we would buy materials. We hadn’t asked the villagers what they wanted,” Douville said.

To shore up their plans, the group recruited a professional engineer, Peter Anderson of Bridgewater, N.J., as a mentor. In May, Anderson flew to Peru with McGowan, Olivi, and Sahoo to collect data and assess Huamanzaña’s needs. McGowan was floored when he arrived. “The enthusiasm was way beyond expectations,” he said. “They were really ready to make changes.”

The engineers surveyed the latrine site and tested the soil. Olivi set up meetings so villagers could discuss their ideas. The townspeople suggested adding a shower and enlarging a 4-foot-deep ditch used to mine clay for adobe bricks to make the seepage pit.

After the team returned home, EWB approved the final plan and site survey. The group had little more than two months to line up remaining details and logistics. “Seb was working 16-hour days at his summer job and then coming home to work on the project,” McGowan said.

The team finished the latrine in three weeks, one week earlier than planned.

Yet construction moved quickly. The school’s parents’ association organized a rotation of men to help build while others tended their crops. A similar rotation among mothers kept everyone fed. It turned out that the village had more than enough water for the shower. The team, which had prepared for several different contingencies, quickly poured the concrete base and reinforced pillars to support a 10-foot-high water tower. “You just have to adjust on the fly—that’s what engineering’s really all about,” says McGowan.

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Not every issue was resolved during the few weeks Princeton’s EWB team stayed in Huamanzaña. The school’s parents’ association, for example, decided that only families of school children would be given access to the latrine, even though the whole village would benefit from more sanitary conditions.

Despite their disappointment over this decision, the students saw progress by the time they left. “We also taught all the kids a song about handwashing and how important it was, and after that, handwashing was the coolest thing in the village,” Douville said. “Those kids will grow up, and they will expect to use a latrine and soap. We planted a seed. Things will be different.”

Back in Princeton this school year, the team is recruiting more students, organizing projects for next summer and sowing the enthusiasm they feel so strongly.

“Changing lives in Peru, continued

Uche Honnah, a junior at Coppin State College in Maryland, quite simply summed up his experience working in two Princeton engineering labs last summer.

“If I hadn’t come, I would be oblivious to the general process of research. I really wouldn’t know what to expect,” said Honnah, who has now transferred to Penn State University and is committed to going on to graduate school.

Honnah was among nearly 40 students from small colleges and universities from around the country who spent the summer at Princeton as part of the engineering school’s Research Experience for Undergraduates (REU) program. The students, many of whom came from schools with little opportunity for hands-on research, worked with graduate students and faculty members on projects ranging from the design of hydrogen fuel cells to the genetic programming of bacteria cells.

Exposure to real research is a critical step toward attracting a broader population of students to careers in science and engineering, said Daniel Steinberg, director for educational outreach at the Princeton Institute for the Science and Technology of Materials (PRISM). The program required a significant time commitment from more than two dozen faculty members, but the investment usually pays off, said Steinberg.

“Uche has really been a great student this summer,” said Craig Arnold, assistant professor of mechanical and aerospace engineering. “He’s definitely got it; he’s a scientist.”

You can learn more about the Princeton chapter of Engineers Without Borders at the organization’s Web site at http://ewb-princeton.org.

Uche Honnah worked in the labs of Craig Arnold and Diane Benziger last summer, which fueled his desire to attend graduate school in engineering.

Regan Mejia-Ariza of the University of Puerto Rico conducted research on hydrogen fuel cells in the lab of Jay Benziger. “In only two months, I learned so much I want to continue. I want to apply here at Princeton,” Mejia-Ariza said.
Materials camp lets science teachers bring real-world lessons to students

“The Materials Mini-Camp is part of a much larger slate of outreach efforts at PRISM and the engineering school. Other programs last summer included Research Experience for Undergraduates (REU) (see photos on previous page) and the Princeton University Materials Academy (PUMA), which brought about 60 high school students for one- to two-week sessions of hands-on science workshops and projects.

The Mini-Camp was new this year and was inspired by the idea that materials science offers a good vehicle for hands-on science that crosses many disciplines, which is unusual at the high school level, said Daniel Steinberg, educational outreach director for PRISM. “Most of the teachers here see materials science as a way of bringing the laboratory and the classroom into the real world, and that’s a way to reach many of their students.”

“Our scientists are looking in a very fundamental way at the structure of things, and their fundamental research is going to lead to the new technologies of the 21st century. That’s the same thing we’re trying to teach here,” Steinberg said.

The intensive program allows 30 teachers to work with metals, ceramics, polymers and composites, learning techniques and concepts that can translate into effective lessons to bring back to their own classrooms and laboratories.

The program is organized and funded by the Princeton Center for Complex Materials (PCCM) in partnership with Rutgers University and ASM International, a materials science society that sponsors the camps in multiple venues.

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In addition to their time in the lab, the teachers interact with Princeton chemists, physicists and engineers who can provide insight into innovations in materials science. George Scherer, a professor of civil and environmental engineering, gave a talk on materials issues in art conservation. Scherer then took them on a tour of the Princeton campus to view examples of how water and salt can damage stone buildings and monuments.

Steinberg said the Materials Mini-Camp will be held at Rutgers next year, then return to Princeton the following year. Eventually, the organizers plan to develop an advanced course in addition to this introductory course so that one level can be taught on each campus every summer.

“‘This is the beginning of something big,’ Steinberg said. ‘You teach 30 teachers about materials science, and they each teach 100 or so students in one year—already you’re reaching 3,000 students. Each year that’s going to expand.’

An undergraduate student group called Princeton Engineering Education for Kids (PKEE) is collaborating with teachers at a Princeton public elementary school to help students build their own computer-controlled cars out of Legos and learn principles of engineering. The program has produced an enthusiastic response among the children and is providing valuable experience to the Princeton engineering majors. For a complete story on the program, see www.princeton.edu/main/news/archive/S11/59/25C38/.

“In a recent session on metals in Frick Laboratory, the teachers cranked pennies through a rolling mill to study the malleability of copper and zinc. They also heated, cooled and bent paper clips and bobby pins to observe how the metals weakened and strengthened depending on their physical properties.

During an introductory chemistry session, groups of teachers made their own concrete by choosing any ratio of sand, gravel or cement to mix with water. ‘Everyone used their own recipe, which is something the students in their classrooms will be able to do very easily,’” Steinberg said.

Other activities include taking apart incandescent light bulbs, making glass from common soil, studying the properties of nylon and examining the transformation of peanut brittle from amorphous goo to a glass-like sheet of candy.

Erin Welsh, who teaches physics and chemistry at Hamilton High School West, said, ‘I needed to collect more labs. One of the selling points of this program is that these are inexpensive things you could find in your house, so it wouldn’t cost the school a lot of money.’

Leo Brancato of Pemberton High School, who teaches biology, physical science and integrated science, said the hands-on aspect of materials science will benefit his students.

‘You can pose a question, pull in the materials, generate the data and see the results—and do it in a way that will grab the students,” Lee Brancato of Pemberton High School said. ‘It brings a lot more realism to physics and chemistry, as opposed to just working your way through the chapters.’

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He added with a laugh, “You get to use a lot of fire in this course, which is always fun. The kids love that.”

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Freshman welcome

This fall brought 236 freshman BSE students, the largest incoming class in several years. The freshmen come from 34 states and 19 countries, and the class includes 32 percent women and about 13 percent international students.

During a recent dinner, Klawe heard details of students’ lives, from trouble with math problem sets to the pros and cons of living in Forbes College (including the story of an “exploding” toilet). She heard about non-engineering courses students are taking, from Chinese 101 to “Practical Ethics” with philosopher Peter Singer, and outside interests from a newfound fascination with fencing to a passion for art and sculpture. Klawe interjected follow-up questions and bits of advice about navigating difficulties and seeking help.

In general, the students expressed a lot of enthusiasm. “I really like that all the people are so interesting,” said one freshman woman. “They have so many talents and are so smart, but are so nice.”

Dinners with the Dean help welcome freshmen

Of all the potentially intimidating aspects of being a freshman engineering student at Princeton, having a conversation with the dean doesn’t need to be among them.

That’s one of the messages of “Dinners with the Dean,” a series of small group dinners that Dean Maria Klawe has with every freshman engineering major. This semester, the second year that she has held the dinners, Klawe is attending about 20 dinners with more than 200 freshmen at their residential colleges.

“I found the dinners last year to be great—I had such a good time and learned so much—so I decided I would definitely do it again,” Klawe told students at a dinner Oct. 13. “And this year is even better because I’m less nervous.”

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To help break the ice, the dinner conversation follows a format in which Klawe goes around the table asking students where they are from, why they chose Princeton and engineering, what they like and don’t like so far, what other classes they are taking, and what their outside interests are. In between the set questions, the conversation takes its own turns.

Summer workshops

The Department of Mechanical and Aerospace Engineering introduced a series of workshops on fun and practical engineering subjects for students who are spending the summer on campus.

For a full story on the workshops, see: www.princeton.edu/main/news/archive/S12/47/23M82/.

Recruiters find talent, breadth in Princeton engineers

Recruiters at the annual Science and Technology Job Fair in Dillon Gym on Oct. 14 said they had lots of jobs they were eager to fill, so many were perplexed at the sleepy pace of student traffic at the beginning of the fair.

“This morning I was on the phone to Cupertino, saying, I’m not sure this was such a good idea,” said Scott Gilfoil, manager of university relations for Apple, which was exhibiting at Princeton for the first time.

Many students, it turned out, were attending a late-morning speech by Microsoft Chairman Bill Gates, who was at Richardson Hall accepting the Crystal Tiger Award from Princeton undergraduates.

After the Gates speech, however, the nearly 60 career booths were besieged with students. “The last two hours took the fear out of me,” said Apple’s Gilfoil. “We had a flood of people.” In the end, about 500 students attended the fair.

Microsoft recruiters themselves had little business until the Gates speech was over. At the start of his talk, Gates showed a humorous video of Princeton alumni who work at Microsoft. Some of them were at the Microsoft recruiting table at the job fair. One of them was Corey Sanders CS ’04, who was recognized by several students who passed by the Microsoft booth as the guy who was wearing the orange toga in the video.

Fellow recruiter John Hravin CS ’04, who also was in the video, struck a serious note at the recruiting table. “A lot of people came up really interested in the company, but didn’t know where they would fit in,” Hravin said. “What we told them is that if you’re passionate about the technology and you’re smart we will find a place for you.”

Representatives from the Central Intelligence Agency’s Center for Weapons Intelligence, Nonproliferation, and Arms Control (WINPAC) said that they were looking to find a range of people—engineers, physicists, chemists, international affairs and political science types, and people with strong writing skills and strong interpersonal skills.

“This is a big, big year for hiring,” said Bryan Peters, a recruiter for the CIA. “We have a large recruiting effort because of President Bush’s edict that we bolster our national security staffing by 50 percent. The more specialized, the better. We are looking for highly skilled people.”

Sandia National Laboratories representatives Donald Hardesty ’71 and Jerry Simmons ’80 S’82 said they were especially interested in candidates with backgrounds in physics, chemistry, and materials science to do basic research at a new nanoscience center funded with $20 million from the Department of Energy.

Aaron Boyd, director of application development at Wireless Generation, said his company was looking for people with broad skills.

The New York City-based company, a first-time exhibitor at Princeton, builds hand-held and web-based software for teachers’ instructional needs. “We are developing software used by a population that aren’t usually early adopters,” said Boyd. “We need people who can engineer but who can also think intelligently about product design.”

Kevin Banks, senior technical recruiter for Ask Jeeves, called the fair an “awesome event.” “Our hiring executives will be excited by the quality of the candidates,” Banks said. “This is our first time here, but it won’t be our last.”

Peter Bogucki, associate dean for undergraduate affairs at the school of engineering, organized the fair with the assistance of Vanessa Carter and Sharon Kulik. “The event offered at least one company or organization of interest to just about every student in engineering and science,” Bogucki said. “Of course, these are not the only companies that recruit at Princeton, and many others visit campus at other times of the year or receive applications through their Web sites.” A full list of job fair participants is available at www.princeton.edu/engineering/jobfair05.htm.

Companies displayed a wide range of goodies to entice potential hires to their tables. Navigant Consulting gave out swank pens sheathed in velvet, the Institute for Defense Analysis offered up leather-covered notepads, and Ask Jeeves rewarded visitors with special decks of playing cards.

“They’ve got some cool stuff here,” said Mike Lee EE ’07, who received his highest praise for D.E. Shaw & Co., the specialized investment and technology development firm based in New York City that gave Amazon founder Jeff Bezos EE CS ’86 a job early in his career. D.E. Shaw gave out Rubik’s cubes. “People were really impressed by that,” Lee said.
Fellowships honor grad students

The School of Engineering has announced the appointment of two new departmental chairs: Michael Celia, chair of civil and environmental engineering, and Robert Vanderbei, chair of operations research and financial engineering.

**Fellowships**

- **AT&T Labs Fellowship**
  - Nadia Heninger Ph.D. COS
- **National Defense Science and Engineering Graduate (NDSEG) Fellowship**
  - Gordon Y.S. Wu Fellowship
  - Andrew Ferguson Ph.D. CHE
  - Andrew Marencic Ph.D. CHE
  - Eugene Brevedo Ph.D. CEE
  - Jing Xiong Ph.D. CEE
  - Sergey Nadtochiy Ph.D. ORFE
  - Wei Dong Ph.D. CSE
- **Intel Foundation Fellowship**
  - National Science Foundation (NSF) Fellowship
  - Corey Toler-Franklin Ph.D. CEE
  - Janet Yoon Ph.D. CEE
  - Nathan Grube Ph.D. CEE
  - Shona Patel Ph.D. CEE
- **President’s Fellowship**
  - President’s Fellowship
  - Corey Toler-Franklin Ph.D. CEE
- **Merck and Company Graduate Fellowship**
  - Samsung Lee Kun Hee Foundation Fellowship
  - Wallace Memorial Fellowship
  - Pallav Gupta Ph.D. CEE
- **Honda Prelude**
- **Ann Arbor Skyline 2001 Honda Prelude**
- **Merck and Company Graduate Fellowship**
  - Marjan Gindy Ph.D. CEE
  - National Collegiate Athletic Association Scholarship
  - Trenton Franz M.S.E. CEE
- **Hydrology Section Award**
  - most recent award
  - Drives: Honda Prelude
- **Research interests:** Algorithms for nonlinear optimization and their application to problems arising in engineering and science
- **Former most unusual hobby:** Soaring; was chief instructor of the Central Jersey Soaring Club for 10 years until he traded in his glider for a telescope
- **Current most unusual hobby:** Astrophotography—some of his photos were displayed at the National Air and Space Museum and can be seen at http://www.nasa.gov/si/gallery/111/universe/firstlight/
- **On his bookshelf:** The Odyssey; just about everything written by John Irving
- **Favorite song:** “Psycho Killer,” by the Talking Heads
- **Unanticipated claim to fame:** The Purple America Map, Rather than depicting county-by-county voter preference in the 2004 presidential election with red for Republican and blue for Democrat, his map used shades of purple to represent the percentage of Democratic and Republican votes in each county. The blogosphere went wild over the map, with one poster deeming it “wicked cool.”
- **On the drawing board:** A new building for ORFE, which is being designed by Frederick Fisher and Associates

Celia and Vanderbei appointed departmental chairs
Appointments, promotions and retirements
Booz Barak and David Blei have joined the Department of Computer Science as assistant professors. Barak is a specialist in cryptography and earned his Ph.D. from the Weizmann Institute of Science in 2004. Blei’s field is artificial intelligence. He has been a postdoctoral fellow at Carnegie Mel-
on University and received his Ph.D. from the University of California-Berkeley in 2004.

Jaswinder Singh ’97 of computer science has been promoted to full professor from associate professor. Jeremy Kasdin of mechanical and aerospace engineering has been promoted from assistant professor to associate professor with tenure.

Frediano Bracco ’70, professor of mechani-
al and aerospace engineering, has trans-
ferred to emeritus status. An expert in the internal combustion engine, he has written or co-written more than 200 papers. His research was supported by the U.S. Depart-
ment of Energy, the Army Research Office, and many companies, including General Mo-
tors, John Deere & Co., Nissan and Yamaha. He was the recipient of many awards from the Society of Automotive Engineers, to which he was elected a fellow in 1988. Bracco earned his Ph.D. in aerospace and mechanical science from Princeton in 1970 and immediately joined the department’s research staff and then the faculty.

Margaret Martonosi, professor of electrical engineering, has been named associate dean for academic affairs of the school of engineering. Martonosi is sharing the responsibility for academic affairs with Catherine Peters, associate pro-
fessor of civil and environmental engineering.

Three win National Science Foundation CAREER Awards
The National Science Foundation recently awarded its prestigious CAREER award to three members of the engineering faculty. Mikiko P. Hozaita, an assistant professor in the department of mechanical and aerospace engineering, received funding for a project titled “Computational Studies of Elastic and Dislocation Effects on Microstructure Forma-
tion.” Vicky Henderson, assistant professor of operations research and financial engi-
neering, will study “Financial Engineering, Incomplete Markets and Investment Under Uncertainty.” Ron Weiss, assistant profes-
sor of electrical engineering, will investigate “Artifical Patterm Formation with Synthetic Gene Networks.”

The award was established to support the early-career development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their organization.

Awards recognize junior faculty achievements
At Class Day in May, the engineering school announced the recipients of its annual junior faculty awards, which recognize the most promising assistant professors across the school’s six departments. The rigorous selection process weighs the nominees’ scholarly achievements, teaching activities, and records of service to the school and the professional community.

Mung Chiang, assistant professor of electrical engineering, received the Howard Wentz Award. Julie Young of civil and en-
vironmental engineering received the Alfred Rheinstein ’11 Award. David Walker of com-
puter science and Craig Arnold of mechan-
al and aerospace engineering both received the Lawrence Kidder/Emerson Co. Faculty Advancement Award.

Faculty awards and honors
Roland Heck, associate dean for adminis-
tration of the engineering school, has been named a Fellow of the American Institute of Chemical Engineers. He was officially recog-
nized at the annual meeting in October.

Stanislav Shevtzaman ’99, assistant profes-
sor of chemical engineering, was selected to participate in the National Academy of Engineering’s Frontiers of Engineering symposium. The program, which took place in late September, brought together some of the best young engineering talent in the country and included discussions on ID and verification technologies, the engineering of complex systems and engineering for develop-
ing communities.

Michael Celia ’83, chair of the Department of Civil and Environmental Engineering, has won the American Geophysical Union’s 2005 Hydrology Section Award. The award is given for outstanding and creative contri-
butions to the hydrologic sciences. It will be presented to Celia during the annual meeting of the AGU in December in San Francisco.

Sanjeev Arora, professor of computer science, was chosen by The McGraw Center for Teaching and Learning and the Gradu-
ate School to receive a Graduate Mentoring Award. The award honors Princeton faculty members who are exemplary in supporting the development of their graduate students as teachers, scholars, and professionals. Arora was presented with the award at the Graduate School’s hooding ceremony in May.

Perry Cook, associate professor of com-
puter science, was a winner of the 2005 Conservatory of Music Alumni Achievement Award at the University of Missouri-Kansas City (UMKC). Cook is the first person to receive alumni awards from two academic units at the university. In 1992, he was honored by the School of Computing and Engineering at UMKC.

Tauf Beta Pi, the engineering honor society, has named H. Vincent Poor ’77 the 2005 winner of its Distinguished Alumnus Award. Poor is the director of the new Center for Innovation in Engineering Education and is Princeton’s Michael Henry Strater University Professor of Electrical Engineering.

James Sturm ’79, professor of electrical engineering and director of the Princeton Institute for the Science and Technology of Materials (PRISM), has been awarded an endowed professorship. He is now the William and Edna Macalzer Professor of Engineering and Applied Science.

Sharad Mallik, professor of electrical engineering, is the co-recipient of the 2005 School of Engineering and Applied Science Distinguished Teaching Award. Since joining the Department of Electrical Engineering in 1991, Mallik has taught 28 undergradu-
ate and graduate courses. More than half of these courses received student ratings above 4.5/5.

Joseph C. Elgin Professor of Engineering Stephen Chou has been inducted into the New Jersey High-Tech Hall of Fame for 2005.

In recognition of his contributions to the field of information theory, the Polytechnic University of Catalonia in Barcelona, Spain, on October 11 awarded Sergio Verdú, professor of electrical engineering, a doctor-
ate honoris causa.

Philip Holmes, professor of mechanical and aerospace engineering, gave the opening plenary lecture at the Fifth EUROMECH Nonlinear Dynamics Conference (ENOC- 2005) at Eindhoven University of Technol-
yogy, The Netherlands, in August 2005. His topic was "Niney plus thirty years of nonlinear dynamics: More is different, and less is more."

Craig Arnold, assistant professor of mech-
anical and aerospace engineering, has been named an Office of Naval Research Young Investigator Program award winner.

Naomi Leonard ’85, professor of mechani-
al and aerospace engineering, was chosen to receive the 2005 Mohammed Dahleh Award from the University of California-Santa Barbara. As recipient of this award, Leonard gave the Mohammed Dahleh Distinguished Lecture, titled "Foraging by Design: Schools of Self-Guided Robotic Gliders Explore the Ocean."

David Srolovitz, professor and chair of mechanical and aerospace engineering, has accepted the 2005 presidency of the Society of Engineering Science. The organization was begun in 1963 to foster interactions among the many disciplines of engineering science.

Michael Littman, professor of mechanical and aerospace engineering, was presented with the Optical Society of America’s 2005 Engineering Excellence Award at its October meeting. Littman shared the award, which honors exceptional technical achievements in optical engineering, with René-Jean Es-
siambre from Lucent Technologies.

Robert Kahn ’51 ’55, professor of mechani-
cal and aerospace engineering emeritus and senior research scientist, was awarded a medal for “Outstanding Achievement in Electric Propulsion” at the 29th International Electric Propulsion Conference held at Princeton University Oct. 31 through Nov. 4, 2005. Medals were awarded to six of the most senior and important contrib-
utors to the field of electric propulsion during a special centennial celebration marking 100 years of research.

Marlan Scully, professor of mechani-
cal and aerospace engineering, has been awarded the American Physical Society’s Arthur Schawlow Prize in Laser Science. The society cited Scully’s “many far-reach-
ing contributions to quantum optics and quantum electronics and, in particular, for the quantum theory of lasers, for the theory of free-electron lasers and laser gyro’s, and for theoretical and experimental contributions to optical coherence effects.”

Jianqing Fan, professor of operations research and financial engineering, has been made a fellow of the American As-
sociation for the Advancement of Science (AAAS) in recognition of his far-reaching contributions to statistical theory and meth-
ods, financial econometrics, statistical ap-
plications to health sciences, and particularly for studies of nonparametric biostatistics. The official recognition ceremony will be held in February 2006 at the AAAS annual meeting in St. Louis.

Fan also was listed by Thomson ISI Essential Science Indicators as being consistently among the top 10 most cited mathematicians.

William Massey ’77, professor of operations research and financial engineering, is one of the most frequently cited mathemati-
cians in the world, according to the Journal of Blacks in Higher Education.

The journal published a study in Septem-
ber that ranked the most frequently cited 98 black mathematicians. Massey, who has published more than 50 papers on prob-
ability analysis, ranked second. His work was cited 59 times in academic journals pub-
lished during 2004.

Sanjeev Arora, professor of computer science, was chosen by The McGraw Center for Teaching and Learning and the Gradu-
ate School to receive a Graduate Mentoring Award. The award honors Princeton faculty members who are exemplary in supporting the development of their graduate students as teachers, scholars, and professionals. Arora was presented with the award at the Graduate School’s hooding ceremony in May.

Perry Cook, associate professor of com-
puter science, was a winner of the 2005 Conservatory of Music Alumni Achievement Award at the University of Missouri-Kansas City (UMKC). Cook is the first person to receive alumni awards from two academic units at the university. In 1992, he was honored by the School of Computing and Engineering at UMKC.
Robert Kahn ’64 wins Presidential Medal of Freedom

President George W. Bush has awarded the Presidential Medal of Freedom to Princeton Engineering alumnus Robert Kahn, who co-created the networking protocol that is the basis for the Internet.

Kahn, who earned a 1964 Ph.D. in electrical engineering from Princeton, received the award along with his co-inventor, Vinton Cerf, and 12 other Americans at a White House ceremony Nov. 9.

“More than 30 years ago, Vinton Cerf and Robert Kahn designed the architecture and communication protocol that gave rise to the modern Internet,” the president read in his citation. “The innovative work of these two pioneers laid the foundation for a global transformation of communication, commerce, and entertainment. The United States honors Vinton Cerf and Robert Kahn for their outstanding contributions to science and for improving the lives of all Americans.”

The medal is the nation’s highest civilian honor and is given to those who have made exceptional contributions to America’s security, world peace or who have had a significant impact on the cultural life of the nation through their efforts.

After receiving his Princeton Ph.D., Kahn worked at Bell Labs and MIT before joining the Defense Advanced Research Projects Agency (DARPA) in 1972. At DARPA, Kahn conceived the idea of open-architecture networking and was co-inventor of the TCP/IP protocols that are used in routing information on the Internet. He is responsible for originating DARPA’s Internet program.

Kahn is now president and CEO of the Corporation for National Research Initiatives, a not-for-profit organization that fosters research and development of the nation’s information infrastructure. In February, the Association for Computing Machinery awarded Kahn the Turning Award, a $100,000 prize that is the highest honor bestowed in the field of computer science. He received an honorary Doctor of Science degree from Princeton in 1998.

Alumni briefs

Amy Alving ’88 has left her job at DARPA to join Science Applications International Corporation (SAIC) as the chief technology officer of its Transformation, Training and Logistics Group.

Alving’s responsibilities will include strengthening the company’s technical readiness reviews as well as overseeing independent research and development and career development for scientists and engineers.

Alving, who received her Ph.D. from the Department of Mechanical and Aerospace Engineering, had served as director of special projects at the Defense Advanced Research Projects Agency where she was in charge of strategic planning, operations, finances, security and program development and execution.

In July, Alving was given the DARPA director’s “coin,” an award that recognizes those individuals who have helped DARPA fulfill its mission to conceive, explore, and demonstrate advanced and breakthrough concepts and technologies.

Thomas Connelly Jr. ’74 has received the 2005 Award for Executive Excellence from the Commercial Development and Marketing Association. The award is given annually to an individual who has made an outstanding contribution in the field of commercial development and marketing in the chemical and allied industries. Connelly, who is senior vice president and chief science and technology officer at DuPont, received undergraduate degrees in chemical engineering and economics from Princeton and a 1977 Ph.D. in chemical engineering from the University of Cambridge. He is currently a member of the Department of Chemical Engineering Advisory Committee.

Leah Jamieson ’77 has been selected as the 2006 president-elect of the IEEE, the leading professional organization in the field of electrical engineering. The position means that Jamieson will begin serving as president of IEEE on Jan. 1, 2007 pending acceptance of the election-tally report by the organization’s board of directors.

Jamieson is associate dean for undergraduate education at the Purdue University College of Engineering, where she also is the Ransburg Professor of Computer and Electrical Engineering. She has authored more than 160 technical papers in the areas of signal processing, parallel computation and engineering education.

Jamieson also has been honored with the National Science Foundation Director’s Award for Distinguished Teaching Scholars, the Harriet B. Rigas Outstanding Woman Engineering Educator Award from the IEEE Education Society and the Chester F. Carlson Award for Innovation in Engineering Education from the American Society for Engineering Education. She currently serves as a member of the Advisory Council for Princeton’s Department of Electrical Engineering.
The family of the late William "Jerry" Knapp ’47 has endowed a professorship in his memory for the study of civil engineering. The inaugural recipient of the William L. Knapp, Class of 1947, Professorship for the Study of Civil Engineering in the School of Engineering and Applied Science is George Scherer, who has been a faculty member since 1996 and is a leading figure in several areas of materials science.

"This very generous gift will help strengthen our faculty in areas of critical need," said Michael Celia, chair of the Department of Civil and Environmental Engineering. "I am grateful to the Knapp family for creating a permanent legacy that connects generations of Princetonians while advancing our goals of teaching and research."

The opportunity to support civil engineering at Princeton would have pleased Jerry Knapp, according to his widow, Priscilla Knapp. "He had a great love and respect for Princeton," she said. "It was a wonderful part of his life."

Jerry Knapp came to Princeton as a freshman in 1943, but left the following year for a two-year tour of duty with the U.S. Merchant Marines. He returned in 1946, and completed a following year for a two-year tour of duty with the U.S. Merchant Marine, returning in 1948, and once again completed a two-year period of active duty. During this time, Knapp maintained close ties to the University. He very much enjoyed interviewing prospective students, and had a particular interest in recruiting scholar-athletes. Before his death in 1984, he and his family created the William L. Knapp, Class of 1947, Scholarship Fund.

Scherer, whose appointment to the Knapp chair was approved by the University Board of Trustees in November, has broad research interests in materials science and has worked recently on the transport of fluids in concrete and other porous building materials. This work has included research on the deterioration of stone monuments as well as analysis of the safety of proposed methods for trapping the greenhouse gas carbon dioxide in deep underground wells.

Scherer also has established a reputation as a dynamic teacher at Princeton. Along with advanced-level courses, he created and continues to teach a popular lab-based course in art conservation, which draws many humanities majors as well as science and engineering students.

Knapp family endows professorship

Lava Trading founders endow lecture series, fund student research

Richard Korhammer (left) and Kamran Rafieyan (right) endowed a lecture series and a fund to support student research at Princeton. The two have long been friends and former roommates at Princeton. They co-founded Lava Trading, a financial technology firm, and have continued to work together to support education and research at Princeton.

"The gifts that Richard and Kamran have made to our department will provide exciting opportunities in both teaching and research," said Peter Ramadge, chair of electrical engineering. "It's hard to overstate the value of the infusion of ideas that come from having visiting speakers, and it's critically important to have resources to turn those ideas into learning and research opportunities for our students."

Even while they were in the thick of their undergraduate educations—plowing through the requirements of BSE degrees in electrical engineering—Richard Korhammer ’88 and Kamran Rafieyan ’93 had more on their minds than technology.

Rafieyan's rock band RF Raf was popular on campus, and Knorrhammer sat in with the band on guitar when he wasn't selling beer mugs and helping win a national gold medal for the swim team. But more than extracurricular activities, the two friends' interests extended to economics and business and how they could apply their technical expertise to other fields.

Today Korhammer and Rafieyan are in their seventh year of leading a company they founded, Lava Trading, which has become a major force in Wall Street by using computer technology to increase the efficiency of financial markets. They also are helping ensure that students and faculty at Princeton continue to make intellectual and practical connections in their work through major gifts to the Department of Electrical Engineering.

Rafieyan, who is Lava's chief information officer, has given $100,000 to endow an undergraduate research fund in electrical engineering, while Korhammer, the company's chief executive officer, has given the same amount to create a lecture series in the department. As part of a larger gift, Korhammer also gave to Princeton's Bendheim Center for Finance, which has strong ties to the Department of Operations Research and Financial Engineering.

"I found that the opportunity to pursue independent work within the school of engineering was one of the highlights of my Princeton education, and provided an excellent balance between the theoretical and practical aspects of my education," said Rafieyan. The fund he endowed will help purchase equipment and provide other support to students conducting independent research during their senior year.

Korhammer said he wants his endowment of a lecture series to foster greater interaction between industry and academia. "One of the goals in education is to create as much cross-pollination of ideas as possible," Korhammer said. Speaking of his own experience in business, Korhammer said that the best insights and opportunities are often preceded by a broad exposure to people and experiences in a given field.

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Lava Trading founders endow lecture series, fund student research

After graduating, Korhammer and Rafieyan went in separate directions, but both focused on business applications of technology. Rafieyan earned a masters degree from the University of California at Berkeley and then worked as an employee and a consultant for a variety of firms, focusing on financial trading systems. Korhammer joined NVT Computer Systems, which was founded by Apple’s Steve Jobs, and worked closely with Wall Street firms to help develop custom trading solutions. Korhammer then went on to form his own management consulting firm, which served the trading departments of leading investment banks.

In the late 1990s, Korhammer and Rafieyan began working out ideas for a new technology that would consolidate electronic data from several financial markets at once, including NASDAQ and other exchanges, and allow trading firms to make more accurate, streamlined decisions. After creating their company, the two entrepreneurs "flew under the radar" at first, said Rafieyan, before unveiling their technology later in 2000, said Korhammer.

Lava Trading now employs more than 300 people and its information systems support many of the leading brokerage firms, investment banks, hedge funds and institutional investors. The company is continuing to grow after having been purchased by Citigroup in 2004. “In the world of trading, great technology is a competitive edge, and Lava’s goal is to provide its customers with that edge,” said Rafieyan.

At the same time, Korhammer and Rafieyan have not lost track of their outside interests, which for Rafieyan now includes serving on the electrical engineering advisory committee. “It’s been a pleasure to return to Princeton on a more frequent basis and see all the good things that Peter Ramadge and the rest of the faculty have done with the department,” Rafieyan said. “I’ve also had the opportunity to meet a number of the current undergraduate students, and they are just as impressive as ever.”

Korhammer and Rafieyan also are keeping their interest in music. The Lava Band, including the two top executives and other employees, makes periodic appearances in New York bars.

“No one is quitting their day job,” said Korhammer. “But the band is not bad.”

Reunions weekend 2005 was rich with events sponsored by the School of Engineering and Applied Science. On Friday, May 27, alumni attended a luncheon reception to preview the new EQuad Café, participated in talks and panel discussions and then relaxed with friends, food and drink under a tent outside the Friend Center for Engineering Education.

Cato Laurencin ’80, professor of biomedical and chemical engineering and chair of orthopedic surgery at the University of Virginia, led a panel discussion on “Frontiers in Bio-Engineering.” He asked his four alumni panelists to predict a major advance in bioengineering that will come into widespread use in the next decade. They sealed their answers into a handsome wood box that will serve as a time capsule until 2015. The other panelists were Andrew Donker ’59, Timothy Gardner ’95, Beth Junker ’84, and Charles Goldstein ’71. Other panels had simultaneously and drawing large audiences were titled “The History and Future of Flight” and “Solving the Carbon Crisis.”

Richard Korhammer (left) and Kamran Rafieyan (right) who founded the highly successful financial technology firm Lava Trading, have always combined many interests, including playing together in bands. The two have endowed major gifts to the Department of Electrical Engineering to expand opportunities for teaching and research. Photo courtesy of Lava Trading.

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