GETTING TO GREEN: THE HURDLES TO HYDROGEN
Charles Bakis, professor of engineering science and mechanics, won the 2006 American Society for Composites Award.

Enrique del Castillo, professor of industrial and manufacturing engineering, was elected editor-in-chief of the Journal of Quality Technology.

Amy Freeman, assistant dean of engineering diversity, was elected president of the National Association of Multicultural Engineering Program Advocates.

Iam-Choon Khoo, distinguished professor of electrical engineering, was named the William E. Leonhard Endowed Professor of Electrical Engineering.

Soundar Kumara, distinguished professor of industrial and manufacturing engineering, was named the Allen E. Pearce/Allen M. Pearce Professor of Industrial and Manufacturing Engineering.

Akhlesh Lakhtakia, distinguished professor of engineering science and mechanics, was named the Charles Godfrey Binder Professor in Engineering Science and Mechanics.

Bruce Logan, the Kappe Professor of Environmental Engineering, was named one of the “Nation’s Top 50 Trendsetters” in the November 2006 issue of Public Works magazine.

Susan Pysher, coordinator of administrative support systems, won the University’s Staff Excellence Award.

Costas Maranas, the Donald B. Broughton Professor of Chemical Engineering, received the Outstanding Young Researcher Award from the American Institute of Chemical Engineers’ Computing and Systems Technology Division.

Arthur Miller, distinguished professor emeritus of civil engineering, was awarded diplomat status by the American Academy of Water Resources Engineers.

Bernhard Tittmann, the Schell Professor of Engineering Science and Mechanics, was elected a Fellow of ASM International, the materials information society.

Stefanie Tomlinson, alumni and public relations staff assistant in the Engineering Dean’s Office, received the 2006 Ally Recognition Award from the University’s Commission on Lesbian, Gay, Bisexual and Transgender Equity for her work with the group.

Thorsten Wagener, assistant professor of civil and environmental engineering, received the Early Career Research Excellence Award from the International Environmental Modeling and Software Society.

Vigor Yang, professor of mechanical engineering, was appointed the John L. and Genevieve H. McCain Chair in Mechanical Engineering.

Shizhou Yin, professor of electrical engineering, was elected a Fellow of the Optical Society of America.
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Clean power generated by hydrogen is one of the Holy Grails of energy. Employing hydrogen on a large scale, however, will require extensive research like that under way by Penn State engineers. See page 8.
**Envisioneers win Rube Goldberg contest**

For the second year in a row, the Envisioneers captured first place in the Penn State Rube Goldberg Machine Contest in February.

Challenged to design a machine that could take a whole orange, juice it and pour the juice from a pitcher into a cup in 20 or more steps, the Envisioneers created a contraption titled “Rube Goldberg in Florida.” The 6-foot by 6-foot by 5-foot machine featured sand, palm trees, an alligator swamp, Cinderella’s Castle from Disneyland, and the Indiana Jones stunt show from Disney-MGM Studios.

The Society of Hispanic Professional Engineers was awarded second place. Their machine was based on a secret agent theme.

The contest is sponsored by the Penn State Engineering Society, the College’s alumni advisory board.

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**University recognized for excellence in entrepreneurship education**

The National Consortium of Entrepreneurship Centers (NCEC) recognized Penn State as one of two universities to win the NCEC Award for Exceptional Activities in Entrepreneurship Across Disciplines. Temple University also won the award.

The College of Engineering contributes to Penn State’s focus on entrepreneurship by offering the engineering entrepreneurship minor. The minor is aimed at students interested in starting their own technically based businesses or in bringing innovation and creativity to existing companies. The Smeal College of Business, the Huck Institutes of the Life Sciences and the Colleges of Communications, Health and Human Development and Agricultural Sciences also offer entrepreneurship-focused programs.
As part of the Society of Women Engineers’ effort to raise money for the Interfraternity/Panhellenic Dance Marathon, the group held its fourth annual Mr. Engineer Pageant at the Hetzel Union Building’s Alumni Hall.

Uzair Qadeer, an industrial engineering senior, was crowned this year’s Mr. Engineer. Qadeer took home a $250 scholarship from the College.

Eleven contestants representing different student groups and charitable causes participated and were scored in several events, including how much money they raised for Dance Marathon, “engineering wear,” formal wear, talent and a series of questions. The event serves as a spoof of mainstream beauty contests.

The Mr. Engineer Pageant raised $700 for Dance Marathon, an annual University-wide event to raise money for children with cancer.

In an effort to enhance coordination and collaboration among the many and varied green energy research projects under way and planned across the University, Penn State has created the Biomass Energy Center.

An interdisciplinary initiative that includes the College of Engineering, the Eberly College of Science and the College of Earth and Mineral Sciences, the center will be housed in the College of Agricultural Sciences’ Environment and Natural Resources Institute.

Led by Tom Richard, associate professor of agricultural and biological engineering, the center’s work will focus on using renewable “crops,” such as corn, switchgrass, trees and manure, to produce energy.

James “Lee” Everett III (ME ’48, MS ’49), former director of the Lockheed Martin Corporation, has designated $500,000 from the Lockheed Martin Directors Charitable Award Fund to endow a new professorship in the Department of Mechanical and Nuclear Engineering.

The endowment will be named the “J. ‘Lee’ Everett Professorship in Engineering” and will be used to support a mechanical and nuclear engineering faculty member’s efforts in teaching, research and service.
Five engineering programs receive high ranking

Five programs in the College of Engineering were ranked among the top ten in the 2005 Faculty Scholarly Productivity Index. The list was published in the Jan. 12, 2007, issue of the Chronicle of Higher Education. Nationally, Penn State ranked third in computer science; third in civil and environmental engineering; seventh in industrial engineering; eighth in computer engineering; and tenth in electrical engineering.

Transportation institute receives $25 million contract, $6.2 million grant

The Pennsylvania Transportation Institute (PTI) at Penn State was awarded a $25 million, five-year intergovernmental agreement from the Pennsylvania Department of Transportation (PennDOT) to fund a broad range of research, education and outreach activities.

The PTI was also awarded a $6.2 million, three-year grant from the U.S. Department of Transportation to continue leading the Mid-Atlantic Universities Transportation Center (MAUTC).

The MAUTC has been the federally designated University Transportation Center for Region 3 since its inception in 1988. Region 3 encompasses Delaware, Maryland, Pennsylvania, Virginia, West Virginia and the District of Columbia.

A multidisciplinary research unit within the College of Engineering, the PTI has conducted transportation-related research, education and outreach for federal and state government and industry sponsors since 1968.
Space Systems Engineering Certificate Program debuts

A certificate program in space systems engineering in the College is now available for students.

Students in the certificate program take a set of courses in space systems engineering-related topics as well as participate in a space systems project.

The program, administered by the Department of Electrical Engineering’s Communications and Space Sciences Laboratory and the Department of Aerospace Engineering, is designed to better prepare students for careers in the space industry.

Sven Bilén, associate professor of engineering design, electrical engineering and aerospace engineering, will serve as the program’s director.

College launches podcasts program

As part of a pilot program started in fall 2006 between Apple and Penn State, the College of Engineering has started posting podcasts on Apple’s iTunes website.

The podcasts are free and may be downloaded by going directly to http://itunes.psu.edu or through the College’s website at www.engr.psu.edu/NewsEvents/podcasts.asp. Users must have the iTunes music program installed on their Windows or Mac computers in order to download the podcasts. iTunes may be downloaded for free at Apple’s website at www.apple.com/itunes/download.

The College’s initial podcast offerings include “An Engineering Life,” an ongoing unscripted audio series featuring Nicole, a first-year student discussing her experience coming to college and majoring in engineering; “Experts From the Field,” audio recordings of guest lectures and instructions on topics that affect our world; and “Producing World-Class Engineers,” a video podcast with students and faculty on Penn State’s approach to training engineers.
Getting to green

Engineers try to realize the dream of environmentally friendly fuels like hydrogen

The idea seems simple enough—transition the nation away from traditional energy sources to ones that are more plentiful, renewable and environmentally friendly.

Leading the list of alternative fuels on America’s wish list is hydrogen. One of the most abundant elements in the universe, hydrogen is often touted as an energy savior. When used as a clean-burning fuel, hydrogen’s only byproduct is water.

But making the jump to hydrogen is something that’s easier said than done.

Employing it on a large scale, such as in power plants, is more complicated than simply switching the fuel source from, say, natural gas, to hydrogen, says Robert Santoro, the George L. Guillet Professor of Mechanical Engineering and director of the University’s Propulsion Engineering Research Center.

For power plants and other large-scale users looking to move to an alternative fuel, it means completely rethinking how everything is done.

Penn State engineers are grappling with a number of issues that keep alternate fuels such as hydrogen on the drawing board.

Before trying to use hydrogen in the massive gas turbines used by power plants, Santoro says researchers need a better understanding of hydrogen as a fuel.

“It’s a different kind of fuel, and they want to use this in land-based gas turbines as a replacement for natural gas,” Santoro says. “We don’t know very much about its combustion characteristics under gas turbine conditions.”

He explains that using hydrogen in a gas turbine takes more than just injecting it as a new fuel source.

To keep emissions low, gas turbine power plants premix the fuel with air before sending it into the combustor, Santoro states.

“Over the past 15 years, emissions regulations have gotten stricter and stricter,” says Domenic Santavicca, professor of mechanical engineering and director of the recently established Center for Advanced Power Generation.

He continues, “One approach for reducing nitric oxide emissions is called ‘lean premixed combustion,’ where the ratio of fuel to air is reduced and the fuel and air are well mixed before they burn. This produces lower combustion temperatures, which results in lower nitric oxide emissions.”

The reduction in emissions, however, comes at a price.

To achieve premixed combustion, it’s necessary to mix the fuel and air before they enter the combustion chamber. This raises the possibility the mixture might ignite in the fuel nozzle and cause significant damage.

“The danger is called ‘autoignition,’ and it’s more likely to occur at the high pressure and high temperature conditions found in modern gas turbines,” Santavicca says.

Santoro concurs. “If it gets too hot and if it takes too long in that mixing process, it will burn before it ever gets to the combustor—and that would be a disaster. For the fuels we use now, we know their autoignition points. We can go to a book and look them up. But for these newer alternate fuels, we don’t understand at what pressure and temperature conditions they auto ignite.”

And with lean premix combustors, a second and more deadly problem looms.

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Using his knowledge and experience in propulsion, Robert Santoro, the George L. Guillet Professor of Mechanical Engineering, is examining the autoignition characteristics of hydrogen-carbon monoxide mixtures for use in land-based gas turbines.
Domenic Santavicca, professor of mechanical engineering, heads Penn State’s new Center for Advanced Power Generation, which is part of a national effort to develop zero-carbon power generation technologies.
“It's called ‘combustion dynamics,’” says Santavicca. “This refers to oscillations in the combustion process—the size and location of the flame—that can occur at frequencies ranging from hundreds to thousands of hertz. These oscillations produce pressure oscillations that can literally destroy the engine. In the worst case, this can occur in a matter of seconds.”

Santavicca has focused his efforts on solving the combustion dynamics problems for the past decade. With the recent push toward alternate energy, he has also been investigating the effects of coal-derived synthetic gases, which contain significant amounts of hydrogen.

Both engineers are focusing on two pieces of the hydrogen puzzle—Santavicca on understanding the effects of hydrogen on combustion dynamics and Santoro exploring the auto-ignition characteristics of hydrogen-carbon monoxide mixtures for use in land-based gas turbines.

Santavicca, whose work is sponsored by the Department of Energy, National Science Foundation, NASA, General Electric and Solar Turbines, says the move to an alternative source won’t come quickly.

“Because of concerns about the effects of hydrogen on auto-ignition and combustion dynamics, the gas turbine industry is approaching the change from natural gas to hydrogen fuel with caution,” he states. “The ultimate goal is to develop ‘fuel flexible’ gas turbine systems that can operate on a range of different fuels, which is what we and many other colleagues around the country are focusing on. Future gas turbines will most likely use sensors to monitor changes in the fuel’s composition and adjust the combustion system accordingly to avoid problems such as autoignition and combustion dynamics.”

But putting into place the next generation of gas turbines will be more of an evolutionary process, rather than a revolutionary one.

Vigor Yang, the John L. and Genevieve H. McCain Chair in Engineering, says, “General Electric, for example, might have a thousand gas turbines in the field. It’s practically impossible to remove these massive turbines and replace them with all new turbines.”

Ideally, Santavicca says, gas turbine owners want to use existing technology or use minimally modified technology.

“One of the important differences with hydrogen is its very high flame speed,” he states. “This changes the flame location in a combustor, and flame location is one of the determining factors in the instability problem.”

The mechanical engineer says no one’s really sure if a hydrogen-carbon monoxide mixture introduced into a gas turbine will cause instability.

Santavicca is researching the initiation of the instability, rather than studying the instability itself. He argues that unstable combustion can be avoided by preventing the initiation of the instability.

Santavicca is focusing on two instabilities: flame vortex interaction and equivalence ratio fluctuations.

“In most combustors, it’s generally assumed that one or both of these processes is responsible for the instability,” Santavicca says.

Using a battery of instrumentation, he is measuring pressure fluctuations, flame shape, the amount of light produced by the flame and velocity of air entering the combustor. All of the measurements are made simultaneously.

“It’s all converging on a method for predicting the occurrence of unstable combustion,” he says.

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Vigor Yang, the John L. and Genevieve H. McCain Chair in Engineering, has assembled hundreds of CPUs to create one of the largest PC clusters for individual researchers. He is using the massive processing power to create very large-scale, three-dimensional simulations of land-based gas turbines.
Yang is helping Santavicca by developing theoretical models and numerical simulations of gas turbines.

“We have one of the biggest PC clusters for individual researchers,” Yang states. “We have more than 600 CPUs and can do very large-scale, three-dimensional simulations, which wasn’t previously possible.”

Yang’s team is working to develop a simulation that models every aspect of a gas turbine.

“My task is to understand everything in this combustor,” he says. “Once we comprehend everything in the combustor, we can optimize the combustor design.”

Like other aspects of moving to hydrogen, understanding the combustor doesn’t come easy.

“The science level is very demanding,” Yang says, listing a dizzying array of factors he has to keep in mind.

“To get proper results, we have to make sure the fluid mechanics part is correct. We have to make sure the fluid evolution within this combustor can accurately be captured, even without combustion or chemical reactions. For example, if I inject a liquid fuel into this combustor, the fuel breaks up into large ligaments and then forms clouds of tiny droplets. This process has to be accurately predicted. The second hurdle is chemical kinetics. For natural gas with hydrogen and air, typically the chemical kinetics involves hundreds of different elementary reactions, which includes radicals of all kinds. We have to make sure that part is accurate. Once you have the fluid mechanics and chemistry correct, then you have to make sure you have a computational model that can accurately accommodate both in a timely fashion.”

He continues, “The kinetics model they’ll supply to me will be huge, involving hundreds of reactions. I have to reduce the model size so that the computational fluid dynamics code can handle it.”

Yang hopes to create a computer model that will quickly and accurately emulate the real gas combustor so engineers can begin working on retrofitting current combustors to run on hydrogen or alternate fuel mixes.

“Engineers could retrofit a current combustor by changing the injectors or changing the control scheme,” Yang muses. “Most likely they’ll modify their products so they can cover a wider range of fuel compositions.”

Though it’s not going to be easy, the engineers say the effort, in the end, is worth it.

“Eventually, land-based gas turbine combustors will operate on 100 percent hydrogen fuels,” Santavicca says. “When you burn hydrogen, you produce only water. There’s no cleaner fuel.”

---Curtis Chan

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**Artificial jet fuel**

The push into alternate fuel sources isn’t something new for Robert Santoro. He and fellow faculty member Thomas Litzinger, director of the Leonhard Center for the Enhancement of Engineering Education and professor of mechanical engineering, are part of a Multidisciplinary University Research Initiative (MURI) by the U.S. Air Force to develop a surrogate for jet fuel. The Penn State engineers are working with fellow scientists at the University of Illinois, Princeton University and Case Western Reserve University to create an artificial jet fuel.

“If you took a jet fuel, it has hundreds, if not thousands of components. You can’t attack such a complex fuel if you want to learn about the combustion chemistry,” Santoro states. The team’s goal is to make an artificial jet fuel out of just three or four components that simulate the combustion behavior of jet fuel.

“Artificial jet fuel doesn’t mean something new for us. We’re working on this for a while,” Santoro said. “We’re trying to find a way to make a jet fuel that’s more fuel efficient, environmentally friendly and economical.”

“At Penn State, we’re studying the ignition process and we’re looking at the soot formation process to determine whether a candidate surrogate fuel developed by the team accurately represents the combustion of jet fuel,” he explained about the University’s role in the project.

“It will have to match the major combustion characteristics of the real fuel,” Santoro says. “That includes having the same emission levels, the same ignition characteristics, and the same combustion characteristics in terms of soot formation, energy release and temperature you achieve.”

As part of the five-year MURI grant, Santoro and Litzinger will receive $300,000 per year.

“This has pretty wide implications because if this project is successful, it can be applied to almost any combustion device.”

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Photo credit: Gene Maylock
A computer model or “virtual stomach” has revealed a central “road” in the human stomach, according to a team creating computer simulations of stomach contractions.

Dubbed the Magenstrasse, the discovery could explain why pharmaceuticals sometimes have a large variability in drug activation times.

“We are predicting variables that we wish we could measure, but we cannot,” says James Brasseur, professor of mechanical engineering, bioengineering and mathematics. “Now that we know the Magenstrasse exists, we can look for it, but it will not be easy to measure its existence and could require expensive technology.”

Brasseur, working with Anupam Pal, research associate at Penn State, and Bertil Abrahamsson of AstraZeneca, was interested in how the stomach empties its contents and how material passes from the stomach to the small intestines.

“The sphincter between the stomach and the small intestine is interactive,” says Brasseur. “The sphincter opens and closes in a controlled way to regulate the flow of nutrients to the small intestines. Sensor cells in the intestines modulate the opening and closing.”

Two types of muscle contractions control food movement in the stomach. One type of contraction, antral contractions, occurs in the lower portion of the stomach and break down and
mix stomach contents. The other type of contraction, fundic contractions, occurs over the upper surface of the stomach.

It was thought that the fundic contractions move food from the top of the stomach where it enters from the esophagus, to the bottom of the stomach where the chyme leaves and enters the small intestine. The assumption was that particles left the stomach in the same order they entered the stomach.

The researchers modeled the stomach contents and discovered that a narrow path forms in the center of the stomach along which food exits from the stomach more rapidly than the regions near the walls of the stomach. They used MRI data from human subjects to create the proper geometry of the muscle contractions.

“We looked at a ten-minute window of digestion, and we tagged all the particles as they left the virtual stomach,” says Brasseur. “We then reversed the flow on the computer and saw where the particles came from.”

In essence they ran the simulation backwards and were surprised to see a central road appear. Those particles in the virtual stomach that were on the central road exited the stomach in ten minutes. The Magenstrasse extended all the way from the stomach’s exit up to the top of the stomach’s fundus. Material that entered the stomach off this Magenstrasse could remain in the stomach for a long time, even hours, in the real stomach.

“This discovery might explain observed high variability in drug initiation time and may have important implications to both drug delivery and digestion,” the researchers reported online in the *Journal of Biomechanics*.

Because most drugs target the small intestines for absorption, a pill disintegrates in the stomach and activates in the small intestines. With this new understanding of how the stomach works, where in the stomach a pill or capsule disintegrates becomes very important. Drug delivery times may differ from ten minutes to hours depending on location.

“Therefore, drugs released on the Magenstrasse will enter the duodenum rapidly and at a high concentration,” the researchers report. “Drugs released off the gastric emptying Magenstrasse, however, will mix well and enter the duodenum much later, at lower concentration.”

For some drugs, rapid release is important. For others, slow release over long periods of time is the desired outcome.

“If you do not know a Magenstrasse exists, you will not factor it into the designs,” says Brasseur. “Now that we know, perhaps researchers can design pills with higher densities to sit around at the bottom of the stomach, outside the Magenstrasse, and let the drug out slowly.”

—Andrea Messer

*Dr. Brasseur can be reached at brasseur@psu.edu.*
Fiber in the sky

As the military relies more on lasers to transmit information, it looks to increase their dependability

Just as clouds block the sun, they interfere with laser communications systems, but Penn State researchers are using a combination of computational methods to find the silver lining and punch through the clouds.

“Radio frequency communications are generally reliable and well understood but cannot support emerging data rate needs unless they use a large portion of the radio spectrum,” says Mohsen Kavehrad, the W. L. Weiss professor of electrical engineering and director of the Penn State Center for Information and Communications Technology Research (CICTR). “Free space optical communications offer enormous data rates but operate much more at the mercy of the environment.”

Laser light used in communications systems can carry large amounts of information, but the dust, dirt, water vapor and gases in a fluffy cumulus cloud scatter the light and create echoes. The loss of some light to scattering is less important than those parts of the beam that are deflected and yet reach their target, because then, various parts of the beam reach the endpoint at different times.

“All of the laser beam photons travel at the speed of light, but different paths make them arrive at different times,” says Kavehrad. “The Air Force, which is funding this project through the Defense Advanced Research Agency, would like us to deliver close to 3 gigabytes per second of data over a distance of 6 to 8 miles through the atmosphere.”
That 6 to 8 miles is sufficient to cause an overlap of arriving data of hundreds of symbols, which causes echoes. The information arrives, but then it arrives again because the signal is distributed throughout the laser beam. In essence, the message is continuously being stepped on.

Kavehrad and Sangwoo Lee, graduate student in electrical engineering, presented their solutions to the echo problem at the Institute of Electrical and Electronics Engineers Military Communications Conference in Washington, D.C.

“In the past, laser communications systems have been designed to depend on optical signal processing and optical apparatus,” says Kavehrad. “We coupled state-of-the-art digital signal processing methods to a wireless laser communications system to obtain a reliable, high capacity optical link through the clouds.”

The researchers developed an approach for free-space optical communications that not only can improve air-to-air communications, but also ground-to-air links. Because their approach provides fiber optic quality signals, it is also a solution for extending fiber optic systems to rural areas without laying cable and may eventually expand the Internet in a third dimension, allowing airplane passengers a clear, continuous signal.

Using a computer simulation called the atmospheric channel model developed by Penn State’s CICTR, the researchers first process the signal to shorten the overlapping data and reduce the number of overlaps. Then the system processes the remaining signal, picking out parts of the signal to make a whole and eliminate the remaining echoes. This process must be continuous with overlap shortening and then filtering so that a high-quality, fiber optic caliber message arrives at the destination. All this occurs while either the sender or the receiver or both are moving.

“We modeled the system using cumulus clouds, the dense fluffy ones, because they cause the most scattering and the largest echo,” says Kavehrad. “Our model is also being used by Army contractors to investigate communications through smoke and gases, and it does a very good job with those as well.”

The computer modeled about a half-mile traverse of a cumulus cloud. While the researchers admit that they could simply process the signal to remove all echoes, the trade-offs would degrade the system in other ways, such as distance and time. Using a two-step process provides the most reliable, high-quality data transfer.

The system also uses commercially available off-the-shelf equipment and proven digital signal processing techniques.

—Andrea Messer

Dr. Kavehrad can be reached at mkavehrad@psu.edu.
Ambassadors of engineering

The College’s Engineering Envoys program helps answer questions for future Penn Staters

What is a co-op? Will it delay my graduation date? How can I get an internship? These are some of the questions that often plague engineering students. Fortunately, there is a group of students who can help. The Co-op and Internship Envoys work with College staff and professional employers to answer these questions.

Mary Lee Carns, associate director of engineering cooperative education and professional internships and one of the advisers for the Envoys, says their goal “is to help students prepare for the job market by encouraging internships and co-ops,” along with holding seminars and speaking to underclassmen about the value of experience in the work force.

Envoy Christiana Drayer, an industrial engineering graduate student, states that it is “rewarding to give them (younger students) feedback from their own peers.” Drayer believes that Envoys can bring credibility to the benefits of obtaining work experiences.

Each Envoy has already completed a co-op or an internship and uses that experience to advise younger engineering students. Envoy Ryan Carley, a fifth-year mechanical engineering student, says, “A lot of students don’t want to participate in a co-op or an internship because they worry it will set their graduation date back, but for me it was the best thing I could’ve ever done.” Carley, who has worked with the Walt Disney Company and abroad in both Ireland and Germany, believes what he learned at his co-ops has enhanced his classroom education.

The Envoys and their advisers fully understand the value of experience in the job market. Kim Fox, associate director of engineering cooperative education and professional internships, helps Carns advise the Envoys. She states the co-op and internship experiences are great ways for students to enhance their technical skills and improve their level of professionalism. Students come back from work assignments excited about the opportunities obtained, such as leading teams and taking on new responsibilities.

Envoy students do more than just share their stories and experiences with other students; they also act as an informal advisory committee to the co-op and professional internship program. Fox believes the Envoys have had some great ideas for program improvements. “We look to the Envoys to provide the voice of the students. They have given ideas for technical, professional and etiquette seminars as well as suggested other program offerings.”

Engineering Co-op and Internship Envoys speak to prospective engineering students and parents at open houses, and with current students at first-year seminars and other Penn State campuses about the positive experience they’ve had with their co-op or internship. Amy Scalise, a fifth-year senior in chemical engineering and Envoy says, “It’s a great way for
upperclassmen to talk with underclassmen about their experiences and pass along useful and practical advice.”

Envoys are among the best and brightest students in the College and University and are excellent representatives of Penn State. When corporations visit the College, Envoys act as ambassadors, hosts and tour guides. Corporate representatives eagerly listen as Envoys share their Penn State experience, the value of professional practice and the world-class engineering curriculum.

Envoy Caroline Monroe, a fifth-year senior chemical engineering major, traveled abroad to France for an internship in 2003. She worked for Sollac-Atlantique in Dunkirk, France, and says she had many positive experiences from her time working abroad. Monroe states her favorite part about the Envoys is being able to help calm the fears of younger students. “Internships, co-ops and the job market can be scary things, and it’s nice to know you can help,” she says.

—Melissa Frill
Staying the night

A Society of Women Engineers program lets high school girls take in the Penn State experience

open house. It’s a meet-and-greet for high school students and the College. Classes, tours and info sessions are all geared to help students get ready for the big transition next year. But for a group of high school girls, open house was the ultimate sleepover. Hosted by the Society of Women Engineers (SWE), these aspiring engineering students learned firsthand what it’s like to be an engineering student at Penn State.

Rachel Dutter, a sophomore chemical engineering major and member of SWE, coordinated this year’s stay-over event. “We hold it so the girls can get a feel of what it’s like to be a student at Penn State,” Dutter says.

Seventeen-year-old Deanna Jacoby from New Tripoli, Pa., says, “It’s a lot better experiencing it [college life] than just hearing about it.”

SWE sent out mailers to all girls accepted into the College inviting them to sign up for the stay over. Each high school student was then matched up with a college student who lives on campus. The high school girls arrived Thursday evening and stayed until Saturday morning. During the stay over, the girls spent most of their time together, attending game night, going to classes and enjoying meals together.

To get ready for the visit, hostesses attend a 30-minute info session and check with professors before bringing their guest to class.

For Krystle Carstens, 17, of Orefield, Pa., the stay over was a success. “I am a little less nervous now about coming to college. We definitely have an advantage over students who don’t have this chance,” she says.

More importantly, visiting high school students like Erica Carson, 18, of Mechanicsburg, Pa., learned that “coming to college may be hard, but they let you know you are capable and you can do it, and that’s encouraging.”

“Over the past couple of days, I’ve really felt like ‘mom’,” Dutter adds. Breanna Jordan, 17, of Telford, Pa., said coming to Penn State was a good idea, “it helped me learn a lot about the university, and I feel like we’ve become this little family … and that’s going to be a big help next year when we are freshman.”

—Melissa Frill
When we think about the essentials to the classroom, paper, pens and books come to mind. Perhaps a highlighter or some white out. But most will never have the vas deferens of a bull on special order or a biopsy needle used in surgery or a special sheathing used in endoscopic procedures. For the students of Mary Frecker’s mechanical engineering class, these special items are the essentials for the classroom.

Mechanical Design Systems ME 415 is a senior design course for mechanical engineering majors that gives students a first-hand look at what their future worlds may have in store for them. Frecker teaches a “special-emphasis” section of ME 415 focused on medical device design, where the project sponsors include physicians from Hershey Medical Center and other area hospitals.

Frecker, associate professor of mechanical engineering, explains that students who sign up for her section “do so because of their interest in engineering applications in the medical profession.” Tamara Cohen (ME ’06) says she was “excited this section was offered, because this is exactly what I want to do.” Frecker’s students worked on everything from the creation of a new concept for vasectomy procedures as well as improving the equipment used in endoscopic surgery and creating a more economical solution to producing wheelchair lifts.

Each group of students teams up with a medical professional through the Learning Factory. The Learning Factory works to bring industry sponsors and the College together, giving students the opportunity to work with real-world challenges. What sets Frecker’s students apart from the rest is their passion for the medical profession.
Armand Daigle, a senior mechanical engineering major, Danielle Bishop (ME ’06), Jennifer Donatelli (ME ’06) and Dan Toth (ME ’06) worked closely with anesthesiologist Dr. Morteza Gharib of Altoona in the design of a new mechanical device used to hold a regional anesthesia needle. Gharib had a very specific plan in mind and wanted the anesthesia needle to remain steadily in place while allowing for adjustments as needed. Not only did Gharib want to free his hand from holding the needle, he also wanted to eliminate the need for a second person to hold the needle.

Toth, who was responsible for creating CAD drawings, machining and fabrication, said the success of the senior design experience really depends on how responsive the sponsor is. “We had an exceptional sponsor that interacted well with our team and provided a lot of great feedback,” he says.

Detail is of the utmost importance for students while working on their projects. As students began calculations for designing and building their prototype, they learned that even the smallest of variation could greatly upset their final outcomes. The team of Ben Frasch, mechanical engineering senior, Timothy Crede, mechanical engineering senior, John Brossman (ME ’06), and Cohen worked to create a new mechanism to help lessen the surgical time for a vasectomy reversal. The group learned quickly that even the tiniest error in rounding could cause the mechanism to malfunction.

Each team of students must analyze all aspects of their project and experiment with a variety of possible solutions. Frasch, Crede, Brossman and Cohen’s team website explains how “a design matrix was used to choose a sealant ring design for the device from among four different variations.” By performing a variety of tests, the team ascertained that a sealant ring design was the best fit for their project.

Similarly, the team of Doug Harsch, a mechanical engineering senior, and 2006 mechanical engineering graduates Adam Scherba, Matt Smith and Steve Mergler used a design matrix when working to create a new device used to control an endoscope. The “BioLions” reviewed the results of their design matrix with sponsor Dr. Abraham Mathew of the Hershey Medical Center and chose to use “a ‘Finger Loop’ design where the sheath movement is controlled with the index finger,” as explained by their website.

While many teams worked to create or modify products used during medical procedures, some teams worked to better inventions that help disabled individuals go about everyday activities. 2006 mechanical engineering graduates
Eric Scherzberg, Richard Scherzberg, Frederick Schneider and Jeffery Yatsko worked with Kurt Weber of the Flinchbaugh Company, Inc., of York, Pa., to improve the platform assembly of a wheelchair lift.

Flinchbaugh was looking to not only improve the assembly of the lift, but also to decrease costs in the process. This team of students was able to help do just that. By studying the capability of less expensive materials in a modified design, the group worked to meet the needs of Flinchbaugh. Yatsko explains that “designing a new safety apron is just one of the ways we worked to cut down on the overall cost of production.” Flinchbaugh has already incorporated the students’ design into their commercial wheelchair lift.

Every year students walk away confident that they’ve worked to make a difference. “All in all, I think this class is a solid foundation for getting out in the real world,” says Daigle.

Frecker is proud of her class for coming together within their teams and creating viable solutions for the medical industry. “It’s a great experience for the students,” she says. “By having the opportunity to work with individuals within the industry, students are much more equipped for their post-graduate plans.”

—Melissa Frill
From your president

It's hard to believe that more than ten years have passed since I graduated from Dear Old State. Since then I've been back to campus many times for football games, corporate recruiting and, of course, PSES activities. One of the most memorable trips though was last August when some of my friends and I returned to Penn State for a mini-reunion. Our group of eight turned into 23 with spouses and children. Luckily things are a bit slower in State College in the summer, making for a relaxing weekend!

The 15th Annual PSES Golf Classic is another opportunity to make some memories in State College. The tournament will be held Saturday, Sep. 29, at Toftrees. The proceeds add to an undergraduate engineering scholarship endowment. Even if you can't make it to the tournament, please consider securing a $100 hole sponsorship from your company.

In other PSES news, two teams of students participated in our 2nd Annual Rube Goldberg Machine Contest. The competition was held in February on the night before the College of Engineering Open House. The students showed off their creativity and engineering prowess by building machines that juiced an orange in twenty or more steps. Spectators included visiting high school students and parents.

Since this magazine has gone to a semi-annual format, information about alumni society activities will also be included in the Penn State Engineering Newswire. Create a free account and subscribe at: http://newswires.psu.edu.

For more information about the 2007 PSES Golf Classic or to get involved with any PSES activity, contact Cindy Jones at cjjdo@engr.psu.edu or 814-863-3384.
Alumni Question

The Alumni Question is a new ongoing feature in Engineering Penn State that lets graduates talk about their memories of the University.

This issue’s question: **Who was the toughest engineering professor you ever had and why?**

**By far, Joe Reed was the toughest engineering professor I ever had. In a hydrology course I had with him in 1964, the highest grade he gave was a ‘B.’ I would have had a perfect 4.0 that trimester except for the ‘B’ that I got in that course.**

—**Steve Yanoviak** (CE ’65), certified management consultant

**In chemical engineering in the 50s, it was no contest. The toughest professor was “Black Mike” Cannon. For him the result of the experimentation was not all that counted—the presentation was key. He treated every submission as if you were already in industry. Neatness, grammar, spelling and syntax were weighed evenly with engineering. Many a brilliant experimental result went for naught as the professor imparted to us that you can’t sell an idea or a result on science alone. I finally understood why we took all of those non-science courses.**

—**Stanford Jack Lieberman** (ChE ’56), of Brigantine, N.J.

**It was my junior year that I had to take a course called ME 112 Elements of Heat Power Engineering—basically applied thermodynamics. The professor was named Swigart, a retired admiral. The material in the course was about as far removed from my major as anything could be—entropy, enthalpy and steam tables! And on top of that, the admiral taught the class as if we were a bunch of midshipmen. It was a nightmarish term, but I managed to pull out an ‘A’—a miracle. As we were handing in our final exams and groaning loudly, the admiral said to the class—and I’ve never forgotten this—“Just remember men, when we pass each other on campus, I’ll be saying, ‘Same to you, jella.'”**

—**Larry Wennik** (EE ’63), principal, DeltaPro

**The toughest I encountered at Penn State was Dr. Lew, whose first name I have forgotten. He taught a basic structures course in aeronautical engineering in the early 1950s. In the first exam Dr. Lew gave us, he presented six problems with the instruction that we could work on any five. I did five without difficulty and had time to do the sixth, which I did. When the test was graded, I got all six correct. One of my classmates also did six, but had five correct. Dr. Lew reduced his grade because the sixth was done incorrectly. The classmate argued that since only five were required, he should get a 100 percent on the exam. Dr. Lew explained that if you choose to do six when only five are required, “I will grade you on all that you submitted.” He would not yield, and a valuable lesson was communicated to us. What seemed like a trivial issue over test grading had implications that stayed with me throughout my professional life. Every time I tackled a problem or project, I automatically knew that I would be judged on the entirety of my work, not just on meeting the defined specifications and deliverables. If I chose to work beyond the defined scope, it was my risk. I frequently did so as a means of improving products and generating sales, but was always aware of what I was doing.**

—**Edward Jedrziewski** (Aero ’53), retired senior vice president, Locus, Inc.

**Next Issue’s Question**

In which engineering class did you learn the most, and what did you take away from it?

Please send your responses to:

Jane Harris • 101 Hammond Building • University Park, PA 16802 • Re: Alumni question

E-mail: jharris@engr.psu.edu

Though there is no word limit on responses, we reserve the right to edit any responses we receive. With your submissions, please include your full name, address, telephone number, e-mail address (if applicable) and major with year of graduation.

**Alumni Notes has moved!**

Looking to see what your classmates are up to? Now you can find out faster by going online at www.engr.psu.edu/AlumniFriends. You can also submit your news through the site.
Penn State’s first woman engineer

While her female peers learned to properly set a table, Carrie McElwain learned to build roadways. While they practiced their lessons in labs that included stoves, ovens, ironing boards and cloth diapers, she preferred to tinker in a lab full of rocks, soil, and bridge load measurement tools.

McElwain was not a typical Penn State graduate. Though women had been attending college for decades before her, they tended to pursue “domestic economy,” enrolling in general curriculums or “ladies’ course” studies. McElwain blazed a new trail, breaking the barriers of women’s education to become the first woman graduate in engineering at Penn State in 1893.

Fast forward a century or so, and the educational path McElwain pioneered for women is much more smoothly paved. Penn State’s College of Engineering now boasts an enrollment of more than 1,000 female undergraduates and 280 master’s and doctoral candidates.

With all the measurement tools available to her, McElwain still may not have predicted the dimensions of the window of opportunity she opened. The benefits of women’s increasing interest in and entrance into engineering professions are remarkable.

For employers, females deepen the talent pool and lend a fresh perspective to design, problem-solving and management challenges. Women who pursue such careers enjoy more opportunities for creativity, independence, travel, a better salary and respect.

McElwain certainly chiseled away the first layer of resistance for women in engineering, and vast strides have been made since.

Barbara Bogue, professor of engineering science and mechanics and former director of Penn State’s Women in Engineering Program, notes, “Engineering is a great profession, and one that provides tremendous career flexibility. Graduates go on to be executives, entrepreneurs, teachers, doctors and, of course, really outstanding engineers.”

She might not have baked a cake or hosted a proper dinner party to celebrate it, but Carrie McElwain would surely be proud of today’s growing female population in engineering professions.

—Nancy English

Lucier wins World-Class Engineer award

Gregory Lucier (IE ‘86), president and CEO of Invitrogen Corp., was given the College’s 2006 World-Class Engineer Alumni Award in September.

Established by the Leonard Center for the Enhancement of Engineering Education advisory board in 2005, the award is intended to honor the achievements of a Penn State engineering graduate in the early or middle part of their career.

Winners embody the traits of the “World-Class Engineer,” including being aware of the world, solidly grounded, technically broad, versatile and effective in team operations and leadership roles.

Lucier also holds an MBA from Harvard University.

Before joining Invitrogen, he was president and CEO of GE Medical Systems Information Technologies from 2000 to 2003.

A Norristown, Pa., native, Lucier serves on numerous boards, including the Biotechnology Industry Organization, the Burnham Institute of Medical Research and the E.O. Wilson Biodiversity Foundation.
The Campaign for Penn State Students

We in the College strive to educate students who will become World-Class Engineers. Our education involves developing the solid technical foundations for students and helping them to learn to think creatively in the context of the world, to understand professional ethics, and to develop teamwork, communications and life-long learning skills. These are all traits that are highly valued by industry as well as by graduate programs.

Increasingly, our students’ education is influenced by finances. Students who need financial aid receive a combination of scholarships, loans and work study wages, with a significant fraction of aid devoted to loans and work study. The average student who receives financial aid from the University graduates with a debt load of $23,500.

Studies of student finances by the University have led President Spanier to identify student scholarship support as the highest priority in the new Penn State campaign.

The campaign began quietly on Jan. 1 with the theme: “For the Future: The Campaign for Penn State Students.” The campaign will extend for a number of years and will become public in a few years. However, throughout the campaign the highest priority will be increasing scholarship aid for students.

Each year student scholarships are derived from funds that are designated by alumni, friends, industry and other organizations for student support. These funds generally are provided on a year-by-year basis such as through the annual alumni fund. Also, significant funds in the College result from endowed scholarships, which provide funds directly from earnings on the endowment each year.

In the campaign, two endowed scholarship programs will receive special emphasis. Trustee Matching Scholarships, in which a donor’s endowed gift is matched by the University, and Honors Scholarships, which are designed to support engineering students in the Schreyer Honors Program. Both of these programs will complement traditional endowed scholarship programs and the annual gifts designated for scholarship support.

As the campaign continues to evolve, significant effort will be devoted by the College in response to President Spanier’s priority. In the past, we have found many alumni and friends who have reflected on their experiences at Penn State and fully understand the value of a Penn State education and the need to support students so they may receive an engineering education.

We very much look forward to your continued support and encouragement as we enter into this “Campaign for Penn State Students.”
House of straw

As part of an honors course, students built a strawbale house on the HUB Lawn in late October to raise awareness of alternative housing options. Over the past few years, Penn State students have gone to Montana to build strawbale homes for the Northern Cheyenne tribe as part of the American Indian Housing Initiative.