Fragile Foundations

Our aging cities need more than shoring up. A forward-thinking Hopkins team aims to fundamentally reframe our approach to 21st-century infrastructure.
The devastation caused by the earthquake in Haiti is greater than most of us can comprehend. At the Whiting School, our hearts go out to the people of Haiti and all of those who have been touched by this terrible event. The destruction and suffering we see in the news coverage and in the first-hand accounts we’re receiving from teams of Johns Hopkins health care and disaster relief workers assisting with recovery efforts have inspired relief efforts here on the Homewood campus as well.

As a civil engineer, one element I find most heart-wrenching is how recovery efforts have been thwarted by Haiti’s collapsed infrastructure. Without working transportation, communications, water, and power systems, the delivery of assistance has become almost impossible. I know all too well that these same systems in the United States are also in need of an overhaul.

Much of the national discourse on infrastructure in the U.S. centers on the realization that without strategic investments, our nation’s safety and our economy are at risk. In “Fragile Foundations,” p. 12, writer Mike Field explores the ways Whiting School faculty and alumni are contributing to this conversation and are offering solutions to these problems.

In a similar vein, my ability to make strategic investments in the Whiting School is one of my most important responsibilities as dean. In order to accomplish this task—that of essentially predicting the future—I rely on the collective knowledge of the school’s leadership, including administration, faculty, alumni, and our advisory councils. Thanks to their vision and guidance, while the nation inches toward economic recovery, we are emerging from the economic downturn in a position of terrific strength. Every possible gauge indicates that we’ve invested wisely and that Hopkins Engineering is thriving.

On the research front, our 2006 investment to launch the Institute for NanoBioTechnology has proven fruitful. In addition to numerous research breakthroughs made at the INBT, the National Cancer Institute recently awarded the institute $14.8 million to launch the Johns Hopkins Engineering in Oncology Center (see p. 3). Our faculty received 22 American Recovery and Reinvestment Act grants in 2009, and WSE doubled its revenues generated through intellectual property.

Enrollments, across the board, are stronger than ever. This year’s undergraduate applicant pool is the largest in Johns Hopkins history, and our admissions numbers continue to increase at a pace far exceeding that of our peers. This year we received a record-breaking number of early decision applications to the Homewood Schools, and an additional 6,000-plus students are now competing for admission to WSE’s Class of 2014. Full-time graduate applications are also rising and enrollments in our Engineering for Professionals programs are on the upswing, thanks in large part to the investments we’ve made in our online offerings and corporate partnerships.

Fortunately, during the six years I have served as dean, building security, planning for the future, and optimizing resources have been the school’s priorities. And this, I am convinced, is why we are doing so well today—and why I am so excited about the future.

Best wishes,

Nicholas P. Jones
Benjamin T. Rome Dean, Whiting School of Engineering
FROM THE DEAN

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Dissecting the Language of Surgery

To analyze the spoken word, linguists break human utterances into their smallest components: phonemes. Computer science professor Gregory Hager uses the word “dexeme” to describe the building blocks of the complex process he investigates: the series of movements a surgeon employs in the operating theater. “They’re simple, one- or two-joint motions,” says the director of the Computational Interaction and Robotics Laboratory, “the roll of a wrist to push in a needle or the straight-line movement to pull a suture.”

In a project dubbed “The Language of Surgery,” Hager collaborates with a multidisciplinary team of 20 scientists, clinicians, and students from six departments and three divisions across Johns Hopkins, including fellow engineering faculty Sanjeev Khudanpur, Rene Vidal, and Rajesh Kumar, and researchers David Yuh and Grace Chen from the School of Medicine. Together, they investigate the elegant motions of expert surgeons, track the learning curve of accomplished surgeons acquiring new techniques, and analyze the relatively inexpert movements of doctors in training. “Someone who isn’t skilled makes mistakes—mispronounces, if you will,” says Hager, noting that the team intends to deploy its findings to improve both surgeon education and patient outcomes. “We’re trying to understand what it means to mispronounce in the technical realm.”

Linguists rely on voice recordings to make such judgments. Hager and his team will rely on real-time data from training exercises and actual minimally invasive surgeries performed with the da Vinci Surgical System. Seated at a console outfitted with a stereo video display and two master arms, a surgeon remotely manipulates the da Vinci surgical tools and endoscope to perform minimally invasive procedures—such as prostatectomies and heart valve repairs—in which the relative bulk and limited range of motion of the human wrist would demand larger incisions than the robot requires.

“Once you have the human attached to the robot performing surgery, not only does the device allow them to perform surgery, but we can record exactly what the surgeon did,” says Hager, whose team garnered permission to record both video and motion data from da Vinci systems at teaching hospitals across the country. “This is the first time in history, if you want to be grand about it, where we can get thousands of hours of human motion data on a relatively narrow and well-defined set of manipulation tasks.”

Using data from suturing, dissecting, and tissue-joining activities performed with da Vinci, the team has developed computer algorithms to distinguish the grammatical structure underlying each task. In the process, they have documented the eerie similarity in the movements of experts (side-by-side footage reveals nearly synchronized gestures), and have refined the algorithms to distinguish stylistic embellishments—such as an extra needle adjustment habitually inserted in the tightening of a suture—from basic motions. And because the da Vinci recordings include training sessions for both accomplished surgeons new to the robot and relatively unskilled surgical residents inexpert both at the task and the computer-aided technique, findings also include preliminary information on the skill acquisition patterns of experts and novices. Analyses of those patterns could prove vital to contemporary training programs for surgical residents—instruction more important than ever now that medical residents are limited in how many hours they may spend in the hospital each week.

“Surgery is still taught the way it was more than 100 years ago,” says Hager, quoting the founding chief of surgery at Hopkins Hospital, William Halsted: “See one, do one, teach one.” With greater understanding of how experts move and the gestures that correspond to optimal healing, Hager and his team hope to do Halsted one better by enhancing the training process. “Ultimately,” he says, “what matters is patient outcomes.”

—Sharon Tregaskis
When the Institute for NanoBioTechnology (INBT) was launched in 2006, the institute’s directors noted that its formation marked a dramatic change in the way research would be pursued at the School of Engineering and at Johns Hopkins. At the INBT, complex medical problems would be addressed by a vast array of engineers, scientists, and clinicians from Johns Hopkins’ schools of Engineering, Medicine, Public Health, and Arts and Sciences, who, working in groups, would draw upon their widely ranging skills and expertise in pursuit of common goals.

This fall, the success of this multidisciplinary approach was given wide recognition when the National Cancer Institute awarded the INBT a $14.8 million grant to launch a new interdisciplinary research center: the Johns Hopkins Engineering in Oncology Center at INBT. Aimed at unraveling the physical underpinnings of the growth and spread of cancer, the center is one of 12 Physical Sciences–Oncology Centers being launched by the National Cancer Institute (NCI) as part of a five-year initiative to bring a new cadre of theoretical physicists, mathematicians, chemists, and engineers to the study of cancer.

Denis Wirtz, the Theophilus A. Smoot Professor of Chemical and Biomolecular Engineering and associate director of the INBT, is the new center’s director and principal investigator, and Gregg L. Semenza, a leading researcher at the School of Medicine, is associate director. The new cancer center also includes 11 Johns Hopkins researchers affiliated with the INBT and four from partner institutions.

“The breadth of expertise that Johns Hopkins has to offer is unparalleled,” says Dean Nick Jones. “This funding is a testament to the value of interdisciplinary research and is recognition that creative, collaborative problem solving that we value at the Whiting School is what is needed to tackle the most complex medical issues of our time.” Jones also commended the vision of the INBT leaders in establishing the institute and expressed pleasure at the terrific return on the strategic investment directed to INBT by the four sponsoring schools.

During the five-year initiative, the NCI’s Physical Sciences–Oncology Centers will take new, nontraditional approaches to cancer research by studying the physical laws and principles of cancer; evolution and evolutionary theory of cancer; information coding, decoding, transfer, and translation in cancer; and ways to de-convolute cancer’s complexity.

When the funding for the new cancer centers was announced, John E. Niederhuber, director of the NCI, said, “Physical scientists think in terms of time, space, pressure, heat, and evolution in ways that we hope will lead to new understandings of the multitude of forces that govern cancer, and with that understanding, we hope to develop new and innovative methods of arresting tumor growth and metastasis.”

In an interview with the Johns Hopkins Gazette, Wirtz explained, “Metastasis is a highly coordinated, multistep process. Cancer cells break free from a primary tumor, penetrate into the bloodstream, evade host defenses, stick to the interior walls of blood vessels, and travel to other organs, where they set up new cancer cell colonies. During this cascade of events, tumor cells push on and are pushed by mechanical forces within their microenvironment. Cells translate those mechanical forces into biochemical signals that affect cell growth and function. If we can gain a better understanding of this process, we may find new and better ways to treat cancer.”

Wirtz, working with Greg D. Longmore, a cancer cell biologist at Washington University in St. Louis, will study the physical basis for cancer cell adhesion and de-adhesion and how it increases the likelihood that cancer cells will break free, move into the bloodstream, and migrate to other tissues.

Semenza and Sharon Gerecht, an assistant professor of chemical and biomolecular engineering, will lead another of the center’s three key research areas. Their goal is to de-convolute cancer’s complexity, transfer those mechanical forces into biochemical signals that affect cell growth and function. If we can gain a better understanding of this process, we may find new and better ways to treat cancer.

Konstantinos Konstantopoulos, professor and chair of WSE’s Department of Chemical and Biomolecular Engineering, and Martin L. Pomper, from the Department of Radiology at the School of Medicine and the Kimmel Cancer Center, will lead the third key research area, investigating the effects of fluid mechanical forces at different oxygen tension microenvironments on tumor cell signaling, adhesion, and migration.
Stem Cells in Sutures Enhance Healing

A team of Whiting School biomedical engineering students has demonstrated a practical way to embed a patient’s own adult stem cells in the surgical thread that doctors use to repair serious orthopedic injuries such as ruptured tendons. The goal: to enhance healing and reduce the likelihood of re-injury without changing the surgical procedure itself.

The 10 undergraduates, whose work was sponsored by Bioactive Surgical Inc., a Maryland medical technology company, won first place in the 2009 Design Day competition conducted by the Department of Biomedical Engineering’s Center for Bioengineering Innovation and Design (CBID). In collaboration with orthopedic physicians, the students have begun testing the stem cell–bearing sutures in an animal model, paving the way for possible human trials within about five years.

“Using sutures that carry stems cells to the injury site will not change the way surgeons repair the injury,” says team leader Matt Rubashkin ’10, “but we believe the stem cells will significantly speed up and improve the healing process. And because the stem cells will come from the patient, there should be no rejection problems.”

Bioactive Surgical developed the patent-pending concept for a new way to embed stem cells in sutures during the surgical process. The company then enlisted the student team to assemble and test a prototype to demonstrate that the concept was sound.

The students located a machine that could weave surgical thread in a way that would ensure the most effective delivery and long-term survival of the stem cells and conducted some aspects of the animal testing, although orthopedic physicians performed the surgical procedures. The students also prepared grant applications, seeking funding for additional testing of the technology, in collaboration with Bioactive Surgical.

“The students did a phenomenal job,” says Bioactive CEO Richard H. Spedden. Agrees Lew Schon, a Johns Hopkins foot and ankle surgeon and one of the inventors of the technology, “They have probably cut at least a year off of the development time of this technology, and they are definitely advancing the science in this emerging area.”

As envisioned by the company and the students, a doctor would withdraw bone marrow containing stem cells from a patient’s hip while the patient was under anesthesia. The stem cells would then be embedded in the novel suture through a quick and easily performed proprietary process. The surgeon would then stitch together the ruptured Achilles tendon or other injury in the conventional manner but using the sutures embedded with stem cells.

At the site of the injury, the stem cells are expected to reduce inflammation and release growth factor proteins that speed up the healing, enhancing the prospects for a full recovery and reducing the likelihood of re-injury. The team’s preliminary experiments in an animal model have yielded promising results, indicating that the stem cells attached to the sutures can survive the surgical process and retain the ability to turn into replacement tissue, such as tendon or cartilage.

That could be good news for the 46,000 people in the United States who undergo Achilles tendon repair surgery every year. The operation and subsequent therapy costs are about $40,000 per case, the students said. “After surgery, the recovery process can take up to a year. In about 20 percent of the cases, the surgery fails, and another operation is needed,” says Rubashkin. “Anything we can do to speed up the healing and lower the failure rate and the additional medical costs could make a big difference.”

Along with Rubashkin, undergraduate members of the stem cell suture design team were David Attarzadeh ’10, Raghav Badrinath ’10, Kristie Charoen ’10, Stephanie D’Souza ’12, Hayley Osen ’09, Frank Qin ’12, Avik Som ’12, Steven Su ’12, and Lawrence Wei ’09.

—Phil Sneideman
Lloyd Minor Named Provost

Lloyd Minor, a 16-year member of the faculty at Johns Hopkins School of Medicine and most recently director of the Department of Otolaryngology—Head and Neck Surgery, became the university’s 13th provost and senior vice president for academic affairs on September 1, 2009.

As chief academic officer, the provost is the second-ranking member of the senior administration and coordinates and promotes the university’s research and education initiatives. “At Johns Hopkins, we have uniformity of values,” says Minor. “If each of us sets the goal of excellence beyond our current status, and pursues that excellence with integrity, then Johns Hopkins University will not only be the pre-eminent research university in America but will achieve outstanding new advances in each of our divisions.”

Minor, who was recruited to Hopkins in 1993, holds the Andelot Professorship in Laryngology and Otology and has joint appointments in the departments of Biomedical Engineering and Neuroscience. He is known internationally for his work on the physiological processes that mediate sensing and controlling motion.

Minor succeeds Kristina Johnson, a member of the Whiting School’s faculty who had been provost since 2007; she left to serve in the Obama administration as undersecretary of the Department of Energy. After Johnson’s departure, Scott L. Zeger, vice provost for research and a professor in the Bloomberg School of Public Health, served as interim provost.

Master of 500 Hats

Software developer. Startup advisor. Blogger. Angel investor. Internet marketing guru. Since graduating from the Whiting School in 1988 with a BS in mathematical sciences, Dave McClure has filled each of these roles—sometimes simultaneously—in Silicon Valley. Ask him to pinpoint a common thread that runs through his lengthy career in the high-tech mecca’s ever-evolving information technology industry, and McClure responds matter-of-factly: change.

A self-described “master of 500 hats” (also the name of his blog), McClure has never been satisfied with the status quo. When he entered Hopkins as a freshman, he was just 16 years old. “I was bored in high school,” McClure says, but he is quick to add that when he reached college he had a lot more to learn than he realized.

Shortly after graduation McClure headed west, where he’s been pursuing his entrepreneurial dreams ever since. He cut his teeth as a consultant with Microsoft, where he helped develop a production system used by Intel’s manufacturing facilities worldwide. In 1994, he started an Internet and eCommerce consulting company, Aslan Computing. The basement-born company quickly grew to a 20-employee business, and in 1997 won Microsoft’s Solution Provider of the Year award for Northern California. After Aslan Computing was acquired by Servinet Consulting Group, McClure rode out the rest of the 1990s primarily as an advisor and consultant to various tech-based companies.

McClure didn’t merely survive the dot-com bust of the ’90s. His experience during those tumultuous times landed him premier positions between 2001 and 2005 with PayPal and SimplyHired, where he executed marketing, branding, and product strategy. He credits working in these environments—surrounded by professionals he describes as bright, geeky, and entrepreneurial-minded—with his next career move.

Having found his own niche in Silicon Valley, McClure now helps others make their entrepreneurial dreams come true.

As an advisor and investor, he’s been involved in more than 40 early-stage startups in Silicon Valley since 2004, including Mint.com, a personal finance startup recently acquired by Intuit for $170M.

As a guest lecturer at Stanford University in 2007, McClure taught the nation’s first-ever course on Facebook application development. The students caught on better than expected: Collectively, they developed applications that generated more than $1 million in advertising revenue. One team even raised venture capital.

Most recently, he’s become active in the StartupVisa.com movement, a grass-roots initiative to change U.S. immigration policy and make it easier for foreign-born students and entrepreneurs to start U.S. businesses.

“I’m having a blast,” says McClure. “If I can make a significant difference in whether startups are able to get capital or turn a profit and get to the next level, that’s incredibly rewarding.”

—Elizabeth Heubeck
Under the Sea

Sarah Webster has come a long way since “Marco Polo” meant a swimming pool full of shrieking children. Back then, echolocation was merely the pretext for a game. Today, the mechanical engineering PhD candidate uses underwater acoustic modems, applying the concept to guide robotic underwater vehicles during surveys of the ocean floor and then back to a ship on the surface. There, scientists await the data collected by the crafts—known as autonomous underwater vehicles (AUVs)—which they use to map the ocean floor, document the discovery of new species, and investigate ocean chemistry in their search for insights to global climate change.

“We need a way to accurately know where the vehicle is in order to make the data useful to the scientists, and so we can return to a site of interest,” says Webster. Because global positioning system signals don’t travel through water, Webster’s work relies on acoustics, instead. “Historically you have several acoustic beacons at known locations and the vehicle sends out a ping, ‘Marco,’” she says, “and the beacons respond, ‘Polo.’” Measuring the elapsed time of that call and response, engineers can triangulate the exact position of the AUV and, over time, its trajectory.

Since she came to Hopkins in September 2004, Webster has worked with her advisor, Professor Louis Whitcomb, and University of Michigan ocean engineer Ryan Eustice to develop techniques to replace multiple beacons on the sea floor with a single beacon mounted on the surface ship; they’ve also introduced modems to transmit rich packets of data containing time and depth information to replace the simple tone signals used in previous decades. Together, their innovations reduce mission costs and allow for the use of multiple underwater vehicles to cover broader territories at sea. While Webster has traveled to both the Atlantic and Pacific, she is grateful that much of the testing happens in the Hydrodynamics Testing Facility in Whitcomb’s Krieger Hall laboratory. Says Webster: “It’s climate-controlled, you can go get a coffee, and come in on the weekend.”

Last May, Webster and Whitcomb departed Guam on a 14-day expedition with two dozen other engineers and scientists from the University of Hawaii, the Woods Hole Oceanographic Institute, and the University of Sydney—as well as a camera crew from the Discovery Channel—aboard the research vessel Kilo Moana. On June 2, as the Kilo Moana hovered nearly 7 miles above the Mariana Trench, Nereus, a hybrid remotely operated vehicle, reached Challenger Deep, the deepest place in the world. The historic 26-hour dive included 10 hours of data collection and a 16-hour round-trip voyage. In addition to providing a live video broadcast back to the ship during the dive, Nereus returned to the surface with samples of rocks, sediments, volcanic fluids, and the life forms that thrive where the Pacific Plate slides below the Mariana Plate—all clues in the quest to understand the dynamic relationship between biological and geological processes.

“The immediate big win is data in real time from a vehicle 10 kilometers below the surface,” says Webster, who was at the control desk for launch and ascent. During all of the dives to the Mariana Trench, the vehicle was connected to the ship by a tiny fiber-optic microcable, which was cut by the vehicle before its ascent. To rejoin Nereus and the Kilo Moana on the surface—without crashing the $8 million craft into the ship or losing it at sea—the scientists relied solely on acoustic data transmissions to estimate Nereus’ position in the water column.

While the mission included eight dives, only one ascent proved truly nerve-racking. When the modem on the ship stopped receiving detailed data packets, the team was limited to using simple sound signals to calculate the horizontal distance between the craft and the ship. A senior scientist from Woods Hole, an expert in earlier navigation techniques, stepped up, and Webster stationed herself at his elbow. “I just ‘went to navigation school,’” she says of the impromptu lesson. “I can imagine putting that to use later on and maybe surprising future grad students who have never seen the old-fashioned, low-tech version.” —ST
High Altitude Attitude

At 34, Reid Wiseman, MS ’06, has had more medical tests than a roomful of senior citizens—and this is the way NASA likes it. In order to be accepted into the 2009 astronaut candidate class, he had to pass every known inspection of the human body: CT scan, bone scan, brain scan, MRI, ultrasounds of his entire body (to make sure his organs are in the right places); he saw images of his heart valves and the buildup on his arteries; he had 22 vials of blood drawn. But Wiseman checked out—last August he began training at the Johnson Space Flight Center (JSC), and he’ll be with NASA for the next 15 or 20 years.

Educated as a systems engineer (at Rensselaer Polytechnic Institute and through the Whiting School’s Engineering for Professionals program) and trained by the Navy as a test pilot, Wiseman will spend about 18 months preparing for an assignment on the International Space Station. Continuously staffed for the last nine years, the football field–sized space station serves as an international research headquarters located in the Earth’s orbit and maintained by astronauts from Russia, the U.S., Canada, and Japan, who live on the station for up to six months at a time.

The plan is for Wiseman to complete candidate training in May 2011. But first he has to master a few things. He’s studying every aspect of the operation of manned space systems—how to make repairs, what parts and tools to use, and what to do if a part breaks. “If you need another part and it’s not up there, you have to invent a way to fix it,” he says. He and his classmates—there are nine in all—practice working in pressure suits and will train in the world’s biggest pool, located at JSC, simulating weightlessness. They are studying robotics, as well.

Because about half of the station’s staff is Russian, Wiseman’s class will learn the Russian language throughout their training at JSC. “When the space shuttle is retired [in a year or two], the only ride to the space station will be on Russian rockets,” he says.

Alumni Making News

Crystal Ball

Q. What does the future hold for detection and treatment of brain tumors?

A. Jin U. Kang, professor and chair of the Department of Electrical and Computer Engineering in the Whiting School of Engineering

“We are developing a high-tech tool that would allow for a ‘virtual biopsy.’ Brain surgeons will be able to locate and get a clear look at cancerous tissue—in some cases eliminating the need to cut into the brain for a traditional biopsy, which poses risks for patients. The idea is to provide instant high-resolution pictures of internal cellular structures of a small segment of the brain without actually touching the tissue. These pictures would let the surgeon see where the tumor is and whether it is benign or malignant. And when it’s time to cut out the cancer, these images could help a surgeon see and avoid healthy tissue.

“Our team has been collaborating with leading surgeons at Johns Hopkins Medicine. Their feedback has been very encouraging. They’ve told us that the technology should allow them to better distinguish between a tumor and the critical tissue structures around it that are so important to avoid, such as blood vessels and nerves.

“The tool is innovative and cost-effective. It works by employing ultra-thin optical fiber, the material used in long-distance communication systems, to direct harmless, low-powered laser light onto the area the surgeon wants to examine. When the light strikes the tissue, most of it bounces away in a scattered, incoherent manner. But, by means of a technique called optical coherence tomography, the small portion of light that is scattered back can be collected and used to construct a high-resolution three-dimensional picture of the tissue, down to the cellular level. These images are significantly sharper than those produced by MRI or ultrasound equipment, and should give surgeons a better look at the boundaries of a tumor and the presence of blood vessels and healthy tissue that must be preserved. Compared to the older, widely used imaging systems, the new technology is much less expensive, perhaps in the order of tens of thousands of dollars.

“Thanks to recent funding from the federal stimulus package, I’ve been able to move ahead with developing the technology for the high-tech surgical instrument that will make these virtual biopsies one step closer. The funding will enable us to begin testing in animals and human cadavers, and I’m hopeful that human patient trials could begin within five years.”
A New Start for an Old School

“Am I foremost a scientist or an engineer?” That was the question of the hour at Hopkins in the early 1960s, when an influential group of engineering faculty answered “scientist” and a faculty vote effectively made the School of Engineering disappear.

The beginning of the end came in 1961 when the school, founded in 1913, changed its name to the School of Engineering Sciences—“to insure that Hopkins will continue to produce engineers who are truly educated and creative individuals, not merely cogs in an increasingly complex industrial machine,” in the words of Hopkins President Milton S. Eisenhower.

“This was a period during which Americans’ attitudes toward science were changing. One result of Sputnik and the Cold War was that engineering as a discipline became less favored and the pendulum swung toward science,” observes the Whiting School’s Benjamin T. Rome Dean, Nick Jones. He notes that in 1961, Yale’s School of Engineering became the Department of Engineering and Applied Science within Yale College.

In 1966, the engineering school at Hopkins took an even bolder step and voted to merge the School of Engineering Sciences with the School of Philosophy to create a School of Arts and Sciences. The intent: a move away from the “practical” aspects of engineering instruction and toward the fundamentals of the field.

Although some had strong misgivings (particularly alumni), the arrangement appeared to work, at least initially. But by the mid-1970s, student enrollment in engineering courses began to wane at an alarming rate. The number of engineering faculty had dropped nearly in half, down to 44 at one point. Many believed that engineering had lost its way.

In reaction to the growing expressions of unease, in 1976 then university President Steven Muller appointed eight engineers and scientists to a blue-ribbon committee on engineering. The committee agreed that Johns Hopkins needed to re-establish a separate school of engineering.

George Owen, dean of the School of Arts Sciences and a nuclear physicist with a degree in mechanical engineering, argued that engineering needed its own home. “Engineers, like doctors, live in the present,” he said. “We live in a technological age, and the university must be involved with the present.”

The university trustees established an ad hoc committee to address funding issues and the new school’s organization. Willard Hackerman ’38, a trustee and president of the Whiting-Turner Contracting Company, chaired the committee, which also included trustees Herschel L. Seder ’39 and F. Pierce Linaweaver ’55, ’65 PhD.

Charles R. Westgate, a professor of electrical engineering who chaired the faculty committee for the school’s re-establishment, says that nearly all of the momentum originated with the trustees. “Willard Hackerman in particular had a very big influence. He was concerned, like others were, about the drop in enrollment and the [faculty] layoffs,” says Westgate, now a professor emeritus in the Department of Electrical and Computer Engineering. “He thought that engineering here had become quite vulnerable.”

Hackerman helped secure a gift from the estate of George William Carlyle Whiting, co-founder of Whiting-Turner, which made the new school a reality and the board voted approval of its re-establishment in spring 1978. In the search for the inaugural dean, Muller looked inward and tapped David VandeLinde, an energetic young professor of electrical engineering. VandeLinde, only 35 at the time, says that Muller told him he wanted a school that would be “uniquely Hopkins.”

VandeLinde likes to joke that he started with just an office, a filing cabinet, and a secretary. Clearly, he had a formidable task ahead: Recruit new faculty, reorganize and establish new departments, refurbish laborato-
Modeling Behavior in Nanomaterials

When it comes to technology, smaller is better. And as iPods shrink to the size of postage stamps, there’s a need to understand how different materials such as metals and silicon behave and react on a tiny scale. That’s where Michael Falk comes in. The associate professor of materials science and engineering uses computer simulation to examine materials behaviors on the nanometer scale—as tiny as 1/100th of the radius of a needle’s tip.

Using a simplified mathematical model of the material, a computer simulates what is going on inside a material as it performs its function, undergoes some stress, or is being processed into its final form. The simulation provides a moment-by-moment look at what happens to the atoms on a microscopic level during a reaction. This allows engineers to predict how a material is going to behave and change over time.

One of Falk’s projects is looking at structural applications for a group of materials called “metallic glasses.” These materials might be used to make precision medical instruments, for example. Unlike other metals, their atoms are not arranged in an ordered way. “There’s not a lot understood about why they behave the way they do, and the fact that they’re glasses as opposed to crystals makes it harder to interrogate their structure experimentally,” says Falk. “So the simulations have been something of a breakthrough because they’ve provided a way to look into the structure of these disordered materials even though our experimental techniques are limited.”

Other projects of Falk’s include simulations of an atomic force microscope to understand friction in an oxidized semiconductor material on the nanometer scale, and simulations involving lithium ion batteries. “You can apply this modeling to a whole range of different kinds of materials,” says Falk. “We just have to come up with a mathematical description of the material and then we can apply some of the same techniques whether we’re looking at an atomic force microscope, or a metal being pulled, or at some reaction.”

Falk is particularly interested in extending molecular dynamics simulation to longer time scales. Currently, such simulations are limited to times shorter than a microsecond. “So if you wanted to look at something that took a millisecond, you’re out of luck,” says Falk. He and his students are working on techniques to look at slower processes.

In Falk’s view, theory, simulation, and experimental work go hand in hand. The model helps generate the question, so experiments can provide the answer. “The idea is if we can do these simulations and they show something interesting, then we can come up with a theory that gives the experimentalist some jumping-off point.”

—Abigail Green

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A Scorch of a Summer in 1946

The “From the Archives” story in your summer 2009 issue about returning veterans attending JHU on the GI Bill rekindled many memories from these days.

What was attractive for many of us trying to restart our lives was the program offered by JHU Engineering—starting a freshman class in February 1946, with the stipulation that the second semester be condensed into an eight-week summer session so we could start the sophomore year in September 1946 and graduate with a BE in 1949.

There were no shortcuts in that summer semester. We completed 16 credit hours in eight weeks. We attended classes or labs 32 hours each week. General chemistry alone required six hours in class and 12 hours of lab work.

That summer of ’46 was a scorcher. Some mornings it was 90 degrees F at 8 a.m. and kept getting hotter. Humidity was in the 90s as well. Imagine three hours in a chemistry lab with Bunsen burners going full blast and no air conditioning. I’m sure the instructors were no happier than the students about this.

But we were glad to graduate in 1949, a year earlier than had we started in Fall 1946. In 1949 it was somewhat easier to find a job than in 1950.

On a personal note, while pursuing an engineering degree at JHU, I met a wonderful girl and persuaded her to marry me. The wedding took place on June 4, 1949, one day after my last final exam and 10 days before graduation. Nancy and I are still happily married, with four daughters, 10 grandchildren, and two great-grandchildren. What a country!

Paul B. Hessemer ’49
New Holland, PA

In “From the Archives” [Summer 2009], Keefer Stull ’49 was misidentified [in your photo caption]. It was a privilege to work as a technician with Keefer in the Advanced Development Group at Westinghouse in the late ’50s. He had radar receiver designs coming off of his desk at such a rate that it kept five of us busy full time building and testing the new hardware. He was an inspiration to those who worked closely with him.

Donald Neudecker ’61, ’68

The magazine regrets the error. —Ed.
Hope for Neglected Populations

For every research project that gets designed, funded, and executed, there are many more that do not receive the money needed to get off the ground—leaving important scientific questions unexamined.

With four degrees from Johns Hopkins under her belt, Rebecca Freeman Grais, BA ’95, MS ’97, MS ’99, PhD ’03, tackles the unexamined questions. Trained in engineering, microbiology, and immunology, Grais works in Paris at Epicentre. The nonprofit organization was established 22 years ago by Médecins Sans Frontières, also known as Doctors Without Borders, to ensure the quality of its field operations. She directs the epidemiology and population health division, a role that immerses her in clinical trials and field investigations that evaluate the health situations of populations in “complex emergencies” and “precarious contexts” such as war, displacement, natural disaster, extreme poverty, and refugee camps. These population-based studies research such topics as the effectiveness of vaccine coverage, the success of relief operations, the spread of infectious disease, and more.

Because MSF is entirely funded through private donations, Epicentre is able to conduct studies that wouldn’t receive funding through the usual channels. “Our research goals are to address subjects that academic institutes cannot necessarily address,” often for political reasons, says Grais.

Recently, Grais and colleagues have published studies that address disease and malnutrition in some African populations. One study, published in Journal of the American Medical Association, looked at the effect of ready-to-use foods (RTUF)—viscous liquids containing, among other things, milk powder, vegetable oil, peanuts, sugar, vitamins and minerals—on wasting in children in Niger. The research showed that short-term supplementation with RTUF reduced wasting in children older than 6 months. In September, the Lancet published a study, co-authored by Grais, which reviewed the efficacy of rotavirus vaccines in sub-Saharan Africa. The review showed that while the vaccines protect against the serotypes most common in Europe, North America, and Latin America, many of the strains circulating in sub-Saharan Africa are not targeted by the currently available vaccines.

Having completed her doctorate in the global spread of infectious disease through air travel, Grais has turned her academic training toward improving the health of what she feels are neglected populations. “We use all the same protocols and standards used by academic institutions,” says Grais. “But we have an ability to work in contexts that are quite difficult to work in. And we approach subjects where there’s very little interest or funding.”

—CG

New Faculty

The Department of Materials Science and Engineering welcomed Assistant Professor Margarita Herrera-Alonso in January 2010. Herrera-Alonso received her PhD from the University of Massachusetts Amherst and was previously a postdoctoral scholar at Princeton University and at the Universidad Nacional Autonoma de Mexico. Herrera-Alonso’s research focuses on the use of functional polymers to tailor the surface properties of self-assembled constructs and to generate stimuli-responsive materials exhibiting novel properties.

Feilim Mac Gabhann, who received his PhD in biomedical engineering from Johns Hopkins in 2006, returned to Homewood this fall as an assistant professor of biomedical engineering in the Institute for Computational Medicine. His research focuses on experimental-computational approaches to generating novel therapeutic strategies to major human diseases, including cancer, peripheral artery disease, and HIV.

Professor Rajat Mittal joined the Department of Mechanical Engineering this fall. A world-renowned expert in areas that include computational fluid dynamics, turbomachinery flows, and biofluid dynamics, Mittal came to Johns Hopkins from George Washington University where he was a professor in the Department of Mechanical and Aerospace Engineering.

Sridevi V. Sarma, an assistant professor of biomedical engineering, joined the Institute for Computational Medicine this fall. A graduate of MIT, Sarma’s research interests include control of constrained and defective systems and large-scale optimization.

This fall, Youseph Yazdi was appointed director of WSE’s new Center for Bioengineering Innovation and Design (CBID) and assistant professor in the Department of Biomedical Engineering. Yazdi, who received his PhD from the University of Texas at Austin and is a fellow of the American Institute for Medical and Biological Engineering, served previously as corporate director in the Corporate Office of Science and Technology at Johnson & Johnson.
Corporate Connections

Opening Doors to Tomorrow’s Innovators

Charles Goldstein, MSE ’68, PhD, vice president of research and leader of Becton Dickinson (BD) Technologies, has enjoyed a long and illustrious career with the world-class organization.

But he’s never forgotten where his journey in engineering began. Throughout his professional career he’s worked hard to ensure that the door to research and leadership opportunities at BD remains open for Hopkins engineering students who succeed him.

Increasing interest in chemical biomolecular engineering among Hopkins students excites Goldstein, who serves on both the department Visiting Committee and the Whiting School National Advisory Council. “I’m encouraged, particularly by the uptick in enrollment of students designating Chemical and Biomolecular Engineering (ChemBE) as their major,” he says.

His support for the Whiting School doesn’t end with ChemBE. His relationship to the school has facilitated BD’s sponsorship of Biomedical Engineering (BME) Design Day for the past two years. The highly anticipated event represents the culmination of work by teams of BME students, who choose from among several real-world biomedical design projects and spend the year bringing them to fruition.

Last year, one of the project’s sponsors, Harry Silber, assistant professor of medicine at Johns Hopkins Heart and Vascular Institute, challenged a student team to develop a patient-friendly, industry-standard prototype for a noninvasive diagnostic device he had created to measure left ventricular end diastolic pressure (LVEDP). The condition is associated with fluid overload—one of the primary causes of hospital admission for heart failure exacerbation. Currently, catheterization is the gold standard for measuring LVEDP. But Silber’s device uses a finger pulse oximeter probe, commonly found in hospitals, to calculate a patient’s pulse amplitude ratio, a measure that correlates positively to LVEDP.

Five BME students, including Sung-Jim Nate Sunwoo, jumped at the challenge. “We were interested in determining how we could assess LVEDP noninvasively. The science of it intrigued us,” Sunwoo says.

The project proved to be a win-win. “The students gained an excellent understanding of the clinical need and underlying physiological concepts involved. I plan to incorporate their algorithms into future versions of the device,” says Silber.

Goldstein marvels at the collaborative spirit of today’s Whiting School students. “They are more actively working with each other; there’s a greater camaraderie than in the past,” he says. Such collaboration will prepare students well for professional opportunities, he believes, like the one BD just opened to Whiting School graduates with a PhD or MSE degree.

BD’s Technology Leadership Development Program invites applicants—graduates from select engineering schools—to apply to a highly selective program within BD. Participants are placed on an accelerated track, spending three consecutive two-year rotations in multiple businesses and locations within the company.

The rotations, which are custom-designed and guided by participants’ input, are created “to be fluid, flexible, and dynamic,” according to BD. Participants may rotate among different segments (BD Medical, BD Diagnostics, BD Biosciences) or focus in one area of expertise and rotate through different roles—such as research, product development, and project leadership—within a single business or product line.

Says Goldstein, “We’re preparing new graduates to become our next generation of leaders.”

—EH

The Franklin Institute in Philadelphia has announced that on April 29, 2010, research professor James West from the Department of Electrical and Computer Engineering, along with engineer Gerhard Sessler, from Darmstadt University of Technology, will receive the 2010 Benjamin Franklin Medal in Electrical Engineering.

West and Sessler are being honored for their invention of the electret microphone, a technology that revolutionized the field of sound recording and voice communication. The microphone, invented in 1962, is inexpensive to produce and is now found everywhere—including in cellular phones, computers, digital cameras, sound recorders, and hearing aids. At a cost of only 10 cents apiece to manufacture, more than 2 billion electret microphones are produced each year, representing 95 percent of microphones in use today.

In 2007, West and Sessler received the National Medal of Technology in recognition of this achievement. The Franklin Institute’s Awards Program has long been recognized as the oldest and most comprehensive science and technology honor bestowed in the country and around the world. Past honorees have included Albert Einstein, Marie and Pierre Curie, Thomas Edison, Jane Goodall, Orville Wright, and Stephen Hawking as well as Johns Hopkins engineers; the late Abel Wolman 1913, ’15, received the Franklin Medal in Engineering in 1968 and Professor Emeritus M. Gordon “Reds” Wolman ’49 received the Franklin Medal in Earth and Environmental Science in 2006.

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On a cold winter morning just two days before Christmas 2008, schoolteacher Sharon Schoem was on the road, driving through the moneyed and manicured suburbs of Montgomery County on her way to work. The Maryland county is ranked eighth wealthiest in the nation, and with nearly a third of the population over the age of 25 holding postgraduate degrees, it is the most highly educated as well. Clean streets, top-notch schools, and reliable municipal services are the expected norm in Montgomery County, so it was not without a sense of shock that Schoem suddenly found herself driving into a raging wall of water.
The road was fine and then all of a sudden, just a gush of water came along with boulders and parts of trees,” Schoem would later tell a local television news reporter. Beneath the county’s neat streets a 45-year-old, five-and-a-half-foot diameter water main had ruptured, sending 150,000 gallons a minute rushing down the street, trapping Schoem and more than a dozen other motorists. A wetsuit-clad rescuer was eventually able to pull Schoem from her car and get her to safety. Although no one was seriously injured, several people needed treatment for hypothermia from exposure to the cold water. That evening, TV viewers across the nation watched dramatic footage of four other motorists escaping from their cars by way of a rescue cage dropped from a Maryland State Police helicopter hovering high overhead, perilously close to the high voltage lines that run alongside the road.

Americans may have been startled by the images of fellow citizens escaping an infrastructure mishap run amuck—just as they were horrified by bloated bodies floating in flooded New Orleans streets, and crushed cars pulled from the Mississippi River after the Minneapolis I-35 bridge collapse—but the one thing they shouldn’t be, say experts, is surprised. “Our infrastructure is suffering from years of neglect and inadequate investment,” says Whiting School Dean Nick Jones, who holds an appointment in the Department of Civil Engineering. “In the area of drinking water in particular, our systems have been seriously neglected and are under tremendous pressure. Essentially we are living on borrowed time.”

Warning that “decades of underfunding and inattention have jeopardized the ability of our nation’s infrastructure to support our economy and facilitate our way of life,” the American Society of Civil Engineers (ASCE) released its biennial report card on the state of America’s infrastructure in 2009. The country earned a cumulative grade of D in areas ranging from traffic and mass transit, to aviation, rail, bridges, dams, levees, water and sewer, and electric energy supply.

According to the ASCE, the nation needs to make a $2.2 trillion infrastructure investment over the next five years to address current deficiencies, some of which carry potential consequences that make the outcome of a 66-inch water main break pale in comparison. Thousands of the nation’s dams, for instance, are rated structurally deficient, and no fewer than 1,800 of those are rated “high hazard” dams, meaning their catastrophic failure would result in significant loss of life. Nearly a third of America’s high hazard dams have not been inspected in the past five years, and only half have in place Emergency Action Plans for notifying and evacuating people residing below the dam in the event of a problem. The ASCE report lists similar deficiencies and dangers in almost every one of its 15 infrastructure categories.

Yet it may be a mistake to look only on the dark side of this challenge, suggests Erica Schoenberger, professor of geography and environmental engineering at the Whiting School. Schoenberger’s specialty is economic geography, which is the study of the location, distribution, and spatial organization of economic activities across nations and their change over time. She sees in the crisis of collapsing levees and falling bridges the seeds of something new. “During the New Deal and after World War II we built a ton of infrastructure,” she says of the nation’s civic building spree in the mid-20th century. “Now all this New Deal stuff—the post offices and roads, the bridges and dams and schools and so on—is all coming to the end of its life on the same day. There is a tremendous need to reinvest.”

— Erica Schoenberger, professor of geography and environmental engineering

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“It’s a huge burden. But it’s also a tremendous opportunity if we choose to look upon it that way.” What is most needed now, she says, is engineering that anticipates the needs of the 21st century. “If you are going to overhaul stuff that is about to fall apart, that is the perfect time to invest in future technologies,” she says.

Recognizing that a once-in-generations alignment of need, interest, and opportunity was at hand, a group of Johns Hopkins faculty led by civil engineering associate professor and department chair Ben Schafer, and principal investigator Ben Hobbs, of Geography and Environmental Engineering, has proposed a new center to study and remedy infrastructure systems under stress. The innovative and highly collaborative venture would fundamentally reframe how infrastructure is assessed, modeled, and inspected in the future.

“Around the time of the stimulus funding [the American Recovery and Reinvestment Act of 2009], I asked a group of faculty from across the school to sit down and talk about what Hopkins could do to help,” says Schafer, WSE’s Swirnow Family Faculty Scholar. He did not expect the enthusiasm of the response to his request elicited.

“It was a big surprise to find how willing people from many different disciplines were to engage with the infrastructure problem intellectually.” That enthusiasm, he suspects, is part of a larger awareness developing among non-engineers as well. The American public, he believes, recognizes the need to get serious about the infrastructure problem. “I think there is a window of time during which people are open to it. Five years ago if you said the word ‘infrastructure,’ by the time you got to the second syllable people were asleep.”

But systematic planning is extremely important. Although Gakenheimer began his academic career studying engineering science at Johns Hopkins, an interest in Spanish language and history led him to research and write about the early history of Latin American cities under the guidance of civil engineering professor Thomas Hubbard. That in turn led to a master’s degree in urban planning and an eventual PhD focused on the history of urban development and transportation in Latin America. After that, he says, “I joined the circus and became a city planner.”

In the years since, Gakenheimer has worked as a scholar of international development on projects ranging from metropolitan planning in Riyadh, Saudi Arabia, to transportation needs in San Miguel, El Salvador. Most recently he has been serving as chair of a United Nations-appointed committee charged with overseeing comprehensive planning for Makkah (known in the West as Mecca), Saudi Arabia, which once a year welcomes about 3 million pilgrims for the annual five-day Muslim hajj, bringing the faithful from all over the world together for shared rites.

“There are great opportunities and needs in infrastructure planning and development all over the world, but particularly in the developing countries,” he says. “These solutions need to be ‘green’—in transportation especially we are looking desperately for a transport system that uses a minimum of carbon fuel.” What is really needed, he believes, is systematic redesign of how cities are organized and how they operate. “For the most part cities grew up on an ad hoc basis, but some have been thought through better than others. Although the Romans were good at planning in advance, most other cultures have not. But systematic planning is extremely important to enable urban life to be more externally efficient.”

In the 21st century, he says, the developing world is both rapidly expanding and rapidly motorizing. In order to reduce greenhouse gas emissions, planners and government officials in cities everywhere will need to reduce the amount of travel people undertake, especially in personal vehicles. “I think much of this will be ‘reduce by inducing’—employing techniques like congestion pricing and improved land use to encourage greater efficiency,” he says. “I think we are seeing the beginning of a wide series of strident strategies that will be employed.”

— MF
The resulting $17 million, five-year grant proposal is now under second-round review at the National Science Foundation. If approved, the Mid-Atlantic Center for Infrastructure Robustness and Renewal (or MAC-IR2 as the grant proposal playfully suggests) will be based in the Whiting School at Johns Hopkins but will draw from across the university, as well as from Howard University, the University of Maryland, the Maryland Institute College of Art, Virginia Tech, the University of Sydney, Australia, and TU-Dresden, Germany.

Clearly, the needs for an integrated approach are manifold. Tom Stosur has been with the City of Baltimore for 22 years and since February 2009 has served as director of the Department of Planning, the office charged with developing the city’s overall capital budget based on a six-year projection of what the city needs to spend on infrastructure. Ask him for his “dream list” of what he’d like to do and he quickly rattles off the city’s needs: $2 billion for the schools, another $2 billion for water and sewer, perhaps $3 billion for cleaning up our waterways leading to the Bay, and a whopping $10 billion to $15 billion on transit—and that doesn’t include funds to finance necessary roadway, bridge, pedestrian, and bicycle networks. “A billion dollars doesn’t go very far today,” he says sadly.

Worldwide, an estimated 30 percent of treated drinking water is lost through leaks, breaks, and other shortcomings in water delivery systems. According to the American Society of Civil Engineers, the nation’s drinking water systems are not highly resilient and their present capabilities to prevent failure and properly maintain or reconstitute services are inadequate. In its 2009 Report Card for America’s Infrastructure, the U.S. drinking water systems received a grade of D-, along with a warning that the systems face “staggering public investment needs over the next 20 years.”

In a future in which clean water is expected to become increasingly scarce, the regular loss of nearly a third of treated water to leaks and pipe failures seems especially egregious. But what if water main breaks could be predicted in advance? Not only would this allow municipalities to greatly reduce costly emergency repairs (and the sometimes catastrophic consequences of major water main failures), it could also go a long way toward conserving an increasingly precious natural resource.

One project currently proposed through the Whiting School’s infrastructure center would focus on developing systems-level optimization methods for determining likely leak locations. The goal: to enable water utilities to perform preventive maintenance in advance of catastrophic failure. This would represent an enormous advance over current system maintenance practices. “People are still putting rods to the ground and putting their ears up to it to listen for leaks,” says Buddy Cleveland, senior vice president of Bentley Systems Inc. and chair of the Civil Engineering Visiting Committee. The Pennsylvania-based Bentley Systems is one of the leading providers of software for the design, construction, and operation of infrastructure systems and is a corporate partner in the infrastructure center proposal.

“If you can measure pressure and flow in various parts of a water delivery system, then you can apply genetic algorithms to predict where the leaks will be,” Cleveland says. “This represents the next step in information modeling, where we start to marry the digital sensors to the physical assets and begin to monitor how these things are performing in real time.”
Chief among the Planning Department’s responsibilities is keeping track of the condition and needs of the “traditional” infrastructure, consisting of the water and sewer system, the storm water system, the roads and transportation infrastructure, street lighting and stoplights, and the underground conduits that include fiber optics, gas, phone, and electric networks. Then there is the “green” infrastructure of the parks, city trees, and watershed; and the “systems” infrastructure of schools, recreation centers, trash collection centers, and landfill—all critical components of the quality of life in a major metropolitan area, and almost all owned, operated, and maintained by the city. “That’s our bread and butter,” he says, “to keep them functioning.” It is a task for which needs constantly outstrip resources. “The water and sewer system goes back more than 100 years, and in some cases there are not complete records of what’s down there,” Stosur says. “There are major investments that need to be made in the water and sewer systems, including the current consent decree with the EPA that requires us to invest $1.4 billion over eight to 10 years in upgrading the sewer system. There is so little funding compared to the need that the urgent stuff is generally all that gets done.”

Like Erica Schoenberger, Stosur believes that really smart engineering is the key to a better infrastructure future. “There is no magic bullet,” he says. “We have to keep renewing, and we have to learn how to spend money more smartly. Engineers are the key. Our greatest need is to integrate systems so that while you’re upgrading water and sewer lines you’re also fixing parks and planting trees—in other words, you want to maximize opportunities. It’s about learning to see the connections that can be made.”

But making those connections may be one of the biggest challenges facing any program of infrastructure renewal. “We’re at the moment of understanding that we’ve created systems that are much more complex and highly interrelated than we understood,” says Ben Schafer. “Every part is interconnected, so we are trying to figure out systems-level modeling as a way of thinking things through.” The trick is devising a useful model of decision making that not only makes the connections between interlocking opportunities but also finds a rational way of resolving conflicting and sometimes contradictory demands in an environment of limited resources. “You have to be able to answer the question, Is it worthwhile?” says Whiting School civil engineering professor Takeru Igusa. “The traditional cost/benefit analysis doesn’t work because it is too narrowly focused on specific inputs and outcomes. What we need to be able to measure is how these projects touch on the larger aspects of society as well.”

Hopkins, says Igusa, is uniquely equipped to integrate large and diverse variables into decision making through the development of MIND: the Meta-model for Infrastructure Needs and Decision-making. “MIND is a concept that we hope to develop here. It would be one part of a large collection of projects on infrastructure renewal, and serve to integrate most of these projects,” he says. For instance, one of the proposed projects would focus on developing new robotic sensors for electric transmission lines, another would develop strategies for deploying these sensors, and a third would work on predicting costs to society of service interruptions—all to determine the potential value of the sensing robots. The role of MIND would be to combine all this information to assess whether a municipality
should invest in such robotic sensors to better serve the public; researchers would employ both statistical and machine learning tools to create this assessment. “The output of MIND would go to the actual decision makers in the government as well as to the private infrastructure builders and operators,” explains Igusa. “Hopkins is well-positioned to develop MIND as well as many other related projects on infrastructure renewal because of our faculty expertise in these areas—things like robotics, utility markets, statistics, public health and policy—and because of our collaborative tradition, which is essential to this approach.”

One of the unique contributions the Whiting School can make to the national infrastructure renewal effort comes from this ability to create advanced models of uncertainty and apply them to fundamental issues like keeping the lights on. Recently, assistant professor of geography and environmental engineering Seth Guikema led a team that developed a computer model to predict power outages likely to occur from an approaching hurricane, indicating not only where the outages will occur but how many homes and businesses will be without electricity, and for how long. The model—described in an article published in the journal Risk Analysis—predicts the effects of future Gulf Coast hurricanes by analyzing data from five previous storms that ravaged the area: Dennis, Danny, Georges, Ivan, and Katrina. It is actually two different kinds of data sets combined to create one snapshot of the likely future outcome.

A detailed accounting of the electricity infrastructure (including location of poles, transformers, sub-stations, and other physical assets) is married to variable information unique to each storm, including wind speed, soil saturation, total precipitation, and related measurements. By running the numbers through a complex set of algorithms, Guikema’s team is able to make real-time predictions of where power losses will occur, an invaluable tool in enabling utilities to cost-effectively marshal cleanup and restoration resources.

Guikema’s research has immediate real-world applications—particularly if global warming scenarios predicting more frequent and more disruptive weather patterns hold true—and was funded in part by a Gulf Coast utility company to improve resource management. But the real challenge, says Guikema, is to integrate all interrelated infrastructure in one model. “What we want to be able to do is look at all interdependent systems during a disaster—power, cellular, water, cable, and landlines—to get an idea how really large-scale systems respond. Fundamentally this comes down to the question, How do we define and measure infrastructure? There is a lot of basic engineering research needed to figure out how these systems respond.”

The need for advanced and accurate predictive capabilities is becoming ever more acute as the infrastructure’s built environment ages and new system challenges arise from global climate change. Baltimore planning chief Tom Stosur worries about the prospect of a flooded downtown: “The big concern is what the rise in sea levels means for a coastal city like Baltimore. A rise of even a few inches makes a huge difference. If sea levels rise and storms pick up, suddenly the 100-year flood becomes the five-year flood. Storms are likely to have a huge impact but no one currently is doing control or planning for this. We are in a learning mode.” Climate change issues are trans-national, “Our challenge is to create metrics to judge and grade the systems we have in place, in order to eventually replace them with systems that are more efficient, flexible, and sustainable.”

—Ben Schafer, associate professor and chair of Civil Engineering
Although electricity demand in the U.S. has increased by about 25 percent since 1990, construction of transmission facilities during that same time decreased by nearly a third. Congested transmission paths leading to electricity bottlenecks are becoming increasingly prevalent, resulting in (among other things) an inability to take parts of the system offline for proper maintenance, thus increasing the likelihood of unplanned outages.

More transmission lines are urgently needed, but the question then becomes, where to put them? “If you build for just one vision of the future and something else happens, you find yourself having to adapt,” says the Whiting School’s Ben Hobbs, who holds the Theodore M. and Kay W. Schad Professorship in Environmental Management. He notes that the future of energy is notoriously difficult to predict. “There has been this long-held belief that alternate energy sources were going to come online, chiefly through solar power. But in the last 10 years it’s all been on-shore wind power. That wasn’t anticipated.”

Planning for an efficient electric grid system means being able to predict not only where demand will be greatest but also where the electricity will come from. But with greenhouse gas concerns, the fluid nature of use, and evolving electrical-generation technology, no one can be certain what exactly the future will bring. “What if people suddenly get stiff-necked about building wind turbines everywhere? What if we get a whole lot of electric vehicles on the road that need charging from the grid every night? If you misplace transmission lines you can perhaps even endanger the reliability of the system.”

One key advantage of combining theoretical and practical research in a center like the one proposed at Hopkins is that this combination would provide means of anticipating future needs. “When we look at the energy system over the next 30 years, probably the only thing we can count on is surprise,” Hobbs says. “What knits the vision for this center together is a sophisticated consideration of uncertainty. If we plan the infrastructure we need to consider the full range of possibilities and how we might permit ourselves some flexibility in the future.” — MF
Getting Their Hands Dirty

By Maria Blackburn
Photography by Will Kirk

It takes more than lectures and lab time to learn how to be an engineer. Just ask the students in the popular clubs below. From building ingenious structures out of spaghetti and marshmallows to repairing desperately needed medical equipment for disadvantaged countries, to creating an autonomous robotic helicopter, they’re getting real-world experience tackling important problems.
Simple Solutions to Saving Lives

Sometimes the solution to a big problem can be relatively small and simple. Take, for example, the defibrillator testers that members of the Johns Hopkins chapter of Engineering World Health are building as part of the group’s mission to deliver medical equipment and expertise to underserved nations.

The 4-by-3-inch rectangles of hard black plastic arrive in pieces, their LED lights, wires, and circuit boards in need of an hour’s worth of soldering and assembly. The completed testers are distributed to hospitals in a handful of developing nations including Honduras, Costa Rica, and Tanzania to assess the function of the lifesaving medical device used to treat cardiac patients. Though small, the devices, which aren’t widely available in these countries, can make a huge impact.

“These testers are really important because they can help save lives,” says Danielle Dorfman ’11, a biomedical engineering major and founding member of the group. “Here we are at Johns Hopkins, home to the best hospital in the country and in the world. We know we have the resources to make a difference in these hospitals and that’s just what we hope to do.”

EWH-JHU, which was founded in Spring 2008, plans to assemble at least 100 of the testers this year. But that’s not their only focus. Members are also working to establish a relationship with local hospitals so they can volunteer in the clinical engineering department fixing broken medical equipment. With that knowledge, the students hope to repair the broken medical equipment they’ve collected over the past year and send it to hospitals overseas. And the students just submitted a proposal for EWH’s national design competition to build a manually powered otoscope for use in developing countries where external power sources are inadequate and batteries are not in large supply. Otoscopes, which are used to look into the ears and diagnose ear infections, are not widely available in medical facilities in developing nations, where undetected chronic ear infections are a major cause of hearing impairment.

“In the United States we have all of the medical equipment we need, but it wouldn’t necessarily fit in the environments in the developing world,” explains Brian Keeley ’11, a biomedical engineering major who is president of the chapter. “It might be too technical, require too much power, or be too expensive. What we want to do is come up with a simpler design that’s cheaper to manufacture and easier to use.”

Although many of the group’s 30 members are biomedical engineering majors, their reasons for joining vary. Freshman Manjima Dhar says she wanted to see firsthand how engineering and medicine worked together. What drew Zachary Patterson ’13 was a desire to help people in need. “This is just a great opportunity to serve people who are so often neglected,” he says.

Engineering World Health members say they learn each day of another need for medical supplies and equipment overseas, which strengthens their resolve to help. Not too long ago, Rabia Karani ’13 had such an experience when she told her family about her work with the group. One of her uncles, who works in a hospital in Pakistan, was especially excited about Karani’s involvement in addressing health disparities and emailed her a short list of some basic items like centrifuges that his hospital lacks and desperately needs. She can’t wait to help.

“When you think of all of the luxuries we have in American hospitals that people don’t have elsewhere, it just really opens your eyes,” she says.
The Johns Hopkins Undergraduate Engineering Society
Connections That Stick

It’s called the “Tower of Power Half Hour” and the rules are simple: Take a box of spaghetti and two bags of large marshmallows. Then, working as part of a team of five, build the tallest free-standing structure you can in just 30 minutes. No glue, no scissors, no additional building materials are allowed. And if the tower collapses before a student judge can get an accurate measurement, you’re out.

When the Johns Hopkins Undergraduate Engineering Society (HUES) debuted the wacky, sticky contest in February 2008 as a kick-off event to Engineers Week, the group hoped to field 10 teams. They got 39. The winning structure measured five-plus feet, won its team of engineers a couple of $50 gift cards, and spawned what has now become a much-loved annual event. It also did something else: brought students—and even alumni—from across the Whiting School of Engineering together.

“It’s just fun to be part of something that brings people together who normally wouldn’t be together,” says Max Rich ’10, a biomedical engineering and math major. Rich is a founding member of the group and says the Tower of Power Half Hour will return to campus in February for its third year. “You can take the time to get away from classes. You don’t have to stress out about it. Anytime that you get to interact with your peers and work on solving problems with an interdisciplinary perspective is just great.”

There is no dearth of clubs for undergraduates at the Whiting School of Engineering. But what struck Lee Ouyang ’10 not long after he arrived on campus was that many of the clubs were aimed at particular majors or areas of study. “Some of us thought the groups on campus were a little too narrow,” says Ouyang, who founded HUES in 2007 and is co-president with Stephen Reilly ’10. “We just wanted to bring people together to learn about engineering and have fun doing engineering projects.”

HUES member Julie Fogarty ’10, a civil engineering major, joined the group as a sophomore. “Once you move into upper-level courses specific to your major, it’s easy to get disconnected from the engineering community as a whole,” says Fogarty. “While the administration attempts to foster interdepartmental interaction through the Whiting School semester picnics and Engineers Week in the spring, HUES specifically targets students through competitions and community service to make an engineering student’s experience at Hopkins more well-rounded and enjoyable.”

The group, which has 300 students on its mailing list, isn’t just about fun and games (although the Engineering Carnival the group sponsored last year with other Whiting School student groups was a big hit). The group works closely with the Career Center to help promote workshops and job opportunities to specific engineering majors. There’s an annual day of service. And HUES is hoping to sponsor its first Undergraduate Research Conference in the spring semester. “There’s so much engineering research being done at Hopkins,” Ouyang says. “We just wanted to showcase some of the work and highlight projects that might not be far enough along to be accepted by a large conference.”
Johns Hopkins Robotics Team
Creativity Unleashed

Andrew Rohland ’12 always assumed there would be an undergraduate robotics team at Johns Hopkins. After all, the university is home to one of the premier robotics and computer sensing research groups in the world. And Rohland, whose Southern Maryland high school’s robotics team made it to the national finals in the Georgia Dome, figured there would be lots of like-minded students at the Whiting School of Engineering—classmates who enjoyed the challenge of working together to build and program robots and compete against teams from other schools for cash prizes and bragging rights.

But when he arrived on campus in Fall 2008, the mechanical engineering major learned that the university hadn’t had a robotics team in years. So he decided to start one. “Robotics gives students practice for ‘real world’ engineering and hopefully might even bring professors and undergraduates together for research opportunities,” says Rohland ’12. “I think a lot of students at Hopkins want to be in an extracurricular activity that is related to their field of study and more companies are looking for that as well.”

Rohland was surprised when 40 students who share his love for robotics joined the new team this fall. Faculty advisor and computer science professor Gregory Hager was surprised, too, but also pleased since he knows the experience allows undergraduates to draw on their knowledge of mechanical and electrical engineering, computer science, math, and physics and gain valuable experience. “The hands-on experience students get in the Robotics Team is as different from what they do in class as doing a thesis is from doing homework,” Hager says. “They get creative opportunities to collaborate and pool what they know to develop a complete system, then see it in action.”

On a recent evening, team members met in the Laboratory for Computational Sensing and Robotics to work on designs for two of the three competitions they plan to participate in this year. One group, led by Venkatesh Srinivas ’09, deliberated over the number of thrusters to buy for their entry for an Autonomous Underwater Vehicle competition sponsored by AUVSI (Association for Unmanned Vehicle Systems International). Their vehicle must perform a series of tasks underwater and the more thrusters they use, the easier the submarine will be to control. Despite having only $1,000 in their budget at the moment, the group decided to buy three thrusters, increase their fundraising, and cut back on their future pizza ordering. “Participating in these competitions is fun because you get to play with stuff that you hear about but you don’t understand until you actually do it,” Srinivas says.

Meanwhile, freshman Sinan Ozdemir led the second group in designing an entry for the AUVSI International Aerial Robotics Competition (IARC). Their task: To create a fully autonomous helicopter that can navigate a building, drop the flash drive it is carrying and pick up another, and avoid detection by laser trip wires. Their secret weapon? Sonar. “We’re not sure anyone has ever used sonar before,” says Ozdemir, a computer science major. “It’s a really cool idea that will get everyone’s attention. Even if we don’t win, people will remember it.”

Rohland is already thinking beyond the competitions, however. “It would be neat to have a robotic tour guide at Hopkins,” he says. “I know we could do it.”
Ndubuisi Ekekwe, PhD ’09, refuses to stand by and watch his homeland miss the train on technological innovation.
The lecture hall at the University of Agriculture in western Nigeria was packed, with people leaning in through open windows. All were eager to hear Ndubuisi “Nd” Ekekwe speak. His talk on microtechnology, robotics, and Africa’s need to invest in technology diffusion is one he had given numerous times during his three-month visit to his homeland last spring. But on that sunny afternoon, he was wholly unprepared for the standing-room-only crowd. “I was really touched,” recalled Ekekwe, 36. “I wasn’t coming to give them a gift. I was just coming to talk. It was very emotional for me.”

Ekekwe, who earned his PhD in electrical and computer engineering from the Whiting School last March, made the trip in his role as president of the African Institution of Technology (AFRIT), a nonprofit he founded in 2005. The organization’s goal is straightforward: to move African technology forward into microelectronics and nanotechnology, “to create value and not merely consume technology,” he says. To do that, he’s tapping the expertise and passion of his fellow Africans who are living and studying abroad.

“For many years, Africa has been slow to the development of the most pervasive industry of our time—the semiconductor,” notes Ekekwe. “The major challenge has been the human capital to drive the industry. We must support technological innovation for the continent to survive the intense competition of the 21st century.”

Growing up in the rural village of Ovim, Nigeria, young Ekekwe would see poverty all around him and ask teachers why so few families had running water or electricity. The answer he was given—“I was told there was an engineering gap,” he recalls—would have satisfied most children. For Ekekwe, though, it only led to more questions. “I decided then to become an engineer to help my community,” he says. When he first saw photographs of robotics in a high school textbook, they were nothing short of science fiction to him and his classmates. But they served to inspire his interest in electrical engineering. “I knew it was the pathway to take me to robotics.”

Ekekwe is well on his way to realizing his boyhood dream of an accomplished career in robotics. He has two patents pending for motion sensors used to control medical robots, and in December, a book based on his doctoral thesis, *Adaptive Application—Specific Instrumentation and Control Microsystems*, was published by LAP Publishing. He’s also happily ensconced professionally, as part of the technical design team for Analog Devices in Cambridge, Massachusetts, where he and his colleagues develop next-generation sensors for satellites, computers, robotics, and car airbags.

But he hasn’t forgotten his childhood home, and the questions he posed as a boy still drive him. “In Africa, the problem is that electrical engineering is not being taught,” he says. “The students want to learn, but there might not be the resources or even electricity in the school. In Africa, there are so many things to be done right. Why can’t we get things right?”

After graduating from Nigeria’s Federal University of Technology, Ekekwe spent three years in technical support at Diamond Bank, one of the only career options in his country for electrical engineering graduates. “The only technology that engineers know in Africa is IT and importing technology from the West,” he explains. “I didn’t want to support technological products. I wanted to create technology, so I started asking more questions about how to do that.”

The answers led to Tuskegee University, where Ekekwe earned a master’s degree in electrical engineering on a full scholarship. Next stop, Johns Hopkins. In 2004, he received an Engineering Research Center Fellowship to study robotics at the Whiting School of Engineering. Three years later, he was awarded the Jay D. Samstag Engineering Fellowship, established through a gift from Samstag ’60.

It was during his years at Hopkins that Ekekwe founded AFRIT (originally named NeoCircuit), his first step toward his goal of a technology-rich Africa. After completing his PhD last spring, and before joining Analog in Massachusetts, he returned to Africa for several months on behalf of the nonprofit. He visited...
15 universities in Nigeria and Nairobi, Kenya, to lecture to engineering professors and students, met with small- and medium-sized companies, and lobbied government officials. All told, Ekekwe reached upward of 8,000 people. Plans are well under way for his next AFRIT trips in 2010 to Mali, Egypt, and Cameroon, where AFRIT will host a Microelectronics Summer School with Germany’s Afrisciences.

Thoughtful and eloquent, Ekekwe pours forth passion with each word. While his vision for what could be drove him to found AFRIT, it is his training as an engineer that helped Ekekwe create an efficient and cost-effective system to accomplish his mission—a system built on the volunteer efforts of fellow countrymen. “The African students who study [engineering] abroad discover that our continent is not doing well,” he explains. “We’ve created a conduit for people to return and help. They already have the passion, and the problems are obvious.”

Thus far, AFRIT has hand-picked 45 engineers with expertise in semiconductor-related areas—who are working in the United States, Canada, Great Britain, Germany, and Sweden—to function as a consortium or “brain trust.” When a member of the consortium is traveling to his or her native African country, Ekekwe reviews the person’s vita and his ever-growing list of African universities and organizations interested in AFRIT’s services. Acting as matchmaker, he arranges for the visiting engineer to conduct a free workshop or seminar. Because AFRIT consortium members pay for their own travel and volunteer their time as speakers and consultants, Ekekwe is able to keep costs very low.

“AFRIT is so effective because of the man behind it,” says Chinyeaka Christian Ekenedu, an electrical engineering PhD candidate at Concordia University College of Alberta, who was a high school classmate of Ekekwe’s. “Ndubuisi believes that Africa is a great continent, and [that its] resources in microelectronics and nanotechnology are still untapped. He has the right tool to transform his words to actions. He is well-educated, humane, articulate, and very intelligent. Beyond all these, Ndubuisi is a good man, who is honest and full of ideas and creativity.”

Ekenedu has co-authored two papers with Ekekwe on behalf of AFRIT, including “Challenges and Innovations in Microelectronics Education in Developing Nations,” which Ekenedu presented at the IEEE 2007 International Conference on Microelectronics Systems Education in San Diego.

Schools and small businesses that turn to AFRIT for help can find it in a variety of ways. The nonprofit assists African undergraduate engineering programs with course development and trains African professors, students, and businesspeople to use CAD tools and software and to program robotics (advocating for free software from U.S. companies). AFRIT also collects used lab equipment and books to send to Africa. At Ekekwe’s undergraduate alma mater in Nigeria, AFRIT has founded three awards for the best senior projects in the Department of Electrical and Electronics Engineering.
Ekekwe delivered the 15th Public Lecture at the Federal University of Technology, Owerri.
Fund Allows Students to Showcase Ingenuity

One may end up saving lives. The other appears purely whimsical to the untrained eye. The third offers a unique, never-before-seen perspective of seemingly unrelated projects comprise the culmination of a year’s worth of intensive work by three teams of engineering students. Their common ground? Each was funded by a 2009 Student Initiatives Grant.

The fund, established in 2006 by Dean Nick Jones and supported by gifts from alumni and friends, gives students seed money to pursue the projects of their dreams. Carl Liggo ‘96, MS ‘00, PhD ‘01, has been a staunch supporter of the fund since October 2006 when, as a Society of Engineering Alumni (SEA) Council executive board member, he first learned of the grant. Every year since, he’s given generously to projects that inspire pride and pleasure.

This year is no different.

The muse for Ryan Chang’s project came from a little girl in a Taiwanese hospital. While spending the summer of 2008 shadowing a physician at Taipei Veterans General Hospital, Chang ‘11 watched the young patient undergo a painful procedure to determine if she had acid reflux, a symptom of gastroesophageal reflux disease (GERD)—a common condition affecting more than 45 million Americans annually that, when left untreated, can cause complications that increase the risk of esophageal cancer.

Chang watched as the wire catheter was placed into the patient’s nose and, finally, after eight tries, descended past her throat to reach her esophagus, where the device was lodged for 48 hours to measure her pH levels. Upon witnessing the invasive and painful process, Chang asked himself: “How could I make it easier for these patients?”

He wasted no time finding an answer. He decided to design a new painless and patient-centered method of diagnosing GERD. He obtained sponsorship for his project from biomedical engineering professor Lawrence Schramm and gathered a team of fellow biomedical engineering students: Solomon Liu ‘11, Ping He ‘11, Robert Romano ‘11, Charles Wang ‘11, and Alice Wu ‘11.

Beginning in September 2008, the team worked to develop Chang’s vision. Summer internships at various points on the globe—from San Francisco to Taiwan—didn’t slow the team’s momentum; they held twice-a-week conferences via the Internet and, in the interim, worked independently. Their efforts culminated in a diagnostic tool consisting of a capsule just two centimeters long and 0.5 centimeters in diameter that, when swallowed by a patient, “catches” in the esophagus and reads the patient’s pH levels, which are then recorded by a wireless, hand-held device.

The novel technology, which noninvasively fixes a pill in the digestive tract for upward of 24 hours, has attracted interest from medical experts within the Johns Hopkins Hospital community. “We are continuously working with physicians to ensure our product fits patients’ needs,” Chang says.

Chang is preparing to apply for a provisional patent through the university’s technology transfer office, the first step toward making their non-invasive diagnostic GERD tool consumer-ready. Eventually, Chang envisions designing applications for iPhones or other personalized hand-held devices so patients could monitor their reflux levels at will. “Right now, only about 300,000 people test for gastric reflux, mainly because it’s painful and demobilizing. This type of preventive medicine technology would help patients take care of it early,” Chang says.

The goal of another student project is aimed at creating robotics competition opportunities for years to come. Computer science major Evan Chin ‘10 and his team members received a $3,200 grant to purchase a “game-in-a-box,” plus several radio-operated robotics kits, thereby launching a Johns Hopkins Undergraduate Engineering Society VEX Competition, which Chin hopes will become an annual event.

Once constructed, the robots—guided by student competitors armed with wireless remote controls—face off in a race to see which robots can get balls into PVC pipes first. When the competition is over, each team deconstructs its robots and surrenders them to the engineering department, ready for use for the next year’s competitors.

A third grant-funded project, spearheaded by civil engineering major Conor Kevit ‘09 and his student team, was led this year by computer science major Eli Sutton ‘10. They’ve undertaken the ambitious endeavor of creating a virtual representation of the entire Homewood campus.

Behind this labor-intensive project, dubbed Virtual JHU Gigapixel Panoramas, is new large-scale photographic technology known as gigapixel imaging that allows the user to capture about 200 pictures within a matter of minutes with a digital camera. The catch? A robotic camera accessory called the Gigapan, which facilitates high-speed, high-resolution pictures of up to a billion pixels. Sutton explains the effect. “Say you’re at a lacrosse game, where you have thousands of people in the stands. Zoomed out they’re just dots. When you zoom in you can see the expressions of people’s faces. It’s amazing,” he says.

Together, the team designed its own version of the Gigapan robotic camera platform. It boasts a sturdy design that reduces vibrations—resulting in less camera shaking and faster shooting—and the ability to handle a digital camera with a long-range telescopic lens. “Now, we’re refining it to take faster images,” Sutton says.

“I started out working as a computer scientist on the project, then I moved toward designing the mount, and now I’m involved in the managerial aspect of it,” says Sutton. He figures that in the past year, he’s gotten as much experience as he would working full time for five years at a startup company.

—Elizabeth Heubeck

If you would like to support the Student Initiatives Fund, contact Kelly Turner at engineering@jhu.edu or (410) 516-8723.
A “Hero” of Public Health Earns Lasker Award

New York City Mayor Michael R. Bloomberg ’64 has been honored with the Mary Woodard Lasker Public Service Award, which recognizes those who either support research or who lead public health and advocacy programs “of major importance.”

Bloomberg, who is former chair of the Johns Hopkins Board of Trustees, and a generous supporter of the university, including the School of Engineering, received the award “for employing sound science in political decision making; setting a world standard for the public’s health as an impetus for government action; leading the way to reduce the scourge of tobacco use; and advancing public health through enlightened philanthropy,” according to the Lasker Foundation.

“To many of us, [Michael Bloomberg] is a shining example of an enlightened elected official. To those of us who care about the health of populations, he is a hero.”

—Michael Klag

Bloomberg School Dean Michael Klag offered his congratulations at the announcement of the award, noting, “To many of us, around the world. His passion for and dedication to the cause of a healthier future for all the world’s citizens led to the renaming of what is now the Johns Hopkins Bloomberg School of Public Health.”

Bloomberg has also worked to combat gun violence. From 2000 to 2008, the total number of murders in New York City declined by approximately 20 percent. Much of the reduction in homicides has been attributed to policing methods that have made it riskier to illegally carry concealed weapons. He also founded Mayors Against Illegal Guns, which now includes 400 mayors representing over 56 million Americans.

Faculty Scholars Program Honors Exceptional Faculty

To support some of the Whiting School’s most talented researchers and teachers, the Faculty Scholars program was initiated in 2006. Funded through generous gifts, faculty members hold a prestigious, named Faculty Scholar appointment for a three-year term, and receive financial support to promote innovative research, teaching activities, and entrepreneurial thinking. To date, six alumni have established Faculty Scholar funds.

**William R. Brody Faculty Scholar**
*Holder: Natalia Trayanova, Biomedical Engineering*
*Established by: Robert A. Seder ’81 (A&S), University Trustee, and Deborah L. Harmon ’81 (A&S)*

**L. Gordon Croft Investment Management Faculty Scholar**
*Holder: Jonah Erlebacher, Materials Science and Engineering*
*Established by: L. Gordon Croft ’56*

**Gilbert Decker Faculty Scholar**
*Holder: Allison Okamura, Mechanical Engineering*
*Established by: Gilbert F. Decker ’58*

**Masson-Agarwal Faculty Scholar**
*Holder: Konstantinos Konstantopoulos, Chemical and Biomolecular Engineering*
*Established by: Vinod K. Agarwal ’77*

**Louis M. Sardella Faculty Scholar**
*Holder: Louis Whitcomb, Mechanical Engineering*
*Established by: Louis M. Sardella ’69*

**Swirnow Family Faculty Scholar**
*Holder: Benjamin Schafer, Civil Engineering*
*Established by: Rachel M. & Richard A. Swirnow ’55*
On Thursday, October 22, Dean Nick Jones hosted the first annual Whiting School Fellowship Dinner in Levering Hall on the Homewood campus. There were more than 50 graduate students, alumni, faculty, and friends in attendance to celebrate the generosity of those who fund fellowships and the talented students who receive them. During the program two students, Elizabeth Reilly and Craig Rosenblum, spoke about the role of philanthropic support in their research, studies, and overall experience at Johns Hopkins.

The keynote speaker for the evening was Walter Robb, a former GE executive, active venture capitalist, and longtime friend of the Whiting School.

In 2002, Robb established a fellowship challenge in which he matched alumni gifts to establish fellowships. Lou Brown ’65 and his wife, Wendy, were among the first to respond to Robb’s fellowship challenge and know well the role of philanthropy and leadership in the success of the school. At the conclusion of the dinner, Dean Jones announced that the Browns had made a leadership gift to launch a new fellowship challenge. The Lou and Wendy Brown Fellowship Challenge will fund several first-year graduate fellowships. Like Walt Robb’s gift before, this gift will help support graduate students, and bring many alumni and friends closer to the school.

Said Brown, “My wife, Wendy, and I established our fellowship to provide assistance to young, dynamic researchers as they pursue excellence at the Whiting School. Now is an exciting time in the field of engineering in general, and at the Whiting School in particular, and we are thrilled to support the school and its students in this way.”

Engineering for Professionals Advisory Council

“The EP Advisory Council provides us an outside perspective that can be very important in improving the program,” says Allan Bjerkaas, associate dean of Engineering for Professionals. “According to the charter of the council, its purpose is ‘to support EP in its efforts to maintain the high quality and professional relevancy of its degree programs by providing an external perspective on the assessment of ongoing efforts and the evaluation of future initiatives.’ The council has helped us improve our IT infrastructure, has provided good advice as we have introduced new academic programs, and has been instrumental in building a stronger relationship between EP and Development and Alumni Relations.”

Council members, who are professionals in industry, government, and education, meet twice a year.

**Advisory Council Members**

*Nelson Baker*, Vice Provost, Georgia Tech Global Learning Center, Distance Learning and Professional Education

*Edward Borbely*, Director, University of Michigan, Center for Professional Development, College of Engineering

*Robert Cardwell ’85*, Vice President, Middleware Technology, Red Hat, Inc.

*John Fischer*, Director of Laboratory Programs, Office of the Secretary of Defense/Office of the Director, Defense Research and Engineering

*Chris Horne*, Vice President, Lockheed Martin, Engineering, Technology and Operations

*William Irby*, MS ’00, Vice President, Northrop Grumman

*David Jourdan*, MS ’84, President, Nauticos

*Robyn Kravit*, CEO, Tethys Research LLC

*Kelly Miller*, Chief Systems Engineer, National Security Agency/Central Security Service

*Anne Schelle*, Partner, Acta Wireless

**Whiting School Fellowship Dinner**

The Lou and Wendy Brown Fellowship Challenge

*Wendy and Lou Brown ’65 endowed the The Louis M. Brown Engineering Fellowship in 2004. This past year they established a challenge to fund 16 first-year graduate fellowships.*

*Elizabeth P. Reilly, Carl E. Heath Fellow, Applied Mathematics and Statistics*

*Craig M. Rosenblum, John W. and Mary Lou Ross Fellow, Materials Science and Engineering*
Five Students Honored by Siebel Foundation

This fall, the California-based Siebel Foundation selected five Johns Hopkins students from the Whiting School of Engineering and the School of Medicine as recipients of its annual Siebel Scholars awards, which provide $35,000 to each student to be used for the final year of graduate studies. The Johns Hopkins recipients are among 80 students from prominent graduate schools in the United States and China to be designated as the Class of 2010 Siebel Scholars.

The program was launched in 2000 to recognize exceptional students at the world’s leading graduate schools of business and computer science. With the Class of 2010, it expanded to include some of the world’s leading bioengineering programs. Siebel Scholars are chosen by the deans of their respective schools on the basis of outstanding academic achievement and demonstrated qualities of leadership. Siebel Scholars also serve as key advisers to the foundation, guiding the development of innovative programs that it initiates.

“It’s an honor to be selected from among the top bioengineering programs and to offer five of our outstanding graduate students entry into a vibrant community of exceptionally talented future leaders,” said Nick Jones, the Benjamin T. Rome Dean of the Whiting School. “The Siebel Scholars program will expand our students’ opportunities for entrepreneurship and collaboration, which are themes already integral to our program.”

In addition to receiving the $35,000 awards, the new scholars will convene with alumni of the program and with renowned scientists, lawmakers, and other experts in Spring 2010 to address the topic of climate change.

The Johns Hopkins graduate students selected as 2010 Siebel Scholars in the bioengineering category are:

• **Vasudev Bailey**, who is pursuing his doctorate in biomedical engineering. Under the supervision of Tza-Huei “Jeff” Wang, an associate professor of mechanical engineering and of oncology professors Stephen Baylin and James Herman of the School of Medicine, he has been working on highly sensitive nanotechnology methods for early detection of cancer.

• **Noy Bassik**, who is concurrently pursuing a medical degree and a doctorate in chemical and biomolecular engineering. Under the supervision of David Gracias, an associate professor of chemical and biomolecular engineering, he has been developing miniaturized bioengineering devices, including surgical microtools triggered by enzymes.

• **Raymond Cheong**, who is concurrently pursuing a medical degree and a doctorate in biomedical engineering. Under the supervision of Andre Levchenko, an associate professor of biomedical engineering, he has used a blend of computational modeling and experimentation to study inflammation and has developed a novel microfluidic device for high-content cell screening.

• **Sarah Hemminger**, who is pursuing her doctorate in biomedical engineering. Under the supervision of Reza Shadmehr, a professor of biomedical engineering and of neuroscience, she has made important discoveries concerning motor memory and the neural basis of skill learning. Shadmehr also praised Hemminger for applying her neuroscience knowledge to the Incentive Mentoring Program, which she founded to help failing students in a high school near the East Baltimore campus.

• **Shawn Lim**, who is pursuing her doctorate in biomedical engineering. Under the supervision of Hai-Quan Mao, an associate professor of materials science and engineering, she has been developing biomaterials to influence the development of stem cells in ways that could facilitate regeneration in the nervous system.

—Phil Sneiderman
Final Exam

“I want to go for ‘cool,’ but relatively easy as I’m not great at building stuff,” said biomedical engineering major Ammu Irivinti ’10 to her partner, freshman Amanda Ross. It was early October and the students were discussing the final project for Archimedes’ Lever: How Engineers Move the World, a one-credit engineering course that debuted this fall, thanks to the generosity of John Holmes ’52. For the assignment, pairs of students would build musical instruments on which to play an assigned five-note tune, both as a solo performance and in a round.

On a December morning when the class gathered in Maryland Hall with their completed instruments, the students’ creativity and construction skills were put to the test. Irivinti and Ross’ copper pipe flute passed the sound check with flying colors, as did the flute made from an eggshell and a drinking straw, the shoebox and rubber-band guitar, and the drums constructed from painted PVC pipes.

“Students come here wanting to study engineering, but I’m concerned they don’t really know what it means to be an engineer,” says Ed Scheinerman who, in addition to creating and teaching the class, is the Whiting School’s vice dean for education and a professor of applied mathematics and statistics. “I want them to ‘think big’ about engineering,” Scheinerman says. “I want them to understand that engineering is a force that moves the world and prepare them for leadership in the engineering profession and society.”

The class, named after the second-century B.C. mathematician, inventor, scientist, physicist, and astronomer who first explained the principle of the lever, boasted a roster of visiting scholars whose expertise was as diverse as Archimedes’. For example, “Engineers must know how to communicate,” says Scheinerman. And that is the reason why, on an evening in early October, Caroline Bleggi ’11 stood before her class in Maryland Hall and read one of Shakespeare’s sonnets to Hopkins alumnus John Astin ’52 (A&S).

Astin, a visiting professor of theater (who portrayed Gomez Addams on the 1960s television show The Addams Family), explained to the class, “I’m going to help you talk. You’ll find that life is a lot easier if you’re able to express yourself, if you can use the words you have.” “This is so scary,” Bleggi said before launching into, “Shall I compare thee to a Summer’s day?” When she finished Astin smiled and said, “You’re going to do it again and again and it will get better.”

Other class sessions featured history of science and technology professor Stuart Leslie speaking on the history of engineering; Linda Dillon Jones, JHU’s director of human resources in the Center for Training and Education, discussing group dynamics and interpersonal relationships; and Andrew Douglas, the Whiting School’s vice dean for faculty and a professor of mechanical engineering, who spoke to the students about energy before taking them on a tour of the rarely seen steam tunnels beneath the Homewood campus.

According to Scheinerman, engineering students need to think creatively, work collaboratively, and be open to new ideas. “They must develop skills that extend beyond their talent for solving differential equations,” he says, “if they’re going to reshape the globe.” — Abby Lattes
Looking for security?  
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Enjoy fixed payments for life.

You can establish a charitable gift annuity with a gift of cash or appreciated securities and your benefits will include:

- guaranteed payments for life to you and/or a loved one
- partially tax-free income
- a charitable deduction
- a lasting contribution to the Whiting School of Engineering

<table>
<thead>
<tr>
<th>age</th>
<th>one life rate</th>
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To find out more, please contact John C. Jeppi  
Gift Planning Advisor  
Johns Hopkins Institutions  
410-516-7954 or 800-548-1268  
jjeppi@jhu.edu  
www.jhu.plannedgifts.org

Seek advice from a tax professional before entering into a gift annuity agreement.

Hopkins gift annuities are not available in all States.
Studies have shown that the fun starts here.

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JOHNS HOPKINS UNIVERSITY

SAVE THE DATE! APRIL 9 - 11

Plan now to return to the Homewood Campus for a very special weekend of memories, laughter, activities, great food and old friends. Join us when the fun starts.

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