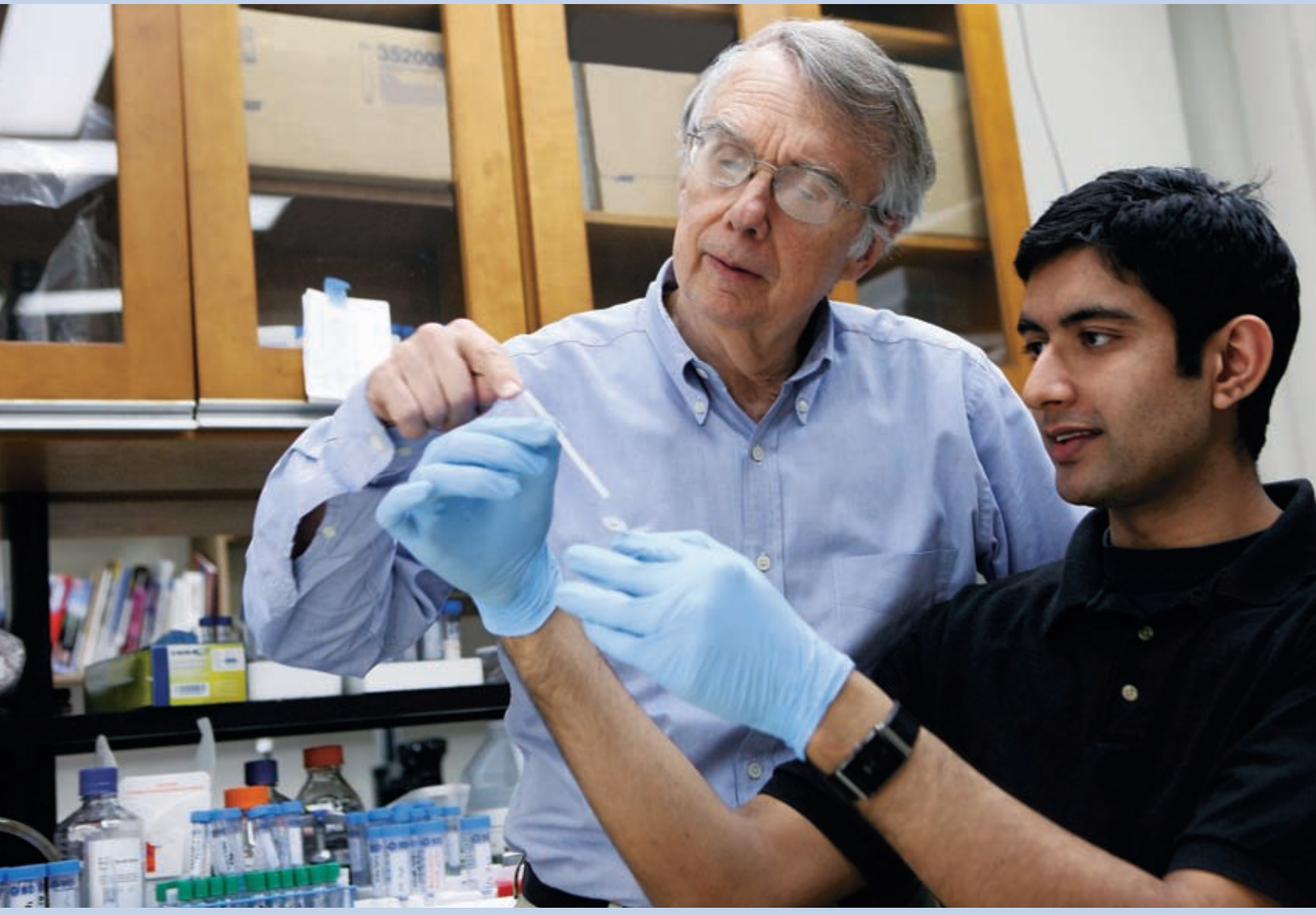
SPRING 2009

McCormick

Northwestern Engineering

Robert R. McCormick School of
Engineering and Applied Science
Northwestern University



Building global partnerships

Studying arsenic in Chile • The $1 HIV test for Africa • A digital X-ray system in South Africa • Electronics in Egypt • Green energy in Panama • French connections • South Korean catalyst • Summer nano study in Munich

McCormick magazine is published by the Robert R. McCormick School of Engineering and Applied Science, Northwestern University, for its alumni and friends.

On the cover
Dave Kelso and graduate student Zaheer Parpia examine a strip test that detects the presence of the p24 protein of HIV.

Assistant dean, director of marketing: Gina Weber Myerson
Managing editor: Kyle Delaney
Editor: Tom Fredrickson
Designer: Vickie Lata
Writers: Emily Ayshford, Kyle Delaney, Michael Klitzing, Lina Sawyer

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Greetings from McCormick

Our cover story in this issue of *McCormick* magazine is one that illustrates the tremendous impact that engineering has on our world. Dave Kelso and his team have led significant efforts in applying our engineering strengths to problems of global health. The result covered in the story, a $1 diagnostic test for HIV, shows incredible potential for transforming medical care in underserved areas.

The story is also an excellent entry into the broader subject of international engagement, the theme for this issue. McCormick has a long history of strong partnerships with collaborators around the world, but we have now embarked on a new strategic effort to bring these relationships to an even higher level. Through an initiative called Global McCormick and led by Professor Vinayak Dravid, we have developed a comprehensive picture of our international collaborations and are prioritizing areas of future growth and collaboration. You can learn more about Global McCormick at www.global.mccormick.northwestern.edu.

In the stories that follow, we feature several of the exciting international projects undertaken by McCormick faculty and students. We are also pleased to highlight three of our new junior faculty members who are bringing new ideas and research to McCormick. We also include profiles of two new professors, Dirk Brockmann and Noshir Contractor. On the inside back cover, we highlight McCormick's upcoming Centennial. Look for more details this summer.

Many alumni have expressed interest in how the financial condition of Northwestern has been affected by the recession. While Northwestern's endowment has suffered significant losses, financial prudence has left the University in a relatively strong position moving forward. President Henry S. Bienen outlined our financial situation in a message to the entire Northwestern community, which you can read here: www.northwestern.edu/newscenter/stories/2009/02/finances.html.

Given the financial challenges facing our world, it is more important than ever to have a lucid sense of direction and a well-defined vision for our future. Engineering thrives on constraints, and the current upheaval finds us well prepared to deal with changes and pursue opportunities.

Inserted into this issue is *A Compass for the Future: The State of McCormick 2009,* which includes a description of our strategy as well as succinct summaries of our new initiatives, ongoing activities, and metrics that chart our progress. We've made great strides over the past four years but still have much more to do. I hope that you will take the time to learn more about our vision for McCormick's future.

As always, I welcome your feedback.

Julio M. Ottino, Dean | April 2009

Schapiro named Northwestern president

Morton Owen Schapiro, president of Williams College, professor of economics, and one of the country's leading experts in the economics of higher education, has been named president of Northwestern. Schapiro, 55, will become the University's 16th president on September 1. He will succeed Henry S. Bienen, who will step down after his 14-year presidency.

Peter Barreras

Schapiro has been president of Williams since 2000. Before that, he was dean of the College of Letters, Arts, and Sciences at the University of Southern California. He previously was on the faculty of Williams from 1980 to 1991 as professor of economics and assistant provost.

"Northwestern has a long tradition of excellence," Schapiro said. "This is a tremendous opportunity to go to one of the best major research universities in the country."

Baxter and Northwestern target new life sciences projects

Northwestern University and Baxter Healthcare Corporation have created a multidisciplinary research and innovation alliance. Under the three-year renewable agreement, Baxter will fund research collaboration projects at Northwestern. Funding for each year will be approximately $1 million, with Baxter determining specific funding levels on a case-by-case basis. These projects will be aligned with Baxter's diversified business model and will focus on new therapeutics, biomedical and device engineering, biomaterials, and drug-delivery technologies.

Faculty from across the University will conduct the research. A committee of senior research and development leaders from Northwestern and Baxter will assist in the identification of potential projects. The McCormick School's Office of Corporate Relations will administer the alliance.

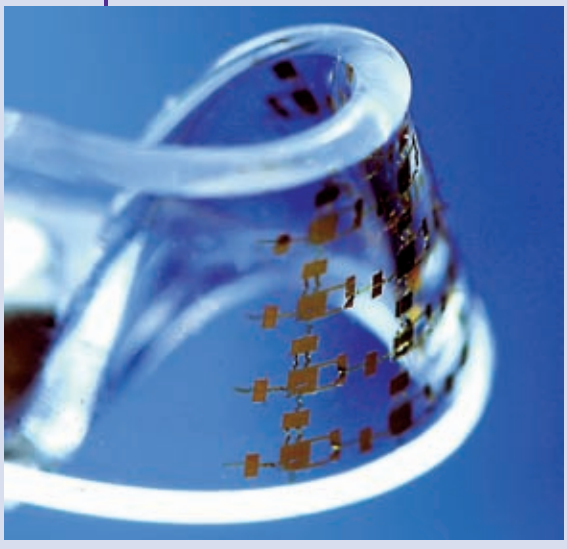
McCormick has similar partnerships with Honeywell International, Ford Motor Company, and the Boeing Company.

McCormick in the media

A team of researchers led by **Vadim Backman,** professor of biomedical engineering, has developed a way to examine cell biopsies and detect never-before-detectable evidence of early-stage pancreatic cancer. He has also developed an optical technique shown to be effective in detecting the presence of pancreatic cancer through analysis of neighboring tissue in the duodenum. Stories about these new technologies appeared in a variety of media outlets, including *The Guardian* and the *Chicago Tribune.*

Noshir Contractor, Jane S. and William J. White Professor of Behavioral Sciences and professor of industrial engineering and management sciences, communication studies, and management and organizations, and his collaborators received media attention after presenting their research at the annual meeting of the American Association for the Advancement of Science. His group is studying nearly 60 terabytes of data from EverQuest II, a massive multiplayer online role-playing fantasy game in which players complete quests and socialize with each other (see page 26). Their work was featured in *Scientific American* and the *Los Angeles Times* blog and on MSNBC.com and the web site Ars Technica.

Yonggang Huang, the Joseph Cummings Professor in civil and environmental engineering and mechanical engineering, was featured in *Popular Science* magazine for his work developing twistable, bendable, and stretchable electronics (shown below).



News

NSBE wins awards

Members of Northwestern's chapter of the National Society of Black Engineers traveled to their fall regional conference and took home several awards. The chapter's Academic Technical Bowl team took first place in the regional competition. Team members included **Okechukwu Chika** (electrical engineering '09), **Reginald Sandy** (biomedical engineering '11), **Evan Dickerson-Rusan** (electrical engineering '11), and **Taju Sanusi** (biomedical engineering '12).

Other winners included **Zuri Hemphill** (biomedical engineering '11), who placed third for her research in memory alloy stents, and **Uchenna Moka** (biomedical engineering '09), who took first place for her research on the formation of pancreatic islets in the developing mouse.

Biomedical student team wins awards

A team of undergraduate students from the McCormick School recently won two prizes for creating a device called the KMC Apne-Alert, which is attached to a baby to monitor its breathing and alerts the mother if the baby stops breathing. Such a device is needed in the developing world, where incubators and heart-rate monitors used to monitor premature babies are rare.

Designed by biomedical engineering undergraduates **Alec Zopf, Shonali Midha, Kurt Qing, Lauren Hart Smith** (shown above, from left), and **James Yang,** the device was named one of the top ten finalists in the Center for Integration of Medicine and Innovation Technology Prize for Primary Healthcare competition. The team received a $10,000 award and is now in the running for the top $150,000 prize. Last year the device won the Biomedical Engineering Innovation, Design, and Entrepreneurship Award from the National Collegiate Inventors and Innovators Alliance.

Farley Entrepreneurship Summit

The Farley Center for Entrepreneurship and Innovation will host its inaugural alumni event and speaker series on May 21. The event will examine current and future trends in the areas of entrepreneurship, innovation, and design. For more information, visit www.fcei.northwestern.edu.

McCormick redesigns its web site

Have you visited www.mccormick.northwestern.edu lately? McCormick has redesigned the web site to create a better user experience. It now features even more news and events information as well as videos, program information, and much more.

Andrew Campbell

Expanding our reach

McCormick is building strong global partnerships

Vinayak Dravid

When it comes right down to it, the McCormick School of Engineering and Applied Science takes up relatively little space: several buildings on a campus in the middle of the country. But its reach — the reach of its students, its faculty, its education, and its research — spans the globe, touching dozens of countries worldwide.

Global connections like these spur new kinds of research and offer faculty and students new views of the world. McCormick has fostered those connections with its long-standing history of global engagement through workshops, exchange programs, research collaborations, and memoranda of understanding with international universities and research institutions.

"In this age, global collaborations are becoming more and more necessary, and in some cases essential, for research breakthroughs and innovations," says Julio M. Ottino, dean of the McCormick School. "Our students need to be global citizens — they need to have a broad view of the world that, for them, is only going to get smaller. McCormick is our home base, but we have relationships that connect us to every region in the world."

In a recent voluntary survey, almost half of McCormick faculty members reported having a total of nearly 600 global interactions, including university visits, student and faculty exchanges, joint publications, international conferences, and other educational activities. These connections involved collaborators in countries on every continent except Antarctica.

Global relations also involve a host of complications — memoranda of understanding and funding agreements, for example. Until now, students and faculty had no easy way to address these concerns or view the breadth and depth of their colleagues' collaborations.

McCormick aims to change that with a new initiative — headed by Vinayak P. Dravid, professor of materials science and engineering and director of the NUANCE Center — called Global McCormick.

"We are immersed in the global ecosystem of education and research," Dravid says. "McCormick is taking the lead to be globally engaged and present itself to the rest of the world in education, research, and outreach."

Dravid, who has been at Northwestern for nearly 20 years, has experienced global engagement firsthand: Over the last decade, he's been involved with several projects with institutions in Singapore, Japan, western Europe, and India — including a new $1.5 million program funded by the U.S.–India Science and Technology Forum that will support workshops and lectures and foster student exchanges. He is part of the Chicago Council on Global Affairs and is active in global outreach with nongovernmental organizations and overseas government agencies. Now he will use that experience as a catalyst to encourage faculty and students to take advantage of global connections.

Over the past year, Dravid has been organizing the development of a web portal that will serve as the central hub for McCormick's global affairs, identifying McCormick's strengths and areas where it

has a strong presence, as well as areas of opportunity. These activities range from the grassroots level — such as individual faculty members connecting with international faculty partners — to major initiatives in which McCormick can play a leadership role.

"We want to leverage the strengths of faculty, research centers, and the overall collaborative, interdisciplinary ambiance at the McCormick School — which is immersed in the 'global city' of Chicago — to nurture and enhance sustainable interactions with global partners," Dravid says.

In the same vein, the web portal will make it easier for faculty to sort through the nuts and bolts of such interactions. "It will help support their aspirations by minimizing barriers," Dravid says.

To help leverage McCormick's strengths, Dravid has called on faculty members with strong expertise and commitment to certain regions of the world to act as leaders in their areas. Those faculty are now appropriately known as McCormick Ambassadors.

"I realized that I could identify opportunities in India and bring them to McCormick, and vice versa," Dravid says. "Then I saw McCormick has a lot of people in that same position. They know the right people and places and can advise other colleagues. We want them to take the lead in developing these activities, seeking out funding opportunities, and creating multi-institutional teams across the globe."

These interactions benefit not only faculty but also students, staff, and alumni of McCormick as well, says Dravid. "It's not inconceivable that a McCormick graduate could find his or her first job in some part of China, then take a promotion somewhere else in the world. We need to address this by offering opportunities like internships, study abroad programs, and research opportunities to prepare global leaders."

The ultimate goal is to expand the initiative to include all of Northwestern. "We want Northwestern to be a highly visible, globally engaged institution with sustainable international programs that have lasting and enduring impact," Dravid says. "So why don't we start with McCormick?"

While this new initiative aims to strengthen McCormick's international presence, the school has long had strong global partnerships. The following articles highlight McCormick's connections in several countries. Although they represent a small fraction of McCormick's total number of global interactions, these articles offer insight into the trials and triumphs of the global world of McCormick.

—Emily Ayshford

GLOBAL McCORMICK

www.global.mccormick.northwestern.edu

The McCormick School has launched the new Global McCormick web site that features information on the school's global initiatives, research, and news.

Visitors to the site can navigate to a map of the world and click on any region to find information on McCormick's collaborations there. Academics, potential research partners, and others from outside the United States who are interested in forming new relationships with McCormick can identify Northwestern faculty members who serve as global ambassadors for specific countries and regions.

The Global McCormick site will also serve as a resource for U.S. students seeking opportunities abroad and for international students seeking opportunities at Northwestern.

The Global McCormick web site is designed to be an ongoing and frequently updated compilation of news and resources about McCormick's international collaborations.

McCormick pioneers low-cost HIV test

In developing countries, where 1.5 million HIV-positive women become pregnant each year, residents face a unique problem: babies born to HIV-infected mothers carry the virus's antibodies — the usual indicator of the virus in the body and what most HIV tests look for — whether they are infected or not.

Early detection in infants is important. While adults can manage the disease for decades, an infant who isn't treated will likely die within a year or two. But tests available today that search for other indicators of the virus, such as DNA or proteins, use complex instrumentation, require specimens to be transported long distances, and can be cost prohibitive.

David Kelso, professor of biomedical engineering and director of the Center for Innovation in Global Health Technologies, and his research group now offer an answer: two new low-cost, portable HIV tests that use DNA or proteins to test for HIV. Though the tests — which use different technologies and have different accuracies and costs — still need to go through clinical trials, researchers are optimistic that they hold the solution to the problem.

Taking on the challenge

McCormick researchers began working on the problem in 2006 after receiving a grant from the Bill & Melinda Gates Foundation as part of a new initiative called Grand Challenges in Global Health. The program — which calls on scientists to undertake 14 challenges, including creating new vaccines, treating infections, and improving nutrition — gave out grants totaling $436 million.

Kelso, along with colleagues at Northwestern's Kellogg School of Management and Feinberg School of Medicine, decided to take on the challenge of improving diagnostics for resource-limited settings.

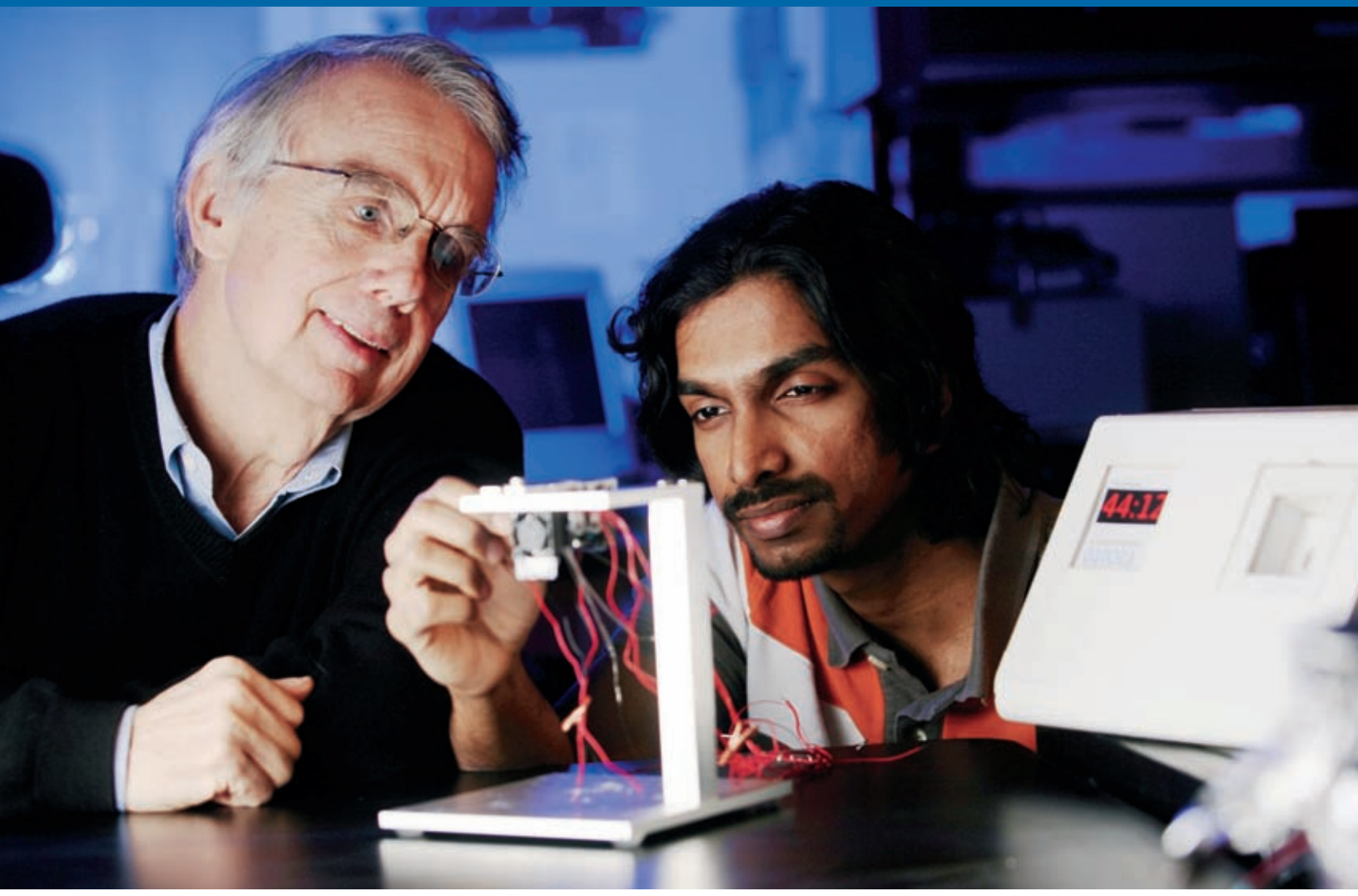
"The idea was that if we did the product development here with the Gates funding, then most of the risk would be taken out of it," Kelso says. "We could transfer the working devices to a diagnostic company who could then manufacture and distribute them." Those companies are Abbott and Inverness Medical Innovations.

To jumpstart the process, Abbott provided Kelso's lab with a working HIV test that uses polymerase chain reaction (PCR) technology that extracts RNA from blood to detect the virus. "Our job was to replace the existing large, expensive instrument with something that was small, cheap, and battery operated," Kelso said.

Inverness gave Kelso's lab an HIV test that works like a home pregnancy test — the patient's finger is pricked and a drop of blood is put on a small strip. Chemicals within the strip perform the test, and the results come in the form of a pink line on the end of the strip.

This strip test is portable, simple, and extremely low cost — but it tests for antibodies, which, in the case of infants with HIV-positive mothers, is not reliable. So Kelso's goal was to create a test that used the same strip but detected the presence of the p24 protein of HIV. "That required a much more sensitive assay," Kelso says, "and a way to free the p24 protein from the infants' own antibodies."

In addition to the two infant tests, Kelso's lab also worked on a similar low-cost, quick test that could measure the viral load of HIV in a patient. The test shows how much of the virus is still active in a patient's body, which in turn indicates whether a drug is working or



Andrew Campbell

Left The strip test detects the presence of the p24 protein of HIV. *Above* David Kelso and graduate student Sujit Jangam examine parts of the HIV test that uses polymerase chain reaction technology to extract RNA from blood.

whether the patient has a strain of HIV that doesn't respond to that medication.

"It also gives patients positive feedback," Kelso says. "Often there are side effects to these drugs, and it's a way to show them they are getting better even though they may be feeling worse." The test also indicates if the virus mutates and becomes resistant to the drug — since the last thing anyone wants is a drug-resistant strain of HIV being transmitted.

Economies of scale

In 2006 Kelso and his lab — which includes a dozen research professors, postdoctoral researchers, and graduate students — went to work trying to find novel ways to perform these tests. "We broke the problem down into smaller pieces, and we let the scientific method tell us which one is the best," Kelso says.

For the strip test that detects the p24 protein, researchers made two breakthroughs: they developed a way to separate the protein from the infant's antibodies, and they changed the indicator line from pink to black, making it easier to see.

"We pretty much had to start from scratch," says Zaheer Parpia, a graduate student working on the project. "We did a lot of chemistry, and then we developed a way to heat the test" — a process that breaks the protein free from antibodies. What resulted was an HIV test that is just a tiny strip of paper and may cost as little as 50¢ to manufacture.

While the test is inexpensive, it sacrifices a measure of accuracy. At stake in these tests are two performance indicators: sensitivity and specificity. Sensitivity is the percentage of the results that will be positive when HIV is present — a test that is 100 percent sensitive would yield no false negatives. Specificity is the percentage of the results that will be negative when HIV is not present — a test that is 100 percent specific would yield no false positives. In other words, if a test's specificity is 90 percent, 10 percent of people who take the test will be incorrectly told they have HIV. The strip test has a sensitivity of 90 and a specificity of 98 percent.

"In most situations, it's better to err on the side of specificity," Kelso says. "You don't want to tell somebody they have HIV when they don't." So why use an HIV test if it's not 100 percent accurate? Accessibility and cost. These tests are easy to use, require no training, and are ideal for rural areas with few or no health-care options. And while 50¢ to $1 may not seem like a large amount to pay for an HIV test, in many countries it's a half day's wage and a significant part of what residents spend on health care in a year.

Faster, better, cheaper

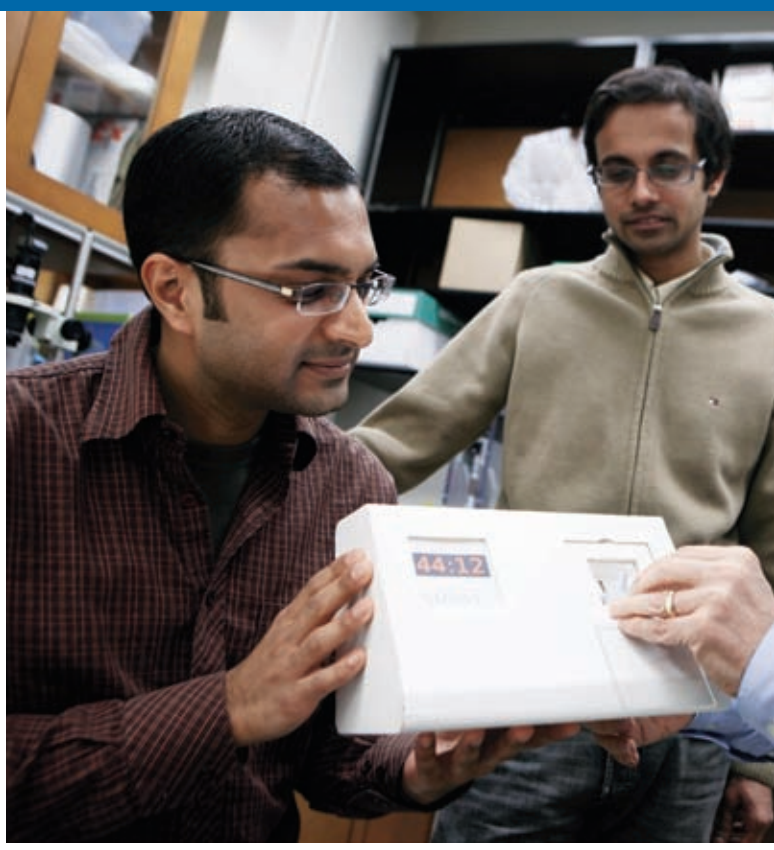
The PCR test, which amplifies DNA, required researchers to find a way to extract nucleic acids in order to replicate them to detect the

disease. "You need to first purify the DNA, and that process usually takes a half-dozen steps and several reagents and is done by complex, expensive robots in laboratories," Kelso says.

But graduate student Sujit Jangam said the team set to work on finding better solutions. "We just tried to think outside the box to miniaturize the process," he says. The result was a battery-operated machine that is about the size of a toaster. This test costs more — $1 to $2 — and requires more power than the strip test, but initial results show the test to be 100 percent sensitive and specific.

For the viral load test — which uses some of the same technology as the PCR test — researchers took a test that used a device the size of a table and found a way to use a microfluidic platform that would simplify the process.

Besides having to make the tests smaller and more portable, researchers faced another parameter: time. To best serve the clients — who may come in for one checkup and never return — the devices had to find a result within an hour. Thanks to the work of Kelso's lab, both infant tests easily meet that standard and can provide patients with results in just one visit.



"This is real-world product development. You have to bring together a group of people with different specialties and perspectives and figure out how to work together to solve these problems."

—Dave Kelso

"It's not our place to make the choice who uses which test," Kelso says. "That choice has to be made by the people in the country who are allocating limited funds and can best assess the trade-offs."

But how to find out who wants what? That's where the Kellogg School of Management comes in.

Designing for developing countries

While Kelso and his lab worked on technology, faculty and students at Kellogg went about studying the markets.

"We take a broader view on product development," says Kara Palamountain, research associate professor at Kellogg and the executive director of Northwestern's Global Health Initiative. "While engineers often focus on the end user, we talk not only with end users but also with purchasers, distributors of the equipment, those who influence whether the equipment should be purchased at all. We bring the strategic perspective."

Palamountain teaches students in the Global Initiative in Management program at Kellogg, which has sent students to 17 developing countries to interview government officials, nongovernmental organizations, and health-care providers to figure out which product attributes are important.

"Each country has its own system," Palamountain says. "In some, the government officials favor accuracy, while the health-care provider favors portability. If we make something acceptable to the provider, it doesn't matter if the purchaser doesn't approve it. We have to decide what the trade-off will be."

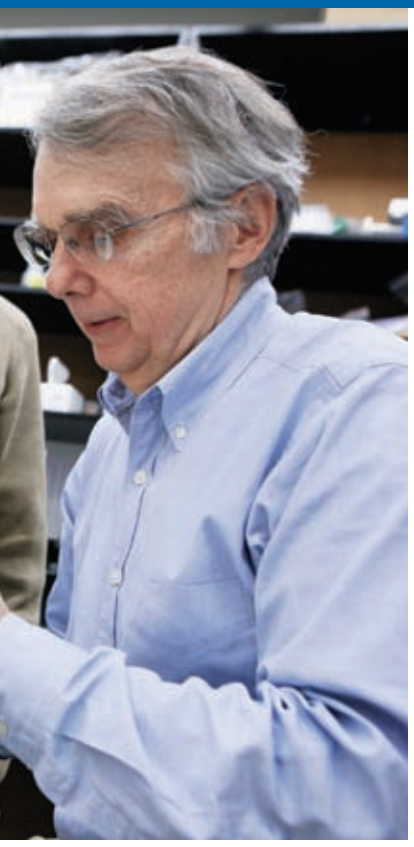
Palamountain and her students have also studied health-care settings, measuring labs for dust (a concern with the optics in the tests) and alerting Kelso's group to the time requirement. "One of the things we discovered early on is that time is critical — to give the patients results in the same visit and because HIV progresses more rapidly in infants," she says. "So we made that choice over other directions we could have taken."

The group traveled to Uganda over spring break to show stakeholders prototypes — developed by design firm IDEO — in order to get their reactions. "Having a prototype really helps bring out the discussion," Palamountain says.

A group effort

Researchers plan to take the two infant tests to Africa for testing in late summer. Since mother-to-child HIV transmission in the United States is so rare, researchers have only been able to test on samples of HIV positive infants that were collected 20 years ago. The strip test will be evaluated in a lab near the University of Cape Town in South Africa — an institution Northwestern collaborates with. Researchers there collect 30 to 40 infant blood samples a day, and up to 10 percent are HIV positive. The DNA PCR system will be tested at Mulago Hospital in Kampala, Uganda. Testing of the viral load test won't start for another year.

"We decided to concentrate on the infant tests first because there is a much more compelling need to have a rapid test in remote settings," Kelso says. "There are more than a million infants born to HIV-positive mothers every year, and right now we think the best



Andrew Campbell

Postdoctoral fellow Abhishek K. Agarwal, graduate student Kunal Sur, and David Kelso examine a prototype that would hold the PCR test.

place to intervene is when infants get their shots. Most mothers will bring their babies to a clinic or a mobile van in order to get their diphtheria and tetanus shots, so while they're getting their shots, we can run this test and advise them to get antiretroviral treatment for their babies if necessary."

For Kelso, the project has been a chance to bring real-world product development into a research lab. "There are three PhD degrees that will result from this research, and in the course of doing their thesis work these students will have developed a product," Kelso says. "It has turned out to be a very rich area for PhD research."

Those PhD students — Parpia, Jangam, and Kunal Sur — say the project has inspired them to work on diagnostics in their careers. "We've come from places that are resource-limited settings," says Sur, who, along with Jangam, hails from India. "So it's especially interesting and scientifically challenging to work on a test that could have an impact like this."

Though they faced a few roadblocks along the way ("And we saw a little magic," Sur says), the students say one of the best experiences was working with researchers from outside the lab — hearing from experts at Abbott and Inverness and finding new ways to look at the technology in light of the Kellogg market research. "It's great to have that interaction — like you're working in a small company," Sur says.

In a field where research can confound laymen and even scientists outside the field, the students say it's nice to work on a project that everyone can understand. "I like the fact that I can explain this to anyone really easily," Jangam says. "By working on this, I've been enlightened as to how much goes into a product. You don't think about it until you're sitting there, examining every piece that goes into the test."

The students already have several provisional patents under their belts — the new platforms they developed for the tests could be used in other areas, like STD testing — and Jangam and Parpia will travel to Africa in late summer to assist in field tests.

All cite Kelso as an inspiration: "Our motivation is Professor Kelso," Parpia says. "He's the driving force."

"He comes into the lab before any of us and leaves after all of us," Sur says.

"We can't match him," Parpia says. "And we're supposed to be in our prime."

But Kelso is quick to praise the efforts of his group. "This is real-world product development," he says. "The end goal is not a paper in *Science*. It's a humanitarian product on the market. And it's different than your perception of university labs where a professor does the research. These problems are too complicated for any one person to solve. You have to bring together a group of people with different specialties and perspectives and figure out how to work together to solve these problems."

—Emily Ayshford

FROM VISION TO REALITY

Alliance brings digital X-rays to developing world

In a country like South Africa, where hundreds of thousands of new tuberculosis cases are reported each year, X-rays — which can provide a quick diagnosis of the disease — require expensive hardware, chemicals, and film and are often locked away in storage closets due to lack of funding. In response to this problem, Northwestern, the University of Cape Town, Rotary International, and other organizations created the World Health Imaging Alliance (WHIA) in 2007.

WHIA has now partnered with several companies to continue striving to provide low-cost digital X-ray imaging to developing countries. Sedecal, a global original equipment manufacturer of X-ray systems, has provided World Health Organization–approved X-ray machines and has also donated equipment and manufactured equipment at a discounted cost.

Digital medical imaging is now provided by Carestream Health, a global company providing medical and dental imaging systems and information technology solutions. Several of Carestream Health's Point-of-Care Computed Radiography systems have been donated for use in the pilot installations.

The software systems that manage the digital images have been provided through a partnership with Merge Healthcare, a leading medical imaging software solutions company. Merge has pledged staff time, software licensing, and product development assistance for the current and next generation of WHIA solutions. Merge is currently working to develop a new generation of its world-renowned MergeBox to encapsulate a site's total image-management requirements in one rugged box.

WHIA is also developing future capabilities that will make it possible for clinics and hospitals to access telemedicine for improved health-service delivery. This would provide clinics and hospitals with the ability to utilize electronic medical records and offer every patient direct access to their own personal health records.

WHIA currently has a site established in South Africa and another under implementation in Guatemala. Close relationships with Rotary International, global not-for-profit organizations, and local organizations have provided WHIA with a lineup of candidate sites interested in receiving its services.

For more information, see www.whia2009.org.

To Chile's deserts, mountains, and snow to see how arsenic flows

The Atacama Desert in northern Chile is rugged, barren, and isolated — the driest place in the world. At more than 4,500 meters above sea level, roads are nonexistent and water is scarce. The few rivers that do cross this desert — including the Río Loa — are the only sources of fresh water for nearby cities and villages, but the water is tainted with toxic levels of arsenic.

Such contamination happens naturally — the Loa originates high in the Andes, in bubbling pools of water heated by the Puna-Altiplano volcanic complex. That complex holds the El Tatio geyser field, which discharges considerable amounts of arsenic into the river, leading to major public health problems for the people farther down the mountain who rely on the river as their only source of water.

Aaron Packman, associate professor of civil and environmental engineering, and Jean-François Gaillard, professor of civil and environmental engineering, are working with researchers from Pontificia Universidad Católica de Chile (PUC) to understand how arsenic propagates down the river and to develop strategies that will protect local communities from this natural hazard.

"It's at the fringe of where people can live," Packman says. "It's a very unusual site and a good test case for evaluating how we can best manage water resources and cope with naturally occurring sources of water contamination."

The partnership with PUC developed several years ago when Gaillard had a graduate student from PUC. Field work in the area started in earnest in 2005 when Gaillard and Packman investigated the sites. Since then, several Northwestern students have participated in sample collection and analysis efforts, working closely with their counterparts from PUC.

"This effort involves a lot of water resource issues — contaminants, chemistry, and public health," Packman says.

When consumed in high amounts, arsenic has been known to cause skin disease and cancer. The World Health Organization recommends a limit of 0.01 mg/L (10 ppb) of arsenic in drinking water. In

Below Jean-François Gaillard and Aaron Packman
Left and right The Atacama Desert in northern Chile

the Río Loa, arsenic levels are routinely more than 100 times greater than this. Arsenic-tainted drinking water is also a problem in the United States, often near mining sites, in industrial areas, and from hydrothermal sources — but nowhere in the United States is arsenic such a widespread problem as it is in northern Chile.

A Río Loa excursion

In 2007 Packman, Gaillard, their students, and their Chilean collaborators Pablo Pastén and Gonzalo Pizarro set out on a 10-day field expedition to characterize arsenic distributions along the entire Río Loa, the longest river in Chile. The extreme conditions and isolation of the region made the work challenging. The group rented trucks in Santiago, got a block of hotel rooms in a nearby city, set up a makeshift lab, then took their trucks up into the mountains. The group split up, taking water and sediment samples from different areas along the river. In some places, particularly in the Río Salado tributary, the "salty river" that contains very high arsenic concentrations, no life could be found in or around the river. At one point they found they could drive no higher in the mountains — snow blocked the roadway.

Andrew Campbell

Gonzalo Pizarro

Aaron Packman

The group tested some samples on site and brought others back to the temporary labs at the hotel. Many samples were shipped back to McCormick as well, and both students and professors are still testing the samples. "The follow-up analysis takes years," Packman says.

Analyzing the results

The group has discovered that arsenic in the Río Loa behaves differently than arsenic in the United States. In most locations here, arsenic in water is mainly found in areas with high amounts of iron. In the Río Loa, arsenic appears to be found where calcium is high. The group also learned that arsenic is highly mobile, and its concentration is controlled by dilution from other rivers and by evaporation, which is quite severe because of the extremely dry climate around the Río Loa. Most recently, the group has begun to scan arsenic distributions in river sediment using X-ray tomography at Northwestern's Synchrotron Research Center and at the Advanced Photon Source at Argonne National Laboratory.

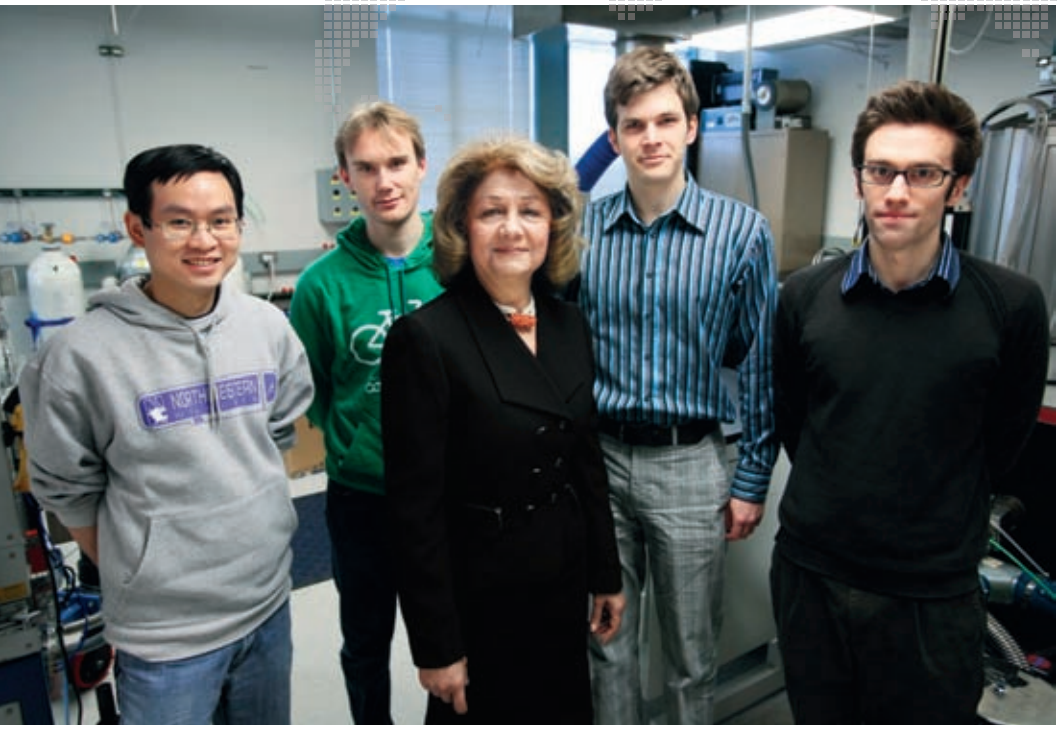
Packman says he hopes the research will spur student groups to develop new processes for removing arsenic from the water. A new program funded by the Chilean Science Foundation will support the design of local treatment methods for villages located along the Río Loa and other arsenic-bearing rivers in northern Chile. This will allow the collaboration between McCormick and PUC to continue: McCormick has a study abroad program with PUC in which Northwestern students combine academic study with research experience, and Marco Alsina, from PUC, is visiting Northwestern as a predoctoral fellow.

"This collaboration allows students to see the field component of environmental engineering research," Packman says. "They take the knowledge gained from the field to help provide solutions to the world's most pressing problems, like access to clean drinking water for everyone."

—Emily Ayshford

French connections

Manijeh Razeghi thinks globally



Andrew Campbell

Manijeh Razeghi (center) with her students (from left) Minh Binh Nguyen, Pierre-Yves Delaunay, Simeon Bogdanov, and Nicolas Pere-Laperne

Part of Manijeh Razeghi's heart and soul will always be in France. Though she came to the United States more than 17 years ago, she got her start in Paris, and all of her family is still there. She keeps up her French connections by collaborating with prestigious French universities — and recruiting their best students.

"The French students are hard working with good backgrounds," she says. "Our connection with France is growing all the time."

Razeghi, the Walter P. Murphy Professor of Electrical Engineering and Computer Science and director of the Center for Quantum Devices, received her MS, PhD, and ES science doctorate in physics from the University of Paris 6 and 11. She began her career in France, first as a senior research scientist and then head of the Exploratory Materials Lab at Thomson CSF, one of the leading international companies in semiconductor devices. At that time, she already had many connections with the academic world, especially with the Ecole Normale Supérieure in Paris and the Ecole Polytechnique, and she has continued those relationships to this day.

Each year Razeghi hosts several visiting student researchers from France. Many come from the Ecole Polytechnique, where every student must perform a four-month internship. Now every time Razeghi goes back to Paris, she interviews students who want to come to her lab. "From 8 o'clock in the morning, they come group by group," she says. "I want to be sure they know it's hard, and I want to see how good they are. This collaboration works well for me because they send very strong students, and working in my facility is hard. It's a very competitive area."

Some students have even decided to pursue their PhDs at Northwestern after completing their four-month internship. To formalize this type of arrangement, she is in discussions with Ecole Normale Supérieure and Ecole Polytechnique to create a collaborative PhD program. Razeghi also receives master's students from the Université Pierre et Marie Curie for internships.

When students arrive in Razeghi's lab, they find that the work is challenging, but it ultimately pays off. Ecole Polytechnique alumnus and current McCormick PhD student Simeon Bogdanov says that he heard about Razeghi's lab from his adviser and then contacted Razeghi to see about doing a master's thesis in her lab. "I was expecting a master's thesis in six months," he says. "She said, 'No. You have to apply for a PhD.' It only took me 30 seconds to decide."

"I don't want to accept students for just six months," Razeghi laughs. "I want them for their PhD. I want to invest for the long term."

Another former Ecole Polytechnique student, Minh Binh Nguyen, says his time in Razeghi's lab changed his life. "I realized that experimental work is just as important as the theoretical work. Professor Razeghi told me I could do theory here as long as it was applied to what we are doing. Once I saw the results in our group, I realized how lucky I am to have invaluable experimental data to build and to support a theory."

PhD student Can Bayram likened Razeghi's lab to a steel factory. "She can take iron and mix it with other materials and make it stronger," he says. "We know that we are strong, but now we know that, thanks to her persistence, we will graduate stronger."

Such an environment isn't available in Europe, Bogdanov says. "I think every European scientist should come to the United States at least once and see how people work here."

In addition to lab work, Razeghi's students are involved in research with Nanovation, a French company founded by Razeghi's daughter, F. Hosseini Teherani, who was the Eshbach Scholar at McCormick in 2008. Nanovation manufactures and commercializes high-quality zinc oxide thin-film coatings and nanostructures. The collaboration between Razeghi's lab and Nanovation has brought about new designs for white light–emitting diodes, which may eventually replace light bulbs for lighting applications.

With such a successful track record, Razeghi says she will continue to do her best to facilitate future collaborations with France. She is confident that these collaborations strengthen both McCormick's relationship with France and the scientific community as a whole.

—Emily Ayshford

South Korean catalyst fuels materials research

While McCormick continues to seek out international collaborations, other countries are looking here for partnerships as well. In South Korea, for example, an initiative called Brain Korea 21 that funds interactions between South Korean and American universities spurred Wooyoung Lee, a materials science professor at Yonsei University in Seoul, to contact Peter Voorhees, the Frank C. Engelhart Professor of Materials Science and Engineering and chair of the department, about a collaboration. A deal was struck and in 2007 Voorhees traveled to South Korea for the kickoff meeting — which, it turned out, was scheduled for Thanksgiving Day.

"I said, 'Do you realize that's Thanksgiving?'" Voorhees says. "And they said, 'No, but could you still come?' So I was the only Westerner in the hotel."

Since that Thanksgiving two and a half years ago, the two professors have traveled to each other's universities once or twice a year to combine research strengths in the field of nanowires. Lee explains why he chose McCormick for the $2 million program. "We wanted to work with a good university, and Northwestern has one of the top materials science departments in the country. And it shows: Northwestern has been very active, and our collaboration has developed well."

Since the collaboration started, Voorhees and several other materials science and engineering faculty members from McCormick have traveled to Yonsei to give talks and meet with professors. Several Yonsei faculty members and students have in turn come to Northwestern to use McCormick's equipment, such as the three-dimensional atom probe, for research.

"It gives our graduate students interactions with people overseas," Voorhees says. "And Northwestern benefits from bringing our name overseas."

Lee first sought a collaborator because he had developed a simple way to grow single-crystal nanowires that have unique transport and thermoelectric properties but needed Voorhees's expertise in the growth mechanisms of nanowires. "He knows the physics of thermoelectric materials, and I help with the mechanism," Voorhees says.

Andrew Campbell

Peter Voorhees and Wooyoung Lee

The professors say efficient thermoelectric nanowires could replace Freon in appliances like refrigerators, and that would reduce pollution. "It's hard to come up with materials that are efficient enough to do that," Voorhees says. "If this works, it would have a big impact."

Because the two see each other only about twice a year, most of their communication happens via e-mail. When Lee visited Evanston recently, he and Voorhees set aside an afternoon to discuss a paper they hope to publish. Both hope the collaboration continues for years to come.

"Peter has been very generous and has been a good friend," Lee says. "Our strengths make a good combination."

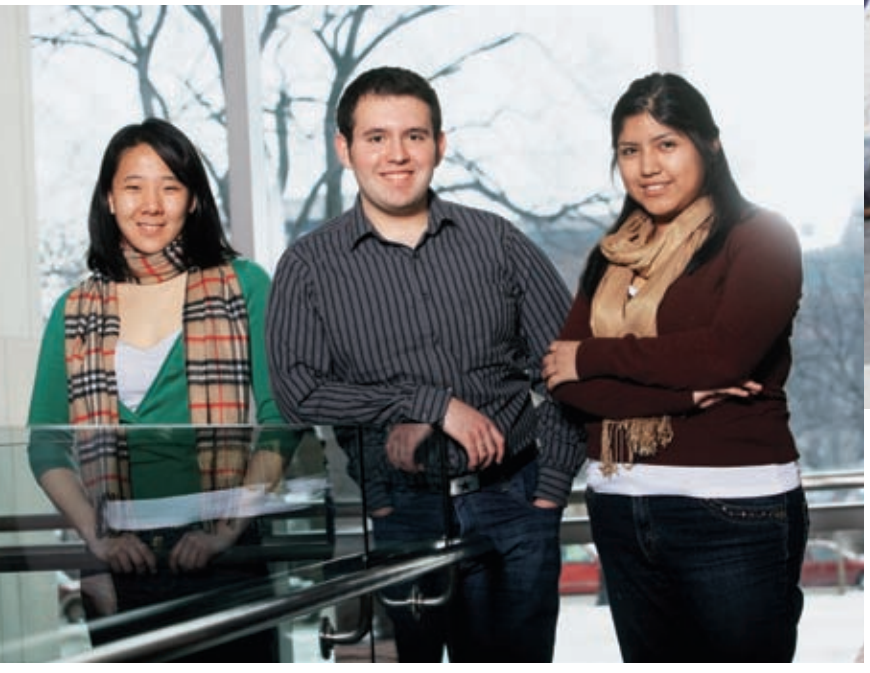
"I had never been to South Korea before," Voorhees says. "It has given me a window into a new culture that I wouldn't have known without this. And it's been delightful. Hopefully we can keep this relationship going in the long term. It can be hard with schedules, but it's collaborations like these that create big progress."

—Emily Ayshford

Making an impact with green energy in Panama

For members of Engineers for a Sustainable World (ESW), school breaks don't mean time on sandy beaches or ski slopes. They mean chances to improve environmental, social, and economic sustainability throughout the world. With such big goals come big challenges, but these students aren't afraid to leave the country — and their comfort zones — in order to make a difference.

In addition to local projects that aim to make shuttle buses more green and middle school students more knowledgeable about sustainability, the McCormick chapter of ESW currently has three projects aimed at improving energy, sustainability, and quality of life in Central America.



Andrew Campbell

Harnessing the sun in Panama

In Panama's rural Chagres National Park, ESW has worked to bring electricity to two communities — Santo Domingo and Santa Librada — that are off the grid. Park regulations restrict the communities from using grid electricity, so over the past three years teams of McCormick students have used their spring, summer, and winter breaks to help install photovoltaic systems on buildings, fences, and schools.

In Santo Domingo, students installed solar panels to provide electricity for cattle fences. Such fences not only separated farmers' cattle but also helped prevent jaguar attacks — a real danger in the area. Based on the success of that project, students installed solar panels to light the local school and power a charging station for batteries. (The sole previous source of electricity in Santo Domingo was batteries, which residents had to charge in the closest town, which is two hours away.) Students also gave a computer to the school — the only one in the community — and modified the lighting system to include an outlet to charge the computer. "Before we brought it down, students didn't use a computer until high school," says Christopher Vega (electrical engineering '10).

The group also worked with a group of students in McCormick's Engineering Design and Communication program to develop a system for electrifying houses in Santo Domingo with solar panels. Last summer a group of ESW students installed panels on three houses, and then the government installed panels on another 10 houses in November. This spring, a group of ESW members installed panels on four more houses.

Far left Suelyn Yu, Christopher Vega, and Maria Salazar
Left Yu helps install a solar panel.

"Our model is education with implementation," says Suelyn Yu (mechanical engineering '10). "Whenever we install a project like this, we work with the community, set up workshops, invite them to work with us, and create a committee to take care of it. They really take ownership of the project."

In Santa Librada, students installed a similar solar system to supply energy to a school — but instead of supplying a computer, they added a much-needed freezer system. Santo Domingo is "a lot more spread out," says Vega. "The teacher would have to take 30 minutes to walk home from the school every day to get food for the children. With a freezer, they can keep perishables nearby."

For another project in Portobelo, an old colonial town of 1,600 people on the Caribbean coast of Panama, ESW members worked on an energy problem of a different kind: a 10,000-gallon septic tank that was in disrepair due to poor design and 40 years of neglect. "It had never been emptied, it wasn't settling properly, and the water that was coming out was polluted," Vega says. After muddling through red tape, the group emptied the tank last summer to see how it could be improved.

"This spring we'll modify the pipes in the tank and make it a double-filtration system," Vega says. But in order to implement the next phase — creating a sludge-drying bed where waste can be directed and reclaimed for fertilizer instead of floating out to the bay — students will have to get through a little more paperwork.

"Eventually we hope to implement a filter to make the water even cleaner," Vega says.

Implementation with education

Though they only visit each community for a week or two at a time, McCormick's ESW students say that their reliability — coming back to check on projects a couple times a year — has helped build trust with locals. Vega, who speaks Spanish, visits homes to help explain projects to residents. Students then suggest ways residents can help. "In Santo Domingo and Santa Librada, the locals are a lot more hands-on," he says. "They want to know what's going on. They want to collaborate with us. We have the technical background, and they know their surroundings."

The group has had more difficulty with residents in Portobelo. Because it's a bigger city, residents are often at work during the day, so it's harder for the students to get to know the community. "This is our fourth year," Yu says. "I'm sure in the beginning it took a while to get their trust. But when you keep coming back and showing progress, they start to trust you."

When ESW members visit a project site, it's not all work. Students often sleep at the community school, and sometimes the children come and sleep at the school with them. Whenever they are working on a project, residents insist they stop for a home-cooked lunch, and show them around important parts of the community, like the local herbal medicine doctor's house.

"Because we have a limited budget, they help us out by giving us a place to sleep and food to eat," Vega says. "And at night the community comes to where we are staying and visits with us. It's all about building a relationship."

ESW continues to seek out new projects. This spring for the first time they headed down to Teustepe, Nicaragua, to work with a nonprofit called Green Empowerment to design and install a biogas digester that will capture methane gas from manure so it can be used for cooking and lighting. Families in the community devote at least an hour a day to foraging for firewood and spend $6 a month on kerosene for lamps, so the digester will provide them with better, cleaner fuel. "Kerosene is really inefficient," Yu says. "It doesn't produce much heat, and it's not good for their health or the environment."

This, too, will be the beginning of a several years-long project. Such projects have taught ESW members about group work that can span long periods of time.

"I'm much more realistic about international work now," Yu says. "It's not easy. You can't just go in and implement a project and leave. It's a commitment. We believe in nonabandonment, and that's hard to do when you keep getting new members and don't have a lot of continuity. But we love the work, and it's worth it when you see the results. It's worth it when you know you're making someone's quality of life better."

—Emily Ayshford

To learn more about ESW, visit www.eswnu.org.

In Munich, a chance for both research and culture

Andrew Campbell

The life of a McCormick undergrad can seem filled with years of required courses, activities, jobs, and internships.

Now a new program offers students a way out of the grind — a summer in Germany that not only fulfills course requirements but also offers days spent touring famous technology corporations and labs and nights filled with German culture and gemütlichkeit.

The program, called Finding Nano, is the brainchild of Matthew Grayson, assistant professor of electrical engineering and computer science. Grayson, who spent seven years at Technische Universität München (TUM), had heard that the German Academic Exchange Service was petitioning German universities to create programs that would attract American students for the summer. He spoke with his connections at TUM, and after a year of networking and building upon his scientific contacts in Germany, the Finding Nano program was created.

The six-week summer program offered by TUM gives students a chance to earn credits by taking a course called Electronic Properties of Nanoengineered Materials as well as a technology course that includes visits to nine research technology centers — including labs, start-ups, and major international corporations — to get a feel for German technological culture. Students also take a German language course, live in a dormitory with German students, and visit cultural sites during evening and weekend excursions.

"I know it's hard to find a study abroad program that has technical aspects," Grayson says. "I had to jump through hoops to study abroad when I was an engineering undergrad. This program offers students the chance to see research labs, start-up companies, and headquarters of companies like General Electric, and it also gives them science courses and a taste for German language and culture."

During its inaugural run last year, 11 students participated in the program, of which Northwestern is the principal American partner. Michael Parrott (mechanical engineering '09) saw an ad for it in the *Daily Northwestern,* and, after applying for and getting a scholarship from Shell Oil, was able to partake in the program and stay on for an internship at a Munich company.

"It was really exciting," says Parrott. "You go to labs where famous German scientists have done work — we even visited Werner Heisenberg's lab — and you do both scientific and theoretical training. It was great to see such a different higher education system."

Seeing the labs motivated Parrott to do his own research, and he's now working with Horacio Espinosa, professor of mechanical engineering, on research involving nanowires.

"I think this program is a hidden gem within McCormick," Parrott says. "It's not comparable to anything else. Besides the experience, I now have friends all over Europe that I never would have had if I didn't do the program."

Grayson is working to further develop the Northwestern-Munich partnership. Last fall he brought to McCormick a production of the Michael Frayn play *Copenhagen* that was originally mounted at TUM. And when he's not teaching courses in the Finding Nano program, Grayson performs research at TUM as well.

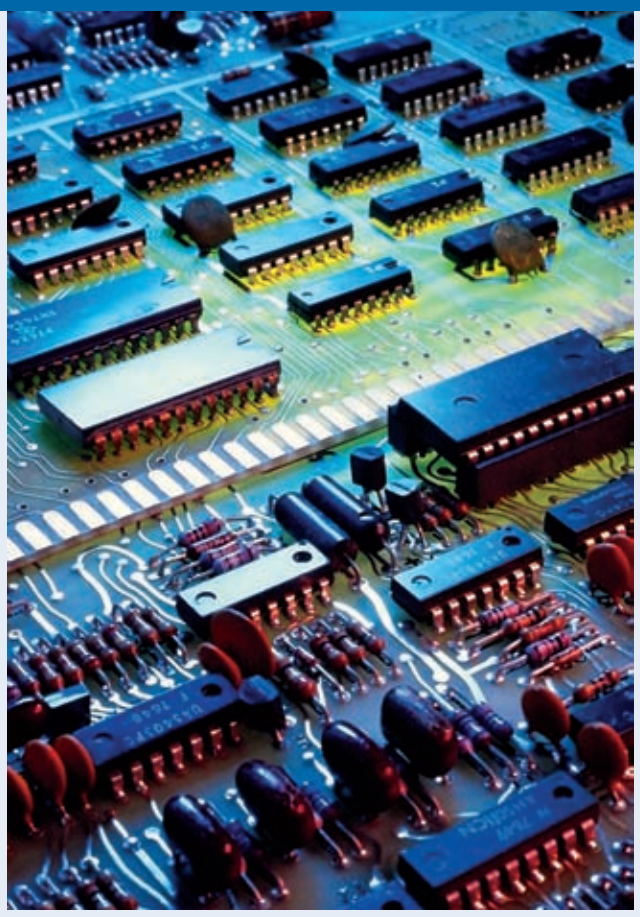
"We already have four McCormick students signed up for summer 2009, so word is getting out," Grayson says. "Having an international experience is an opportunity for students to put miles on their résumé and get out there and see other countries' technological culture and job market. This connection opens doors for them."

—Emily Ayshford

Above **Matthew Grayson**
Right **Students in last summer's Finding Nano program**

Electronics in Egypt

Yehea Ismail operates labs on both sides of the Atlantic



Yehea Ismail had the microelectronics expertise, and he had the knowledge of Egypt. Then suddenly last year the timing for these two areas to merge was perfect: Egypt was poised to become the technological headquarters of the Middle East but lacked the resources to meet the demands of global companies who called Cairo home.

It was then that Ismail knew he could help make a difference. So he took a sabbatical year and went to Nile University, a three-year-old science, technology, and business school in the heart of Cairo's "smart village" Information and Communication Technologies sector. There he started contacting companies in the region to discuss creating a new electronics design and development center. "There was huge interest in such a center," says Ismail, who is an associate professor of electrical engineering and computer science. "It's something that happened out of need."

The Nanoelectronics Systems Integrated Center was born. It focuses on high-performance, low-power integrated circuit design as well as computer-aided integrated circuit design, physical layer design for wireless communications, and design of sensors and micromechanical systems.

With the help of companies like Intel and IBM — both hungry for the technology and talent that such a center would provide — Ismail secured an equipment fund that helped purchase high-speed measurement equipment and a server for the center. He also secured agreements with the companies to foster internships and fellowships and found funding for 12 graduate students.

And he did all this within seven months.

"It's an accomplishment that is startling even to me," he says. "It shows that there is a need. I didn't need to push. There was a hunger for something like this."

To create the center, Ismail used both his experience and his connections. He was with IBM Cairo Scientific Center from 1993 to 1996 and later worked with IBM Microelectronics in New York. His primary research interests include interconnect, noise, innovative circuit simulation, and related circuit-level issues in high-performance VLSI circuits.

Yehea Ismail (third from right) and his students at Nile University

Though he's originally from Egypt, Ismail says the reasons for his involvement with the center go far beyond his love of country. "If you want to work in the Middle East/North Africa region, Egypt is centrally located, and it is also the most open culture in the region," he says. "So every international company has its Middle East headquarters here. Companies are also outsourcing to Egypt."

Such a center could benefit McCormick and Northwestern as well, Ismail says. He hopes to create an official partnership between Nile University and Northwestern to take advantage of these strengths. "We could immediately gain strategic importance in the region," he says. A joint PhD program — where students spend half of their time at each school — could bring more graduate school options to Egypt, where students often leave the country for graduate study, while easing the financial burden on Northwestern.

"The infrastructure is there," Ismail says. "Egypt is the place where growth is going to happen."

—Emily Ayshford

Paving the way for global collaboration

Bob Chang develops workshops to bring the world together

Before it was a buzzword, globalization was the vision of Bob Chang.

For the past 20 years, the professor of materials science and engineering has been traveling around the world, connecting scientists in hopes of spurring solutions to global challenges. What has resulted is a host of networks and programs that aim to break down cultural and economic walls around the world.

"Today we have global challenges like energy, environment, health, and security," Chang says. "It's very expensive for one country to solve these problems, so many countries need to work together. These networks are exactly the right platform to solve these challenges at much lower costs."

In 1995 Chang organized a National Science Foundation (NSF) cosponsored workshop in hopes of promoting cooperation among North American countries. Researchers, educators, and industry leaders came together to discuss how to better collaborate in materials science. It was such a success that over the next decade Chang put together six more workshops — and the Materials World Network, a worldwide network of universities that fosters international cooperation in materials research and education, was born.

"At first I had to talk my international colleagues into it," he says. "There are many challenges to creating networks like this — you have to build up trust and goodwill. There is a lot of diplomacy involved. But once I gained their trust, they realized they shared my vision."

While global partnerships spur new ideas and groundbreaking research, they also come with a host of challenges, including difficulty with funding and travel. Chang's workshops have helped create a framework of joint funding agreements between the NSF and its international counterparts. "This made it possible for me to travel around the world and help establish collaborations among researchers in order to expand this network," Chang says.

Creating a global school

Another product of the Materials World Network is the Global School for Advanced Studies (GSAS), which brings together faculty and graduate students from around the world to solve challenges in energy, environment, and health. The program began as an offshoot of the Pan American Advanced Studies Institute, a program created in 2003 by Chang that brought 40 graduate students to Brazil for 10 days of brainstorming about fuel cells and catalysis for environmental applications.

"Most people who put on programs like this just do lectures. People sit there and listen and then go home," says Jennifer Shanahan, assistant director of global programs at Northwestern's Materials Research Institute. "Professor Chang is never happy with just that. He wants to create things that have longer-term impact."

In Brazil, Chang split up the graduate students into teams and had them come up with research projects that they could work on together. In addition to giving talks, lecturers at the institute acted as mentors to the students. But the institute faced a roadblock when they found no one would fund this type of collaborative research. So Chang and Shanahan expanded the model of the Pan American institute to create GSAS, which they hope will advance innovation in areas like energy and the environment as well as develop leadership among young researchers.

"These are the scientists and engineers of the future," Chang says. "Now they have a better understanding of how to work with their peers from around the world. This is the grand scheme that got me interested in education."

> **"These are the scientists and engineers of the future. Now they have a better understanding of how to work with their peers from around the world. This is the grand scheme that got me interested in education."**
>
> —Bob Chang

GSAS held its first event in Taiwan in 2006; it was funded by the National Science Council of Taiwan. The two-week session on solar cells brought together 20 students from the United State, Europe, Asia, and Africa. Three teams came up with research project ideas, and the

winning team's idea was implemented at the Industrial Technology Research Institute in Taiwan.

Last summer GSAS held a session at the International Conference on Electronic Materials in Sydney, Australia. Rather than sponsoring a competition, GSAS organizers invited a core group of faculty members from universities in the United States, Taiwan, Germany, and Australia to collaborate on a project. GSAS hopes to sponsor another session this year.

"We really want to focus on building a consortium of research hubs in these parts of the world," Shanahan says. "Our vision is that these groups will come up with research ideas and then implement them, with students spending perhaps three months at a time at each of the participating institutions."

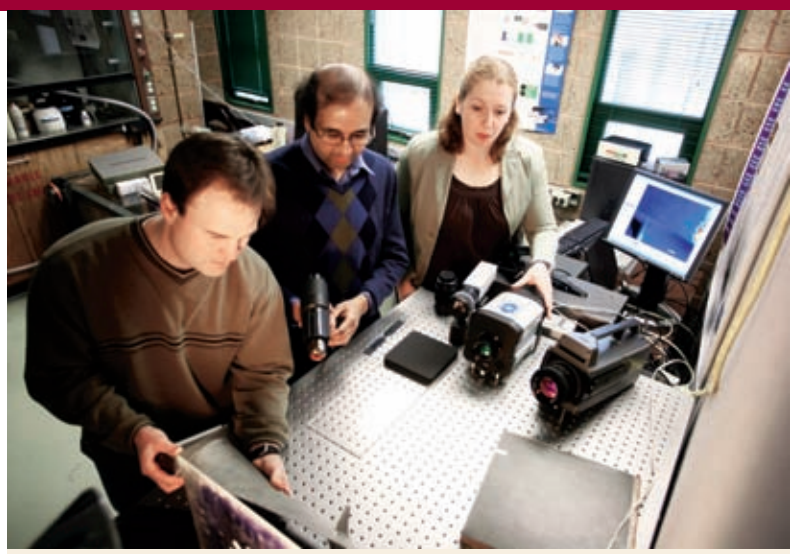
Finding new partners across the globe

In addition to GSAS, the Materials World Network has organized events like the U.S.–China Workshop on Nanostructured Materials for Global Energy and Environmental Challenges, held in September 2008 in Evanston. Such workshops spawn partnerships among researchers in both countries. The Materials World Network has also worked with the International Union of Materials Research Societies, a union Chang helped found, to expand into Africa and the Middle East. The ultimate goal of this worldwide consortium is to build on each member's expertise to collaborate and create the solutions needed for a bright future.

Even with decades of scientific diplomacy under his belt, Chang and his staff continue to plan and write proposals for programs and meetings around the world. That, he says, is his life's mission. "I haven't made a lot of money, but I have made a lot of friends who are willing to help me," he says. "At the end of the day you ask yourself what you've done on this earth. I can say I've helped a lot of people."

—Emily Ayshford

Andrew Campbell



Brad Regez, Sridhar Krishnaswamy, and Aurora Zinck in their lab

Partnering for structural health in India

The Partnerships for International Research and Education–Intelligent Structural Health Management (PIRE-ISHM) program at McCormick links faculty and students with universities around the world in hopes of creating safer infrastructure.

PIRE is a National Science Foundation initiative that seeks to catalyze international research engagement. Last year Sridhar Krishnaswamy, professor of mechanical engineering and director of the Center for Quality Engineering and Failure Prevention, and his colleagues won a five-year PIRE grant to establish a global partnership of universities, laboratories, and companies to engage in cutting-edge research and education in the area of intelligent structural health management (ISHM) — a new concept aimed at preventing the catastrophic failure of structures by using diagnostic sensors to retrieve data about the current state of a structure.

Northwestern's partner universities are mostly in South and East Asia, and projects will include both graduate and undergraduate exchanges, research visits, internships, and, perhaps most importantly, exposure to the culture of research in other countries.

"Over the past 50 years, there's been a lot of global interaction, but it has been predominantly students coming into the United States," says Krishnaswamy, who acts as one of the coordinators of the program. "Our graduate students don't often get experience studying or doing research abroad. The purpose is to expose our students to different cultures and allow them to develop substantial links with researchers around the world."

Last summer Aurora Zinck, a PhD student in materials science and engineering, and Brad Regez, a postdoctoral fellow in mechanical engineering, each spent a month at partner university India Institute of Technology Madras laying the framework for partnerships to come. Krishnaswamy says they hope to send 20 students to partner universities over the next four years.

"With a huge issue like structural health management, the problems are global and the solutions are common," Krishnaswamy says. "Partnerships like these will help create solutions that will help increase structural health around the world."

—Emily Ayshford

Bridging the educational divide

Bob Taggart shrinks the globe, one dish at a time

In any number of villages throughout the developing world — far from most modern amenities — it is not uncommon to find a humble dwelling adorned with a satellite dish. Consider it the evidence of Bob Taggart's lifetime of work.

As a researcher and an entrepreneur, Taggart (BS mechanical engineering '67, MS biomedical engineering '68) has played an integral part in the development and distribution of low-cost satellite dishes that have helped bring informational and educational television to poor communities around the world.

Now residing in Portola Valley, California, with his wife, Donna, Taggart is founder and chief executive officer of Chaparral Communications, based in nearby San Jose. The company has been at the forefront of providing components for satellite television systems for the past 29 years. Chaparral found its most profitable niche building the low-noise block feed — the device that sits in the center of the dish collecting and amplifying the signal and down-converting the frequency so it can be received on a set-top box.

But it is the social impact of the work that brings the most satisfaction to Taggart, a dedicated alumnus who has served on the McCormick Advisory Council for the past 14 years and the Stanford Mechanical Engineering Advisory Council for the past five. "I believe that education is the best thing you could provide to developing nations to bootstrap the whole economy," he says. "An education helps people separate themselves from the usual plight of people in developing nations, which is not too hopeful."

A chance to shine

Given the hurdles Taggart faced on his own educational journey, it's easy to understand his passion. Taggart credits his experience at McCormick for making his rewarding and fulfilling career possible. And his ensuing success is all the more remarkable considering the tough times he overcame.

After struggling with grades as a freshman at Northwestern, Taggart had to cope with personal tragedy when both his parents fell terminally ill. As a sophomore, lacking money for tuition and with his grades only beginning to improve, he was expecting he'd have to continue his education elsewhere when he met with director of undergraduate admissions and financial aid Bill Ihlanfeldt.

"I was just trying to borrow enough money to get through the quarter so I could go out and find a job," Taggart recalls. "I thought I had screwed up the deal."

Thus it was no small shock a few days later when Ihlanfeldt presented him with a scholarship and loan package that allowed him to continue his studies at Northwestern. Taggart says the unexpected assistance caused him to rededicate himself and approach his academic career with a new vigor.

"I really started to shine at that point," he explains. "I got some great grades in my last two years, and that made the difference in my whole life."

Taggart, who calls himself a born "builder of things," was rewarded for his improved academic standing with a National Institutes of Health Fellowship to pursue his master's degree at McCormick. He went on to flourish as a biomedical engineering graduate student under the tutelage of Professor Lyle Mockros, whom Taggart calls a "great inspiration."

Taggart's turnaround paid dividends one day in 1968 when his phone rang as he sat in his office at Tech staring out at the snow and slush. The call was from Stanford University, which, in partnership with NASA, was exploring the possibility of using high-powered satellites to transmit signals to small, low-cost dishes as a means of disseminating information to the developing world. Previous

> **“I believe that education is the best thing you could provide to developing nations.”**
>
> —Bob Taggart

systems utilized low-powered satellites to transmit signals to massive, expensive dishes.

Even though Taggart had no background in satellite communications, the Stanford team wanted him on board. “They needed someone in six months, so they must have been desperate — the Ts are pretty close to the end of the alphabet,” Taggart jokes. “They said if I decided to accept, they’d set up a program and teach me everything I needed to know about communications and antenna design. They said, ‘We want you to give it some thought and call us back because we have to move on this.’”

Staring out at the winter gloom, Taggart says he thought about the California weather and could practically hear a Beach Boys tune playing in his head. It took him about 10 seconds to decide. He accepted the offer to move to an area that would soon become famous under a new moniker — Silicon Valley.

Bob Taggart in 2008 with McCormick Dean Julio M. Ottino (left) and in 1970

A new age

At Stanford, Taggart’s pioneering research helped usher in a new age of low-cost satellite television. “I’m not hogging the credit for this, to be sure,” he says. “I stepped into the program to really make it practical. That’s just one of my niches — I’m good at figuring stuff out and making it simple and low cost.”

Taggart next put that talent to work at Hewlett Packard, where he worked closely with the legendary Bill Hewlett and in 1974 was a key player in the development of the HP-65, the world’s first card-programmable handheld calculator. He spent eight years at HP before moving on to an upstart called Apple Computer and then going into the satellite television business by founding Chaparral Communications out of his garage in 1980.

“We started the company primarily to provide television to people living in rural areas with these fairly large dishes operating at C band,” Taggart explains. “These dishes were 10 feet in diameter, more or less, and that was a very popular service, with about 4 or 5 million of them installed in the United States — primarily on farms and in rural areas. It sort of equalized the availability of information for people who lived in rural areas compared to those who already received cable in suburban and urban areas.”

From its humble origins, Chaparral eventually turned Taggart into a world traveler as it expanded from the United States and Europe to the Middle East, Pacific Rim, and North Africa.

Today the bulk of Chaparral’s business is in Latin America. It maintains an office in Mexico City and sold 35,000 systems to the government of Mexico for use in primary and secondary schools.

“Most developing countries have very few teachers,” Taggart notes. “It’s better to develop programming with the best teachers and transmit it to schools so that the teacher’s helper can be at the school while the children watch. They get a really good lesson and a good education.

“It seems to me that when we design and develop technologies for the humblest of people — the poorest of people — that certainly benefits all of us.”

—Michael Klitzing

Back from study abroad, Jason Sandberg reflects on Africa

As a participant in the study abroad program in global health technologies, Jason Sandberg (biomedical engineering '09) spent spring quarter 2008 working on design projects in Cape Town, South Africa. A year later, Jason reflects on the experience — one that he says will stay with him as he heads to medical school this fall.

For three months last spring I called Cape Town, South Africa, my home. South Africa is a diverse country with 14 nationally recognized languages spoken among descendants of native African tribes as well as European settlers. Solving engineering problems in the context of such diversity was refreshing, but also challenging: refreshing because I never knew what to expect during a given field visit or client interview in an environment so different from what I was used to; challenging because South Africa's diversity required our engineering team to think about how human factors and varying demographics might affect adoption of our device.

"I realized it wasn't just about designing technology to help people. It was about understanding what it means to be South African ... part of a culture different from my own."

While in South Africa, I worked on a team with other McCormick engineers to develop a neonatal apnea monitor that is compatible with Kangaroo Mother Care (KMC). KMC is a practice in which premature infants are nursed back to health not in incubators, but by keeping them in skin-to-skin contact with their mother's chest for hours at a time. While this technique has proved to be an effective solution for the care of premature infants, it does present problems. One major issue is that during KMC the babies are not monitored using traditional methods (checking pulse ox, heart rate, and other indicators that would be measured in an incubator), and there is no current apnea monitor compatible with this therapy's physical peculiarities. Sleep apnea is the primary cause of death for infants undergoing KMC, but an effective monitor could trigger early treatment and improve survival rates.

Some of my favorite days in Cape Town involved trips to local hospitals. We were granted incredible access to mothers and infants. We conducted interviews, collaborated with nurses, and even tested the device on neonates. We later presented our results to students, professors, and doctors at the University of Cape Town.

But my stay in Cape Town was not all work and no play. The program coordinators did an exceptional job ensuring that we experienced everything South Africa had to offer. We took wine-tasting tours through the country's renowned vineyards, went bungee jumping in the Eastern Cape, attended rugby and cricket matches, and enjoyed Cape Town's thrilling nightlife. Perhaps the most impressive experience was a five-day road trip through Namibia, South Africa's northern neighbor. Three other students and I climbed some of the largest sand dunes in the world, took a safari through Etosha National Park, and camped along Africa's western coastal beaches.

I have to admit I was anxious when I first arrived with friends and classmates in Africa. I came with only a cursory knowledge of South Africa, a shortcoming I was not particularly concerned with in the beginning. But three months later, I departed impressed and humbled by a people still striving for a unifying identity among the lingering effects of apartheid. And in the end I realized it wasn't just about designing technology to help people; it was about understanding what it means to be South African. It was about understanding what it means to be part of a culture different from my own.

Modeling the complex systems of the world

Money. Language. Infectious disease.

In our increasingly globalized world, tracking the movement within and boundaries of these huge, complex systems requires large-scale computing, interdisciplinary research, and a different way of thinking. Dirk Brockmann does that kind of thinking. A theoretical physicist who is now an associate professor of engineering sciences and applied mathematics at McCormick, Brockmann is applying his complex systems research to these global issues.

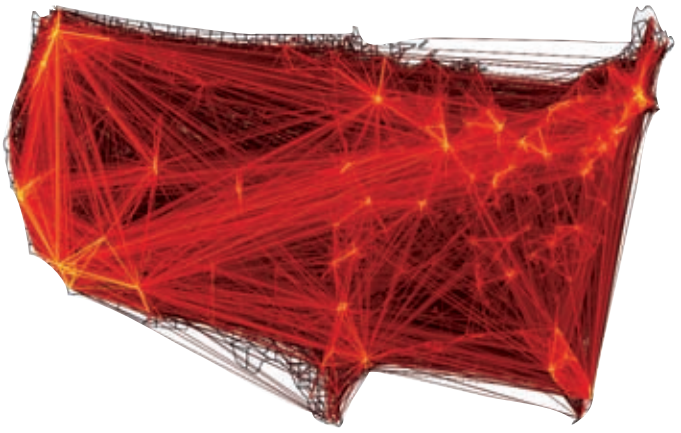
Brockmann started out wanting to use his modeling skills to help solve the world's most pressing issues — like infectious diseases — but he soon found that, like most complex networks, each issue he digs into leads to another, and another, and another. Nevertheless, his findings — illustrated as maps of networks — could have global implications.

Take infectious diseases, for example. In 2003 SARS made headlines when it infected 8,096 people worldwide, and researchers say that a larger-scale flu pandemic, where millions will be infected, is inevitable. "There are a lot of doctors and epidemiologists working on this," Brockmann says. "I'm looking at it from a mathematical epidemiology perspective. We're trying to develop a model to predict the spread of infectious disease worldwide."

Brockmann is examining data to figure out what conditions are necessary for infectious diseases to spread. Knowledge of those factors, along with high-performance computer clusters, can be used to simulate an infectious disease that spreads among 300 million people. "We can, on a very realistic scale, try to model an epidemic that has the same size as a real epidemic," he says.

In order to understand how disease travels, Brockmann must also understand human transportation networks. "These networks play an important role in the spread of infectious disease," Brockmann says. "So we're looking at how people travel in the United States and Europe and trying to find a theory behind human traffic. Then we can unravel the structures within these networks and explain them."

Andrew Campbell



One way to track how people travel is to monitor how money travels. In a 2006 study, Brockmann used data from WheresGeorge.com — a site where users enter the serial numbers from their dollar bills in order to track their travels — to create a model to predict the probability of a bill staying within a 10-kilometer radius over time. That study caught the attention of a linguist in Pennsylvania, who contacted Brockmann to work on a new model — the spatial evolution of language. "English in the United States can be separated into various regions of dialects, and some of those dialect boundaries move over time while others don't move at all," Brockmann says. "It's not understood why those regions are the way they are, so we're trying to use what we know about travel patterns and our network theory tools to see if we can understand how these boundaries work."

This isn't the first time Brockmann has studied boundaries in the United States: He and his research group created a map of community boundaries based on human mobility, rather than the usual state-line boundaries of rivers, mountain ranges, or administrative lines. The map shows that some states, like Missouri, are essentially cut in half — likely due to two large cities that lie on either side of the state. Other boundaries are islands in the middle of states, as is the case with Santa Fe, New Mexico. "These boundaries might be better suited for developing mitigation strategies against epidemics," Brockmann says. "We're working on creating a similar map for Europe."

For his work, Brockmann collaborates with linguists, epidemiologists, ecologists, and other scientists from around the world. "It's fruitful because people have very different perspectives," he says. "It's only productive if the other person thinks that your viewpoint is as valid as theirs, and the other way around."

With so many irons in the fire, Brockmann is motivated by results that could potentially be useful for humanity. "I want to do work that is important, that involves pressing matters," he says. "It motivates me to do research on complex systems that will eventually improve life."

—Emily Ayshford

Top The flux of money among U.S. counties. Yellow lines mean many bills, and dark red lines mean few bills.

Left The movement of dollar bills over one week, according to a study involving WheresGeorge.com.

Tracing disease, assessing sensors, implementing design

These three new professors — all at the beginning of their careers — come to McCormick in hopes of teaching, researching, and collaborating their way to making a difference.

Andrew Campbell

Tracing disease

When it comes to tracing the spread of infectious diseases like HIV, screening programs are by far the most common method of finding infected people. Benjamin Armbruster, assistant professor of industrial engineering and management sciences, wonders if another approach might be more effective. Contact tracing — interviewing infected people, learning who they might have infected, and then seeking out and testing those people — could be more beneficial, his research finds.

"I've looked at the costs and benefits and how it compares to a screening program and thought about how much effort you would want to put into tracing the disease," Armbruster says. "Though it has more costs, contact tracing could provide more benefits because it leads you right to the people who are most likely infected, as opposed to screening programs, which test everyone indiscriminately."

Armbruster comes to Northwestern from Stanford University, where he received his PhD and did his dissertation on contact tracing. "The benefit of contact tracing is that the people who have been in contact with the infected person are quite likely to be infected themselves," Armbruster said. "But there's definitely more cost involved. It takes time and resources to do the interviewing well, and infected people might be reluctant to tell you who they've been in contact with. It also might be difficult to find the people they've been in contact with, especially if you're looking at HIV, where you might want to go back a few months or years."

Nevertheless, Armbruster hopes to take his research even further and make the case for contact tracing of HIV cases in Africa. "Currently most people in Africa find out if they're infected through screening programs," he says. "As far as I know, nobody has done contact tracing or looked at whether this might be a worthwhile idea."

In addition, Armbruster hopes to look at other health care problems, such as gauging the effectiveness of antibiotic use in hospitals and mandatory tests for drug-resistant staph infections for ICU patients in Illinois (the result of a law that went into effect in 2008).

For now, however, Armbruster is focusing on teaching and getting to know Northwestern. "The IEMS department had a good reputation," he says, "and that reputation is absolutely true — everyone here is extremely nice. And I enjoy the students. It is extremely fun to teach."

Measuring materials

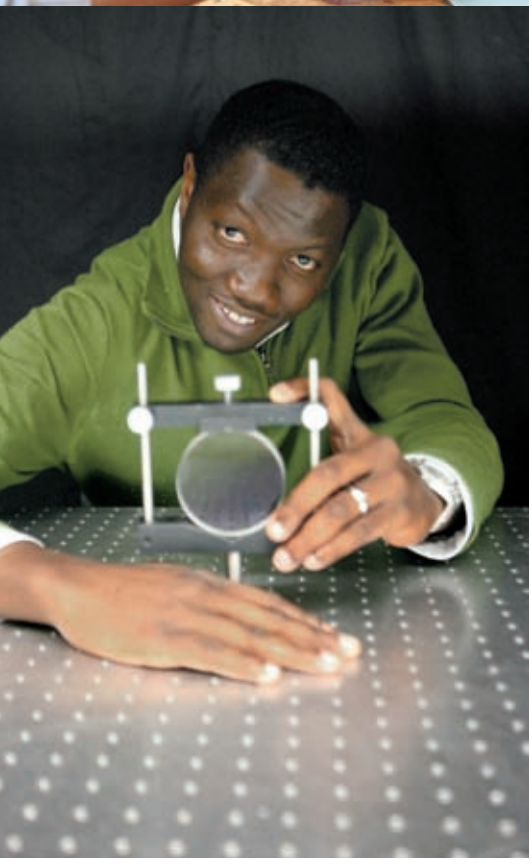
For Oluwaseyi Balogun, assistant professor of mechanical engineering and civil and environmental engineering, McCormick was the place to be. "The excellent scholastic standards, research pedigree, and collaborative atmosphere are very attractive to me," says Balogun, whose research interests are in the areas of optical metrology and materials characterization. "I am truly excited to be in the midst of top-notch engineers and scientists."

Balogun first came to Northwestern as a postdoctoral fellow in 2007. When a position opened in the Department of Mechanical Engineering, Balogun applied and found himself in a world where new ideas and interdepartmental collaborations abound. "It has really motivated me to expand my envelope of knowledge," he says. "Northwestern University has provided me with a unique opportunity to facilitate the continued development of reliable and sustainable engineering structures for high-performance applications through research."

Balogun and his graduate student are working to develop advanced optical tools to assess the structural integrity of engineering structures and predict their in-service reliability and performance.

He is currently developing an optical microscopy system that can be used for the noninvasive mapping of local mechanical and thermal properties in micro- and nanostructured materials used in microelectronic devices, high-temperature coating applications, sensors, and energy-storage devices. The microscopy system uses a laser source for the local generation and detection of thermoelastic waves. Through the measurement of the interaction of the thermoelastic waves with the surface and interior structure of a material, Balogun can determine the elastic and thermal properties with high precision, in addition to probing the internal structure of the material for various types of structural defects that may alter the expected physical behavior of the material.

Balogun is also interested in the application of the microscopy system for the mapping of deeply buried nanoscale defects in microelectronics devices. These defects may adversely affect the functional performance and reliability of these devices. At



Clockwise from left
Elizabeth Gerber, Oluwaseyi Balogun, Benjamin Armbruster

the moment, the characterization of deeply buried nanoscale structural defects in microelectronic devices remains a formidable challenge as the component density of these devices continues to increase.

While the optical microscopy system Balogun is developing is tailored for the characterization of small-scale structures, he is also interested in the development of optical sensors for monitoring the structural health of large-scale civil infrastructures including bridges, dams, and levies.

In the meantime, Balogun is collaborating with a faculty member at McCormick to develop optical fiber and ultrasonic sensors for monitoring the dynamic mechanical response of civil bridges. "The goal of this undertaking is to develop diagnostic and predictive tools for estimating the functional lifetime of aging civil infrastructures," he says. "This is a new and exciting area of research that directly impacts society."

Designing life

Liz Gerber's plan wasn't to be a professor — she wanted to be a designer. In fact, she worked as a designer for a toy company before going back to school to get a master's degree in product design at Stanford University.

But while at Stanford — the moment actually came while designing a laparoscopic suturing device — she found herself more interested in the psychology of the design process than the design itself.

"I had this 'Aha!' moment," she says. "As user-centered designers, we go and observe people and design a solution to their problem, but some individuals and teams are more effective at this process than others. I was more interested in how individuals and teams routinely innovate and the organizational context that supports practices leading to great designs. I went from, 'What's the human reaction to designed products?' to 'What's the human interaction in design processes?'"

So Gerber, now an assistant professor of mechanical engineering affiliated with the Segal Design Institute, spent the next several years studying the psychological experience of enacting design and innovative practices and researching how firms adopted design practices as a means to innovation — all while helping Stanford start up a new design school.

"The Stanford Institute of Design aimed to expand the design process to organizational issues and systems-level design. That's part of what drew me to Northwestern — to be part of an institution that's building something like the Segal Design Institute. Northwestern's proximity to Chicago, a center for improvisational theater and innovation, was also a draw," she says.

A young Gerber had also discovered Don Norman's books on everyday design and found his vision compelling, so the opportunity to work with him — which she will do when she coteaches a Service Design course with him this spring — was too good to pass up. She also saw McCormick as a place where she could apply her theoretical work. "Everybody designs in an engineering school," she says. "So it's a good place to develop theory informed by practice and practice informed by theory."

So far, Gerber has worked with other faculty on big-picture engineering ideas — like teaching freshmen sustainable design practices or exploring the idea that design engineers could engage in civic services like teachers do through the Teach for America program.

"I feel a moral imperative to give students an awareness of issues surrounding green design," she says. "Along the same lines, we're brainstorming with students about what a program would look like if designers and engineers worked in service to their community through participatory design. We're calling the program Design for America."

As a young female faculty member in an engineering school, Gerber also hopes to be a role model for female students. But most of all, Gerber hopes to find a way to inspire good design in all areas. "My vision is to create tools and practices so that everybody has a sense of creative confidence and the ability to design the world around them," she says.

—Emily Ayshford

Andrew Campbell

Left The control room in Noshir Contractor's lab, behind a two-way mirror
Below right Contractor and his graduate students in the SONIC lab

What virtual worlds can teach

In online worlds — where people get together to slay dragons, buy and sell goods, chat, and just, well, hang out — every interaction leaves a digital trace. For an engineer and social scientist like Noshir Contractor, those digital traces are a treasure trove.

Contractor — who is the Jane S. and William White Professor of Behavioral Science with appointments in industrial engineering and management sciences, communication studies, and management and organizations — studies networks: how and why they are formed. By collaborating with other experts and mining online game data logs for clues, he's beginning to find surprising results about online interactions that translate into how we think about networks in the real world.

"The motivation for this comes from the observation that sometimes groups come together and are incredibly successful — and sometimes they are not," he says. "What makes the difference? This sort of social network analysis tries to find out how to improve our ability as a society to assemble effective teams."

Contractor and his collaborators — who include scientists and engineers from around the country — are studying nearly 60 terabytes of data from EverQuest II, a massive multiplayer online role-playing fantasy game in which players complete quests and socialize with one other. The researchers analyzed this data along with a survey of 7,000 players, making it one of the largest social science projects ever performed. (Researchers didn't know the real identities of any of the players from the logs or surveys nor the content of their interactions — just their actions and interactions.)

"In many ways it's a microcosm of our existence in the general social world," Contractor says.

Contractor's group has mined the data logs from EverQuest II to look for "structural signatures" that indicate different kinds of social network configurations. These configurations can then be tested to see if social network theories discovered in offline networks ring true online.

"Up until now, testing these theories has involved labor-intensive interviews that don't get a real sense of a person's network," says Contractor.

A quest for data

By matching up survey results with anonymous player data, researchers found that many players underestimate the amount of time they spend playing the games. They also found that women don't like to play with other women but are generally the most dedicated and satisfied players. And they found that players aren't just teenagers — in fact, the average age of a player is substantially higher.

What surprised Contractor most was that, even though players could play the game with anyone anywhere, most people played with people in their general geographic area. "People end up playing with people nearby, often with people they already know," Contractor says.

"It's not creating new networks. It's reinforcing existing networks. You can talk to anyone anywhere, and yet individuals 10 kilometers away from each other are five times more likely to be partners than those who are 100 kilometers away from each other."

Worldwide, nearly 45 million people play massive multiplayer online role-playing games like EverQuest II, and the amount of real-world money associated with virtual worlds would make it the seventh largest country in the world according to gross domestic product.

"This is not a trivial issue," Contractor says. "Now that we have the computing power to study these networks, we can explore different theories about social processes on a scale that was never possible before."

Contractor and his collaborators have also studied Second Life, which differs from other massive multiplayer online games in that there is no manifest goal: People create virtual avatars of themselves and then chat with other people and buy and sell items. The game currently has more than 15 million accounts.

Exploring Teen Grid

In order to make sure that minors could safely participate, Second Life created Teen Grid, where only teenage players can socialize. How successful could such a world be? Linden Lab, the makers of Second Life, contacted Contractor and his collaborators to find out.

"Among other questions, they wanted to learn how networks might help identify potential troublemakers within Teen Grid," Contractor says. In return, Contractor and his colleagues got access

Andrew Campbell

to huge amounts of data that give them a way to answer how the networks were created.

"We wanted to ask basic questions about communication theory: To what extent are people joining groups because their friends are part of the group? To what extent are they becoming friends with people in the groups they've joined? We don't have good ways of tracking that in the real world."

Searching through vast amounts of anonymous data, Contractor and his collaborators found that teens had online friendships that were most likely to be with people in their immediate geographic area, likely people they already knew. "That finding really went against a lot of the media hype," Contractor says. "People were worried about helpless teenagers talking with strangers, but that is not what we found. This is the first time this has been based on solid evidence." Teenagers also tended to be friends with the friends of their friends, not with people who weren't part of their network already, the researchers found.

Researchers found another ideal test case in Teen Grid: When teenagers turn 20, they must leave Teen Grid and go on to the regular Second Life, leaving their entire network of friends behind. "This provides a nice natural experiment to see the transition of being suddenly severed from one network and being introduced to another," Contractor says.

Besides studying online games, Contractor and his colleagues are studying virtual organizations in science. The National Science Foundation has set up several virtual communities where researchers can come together to share tools, documents, presentations, and data, as well as chat and form teams.

"We want to understand how these teams of scientists come together," Contractor says. "There is all this research that says interdisciplinary research teams that are geographically distributed fail most of the time, but when they do succeed, they succeed spectacularly. What is it about successful teams that allows them to succeed? How can we engineer teams that nurture geographical and disciplinary diversity without breaking down the team?"

In addition to studying those networks, Contractor and his colleagues help enable the network — making recommendations to people (like Amazon.com does with books) based on that person's network of people they know and have collaborated with in the past.

"In this case, we can see not only how teams come together and how they work, but we can also hopefully make a difference in helping to solve the biggest societal issues of our time," Contractor says.

—Emily Ayshford

us about reality

Faculty honors

Jan Achenbach, Walter P. Murphy Professor and Distinguished McCormick School Professor in mechanical engineering, civil and environmental engineering, and engineering sciences and applied mathematics, was elected a member-at-large of the International Union of Theoretical and Applied Mechanics.

Guillermo Ameer, associate professor of biomedical engineering, was elected to the College of Fellows of the American Institute for Medical and Biological Engineering.

Dan Apley, associate professor of industrial engineering and management sciences, has been named editor in chief of the *Journal of Quality Technology.*

Zdeněk Bažant, McCormick Institute Professor and Walter P. Murphy Professor in civil and environmental engineering and in materials science and engineering, received the Outstanding Contributions Award from the International Association for Computer Methods and Advances in Geomechanics and was selected to receive the American Society of Mechanical Engineers Nadai and Wilhelm Exner Medals. He has also been elected foreign corresponding member of the Spanish Royal Academy of Engineering (Real Academia de Ingenieriá). He gave the plenary lecture at CONCREEP8 and the semi-plenary lecture at WCCM8.

Linda Broadbelt, professor of chemical and biological engineering, received the 2008 Mentorship Award, sponsored by the Women's Initiatives Committee of the American Institute of Chemical Engineers.

Fabián E. Bustamante, associate professor of electrical engineering and computer science, became a senior member of the Association for Computing Machinery, the world's largest computing society.

Jian Cao, professor of mechanical engineering, was appointed to the board of directors of the North American Manufacturing Research Institute of the Society of Manufacturing Engineers and became chair of the ASME Manufacturing Engineering Division.

Isaac Daniel, Walter P. Murphy Professor in civil and environmental engineering, won the best paper award from the Society for Experimental Mechanics for "Thermomechanical Enhancement of Fiber Composites with Carbon Nanoparticles," coauthored with research associate Jeong-Min Cho.

David Dunand, James N. and Margie M. Krebs Professor in materials science and engineering, won the Minerals Metals and Materials Society 2008 Structural Materials Division Distinguished Scientist/ Engineering Award.

Horacio Espinosa, professor of mechanical engineering, was elected a fellow of the Society for Experimental Mechanics.

Morris Fine, Walter P. Murphy and Technological Institute Professor Emeritus in materials science and engineering in service, and **Semyon Vaynman,** research professor in materials science and engineering, have won the TMS 2009 Application to Practice Award for their work on steel development and implementation.

Ken Forbus, professor of electrical engineering and computer science, gave a keynote speech at the Australasian Interactive Entertainment 2008 conference in Brisbane in December.

Emmanuel Gdoutos, research associate of civil and environmental engineering, was elected a corresponding member of the Academy of Athens, a member of the European Academy of Sciences and Academia Europaea, and a fellow of the European Structural Integrity Society. He also received an award of merit from the European Structural Integrity Society.

Jason Hartline, assistant professor of electrical engineering and computer science, was awarded an NSF CAREER grant for his project titled "Mechanism Design."

Dean Ho, assistant professor of biomedical engineering and mechanical engineering, served as guest editor of the *Journal of the Association for Laboratory Automation*'s special issue on nanobiotechnology and was named the journal's editor in chief. He was awarded an NSF CAREER grant for his project titled "Scalable Fabrication of Nanodiamond Patch Platforms for Sustained Drug Release."

Yonggang Huang, Joseph Cummings Professor in civil and environmental engineering and in mechanical engineering, gave the Nowinski Lecture at the University of Delaware.

Aggelos Katsaggelos, Ameritech Professor of Electrical Engineering and Computer Science, was the distinguished lecturer of the IEEE Signal Processing Society in December. He was also elected a fellow of the SPIE.

Prem Kumar, professor of electrical engineering and computer science and physics and AT&T Professor of Information Technology, delivered a distinguished lecture sponsored by the IEEE Lasers and Electro-Optics Society at the Time and Frequency Division of the National Research Council. He also was elected a fellow of the American Association for the Advancement of Science (AAAS).

Harold Kung, professor of chemical and biological engineering, delivered a keynote lecture at the 14th International Congress on Catalysis.

Lincoln Lauhon, assistant professor in materials science and engineering and Morris E. Fine Professor in Materials and Manufacturing, has been appointed a Kavli fellow by the Kavli Foundation.

Tobin Marks, Vladimir N. Ipatieff Professor of Catalytic Chemistry and professor of materials science and engineering, has been elected an honorary fellow of the Chemical Research Society of India and a fellow of the Materials Research Society.

Teri Odom, associate professor of chemistry and materials science and engineering, will receive the 2009 Outstanding Young Investigator Award from the Materials Research Society.

Monica Olvera de la Cruz, professor of materials science and engineering and chemical and biological engineering, was appointed vice chair of the Solid State Sciences Committee of the National Academies.

Thrasos Pappas, associate professor of electrical engineering and computer science, is the technical program cochair for the 2009 IEEE International Conference on Image Processing.

Peter Scheuermann, professor of electrical engineering and computer science, was elected a fellow of the AAAS.

Surendra Shah, Walter P. Murphy Professor in civil and environmental engineering, became a member of the Indian National Academy of Engineering. He also gave the keynote address at the 50th Brazilian Concrete Congress (IBRACON 2008).

Selim Shahriar, professor of electrical engineering and computer science, was elected a fellow of the SPIE.

A paper by **Lonnie Shea,** professor of chemical and biological engineering, (written with Teresa Woodruff, professor of obstetrics and gynecology at the Feinberg School of Medicine) published in *Tissue Engineering* in 2006 was identified as having the highest impact in the field over the last two to three years. It was also was named top reproductive biology article over the past five years.

Karen Smilowitz, William A. Patterson Junior Professor of Transportation and associate professor of industrial engineering and management sciences, was invited to participate in a National Academy of Engineering Workshop on Engineering, Social Justice, and Sustainable Community Development.

Sam Stupp, Board of Trustees Professor of Materials Science and Engineering, Chemistry, and Medicine and director of the Institute for BioNanotechnology in Medicine, received the 2009 Israel Pollack Distinguished Lecture Series Award from the Schulich Faculty of Chemistry at the Technion–Israel Institute of Technology. He also received an honorary membership in the Israel Chemical Society and was named a fellow of the Materials Research Society.

Jeff Thomas, research associate professor of civil and environmental engineering, was awarded the Brunauer Award for the best paper published by the American Ceramic Society in the area of cements at the Materials Science and Technology conference.

Chad Mirkin, professor of biomedical engineering, chemical and biological engineering, and materials science and engineering, George B. Rathmann Professor of Chemistry in the Weinberg College of Arts and Sciences, and professor of medicine in the Feinberg School of Medicine, was elected to the National Academy of Engineering. He received the 2008 Biomedical Engineering Society's Distinguished Achievement Award, the Esselen Award for Chemistry in the Public Interest from the Northeastern Section of the American Chemical Society, and the Havinga Medal 2009 from the University of Leiden in the Netherlands. He also received the 2009 Pittsburgh Analytical Chemistry Award for his contributions to the field of analytical chemistry through the development of nanoparticle-based biodetection strategies, the invention of dip-pen nanolithography, and contributions in supramolecular chemistry.

Luís Amaral, associate professor of chemical and biological engineering, has been appointed an Early Career Scientist by the Howard Hughes Medical Institute. With his expertise in computer-based modeling and support from the institute, Amaral wants to build the "Google Maps" of cellular organization — interactive maps of complex biological networks to help guide those working in molecular biology. He is one of 50 scientists from 33 institutions across the United States selected for the honor. He will become a full-time employee of the institute for six years while retaining his affiliation with Northwestern. This year Amaral also delivered a keynote talk at the Networks and Neuroscience Symposium at Cambridge University.

1960s

Samuel A. Culbert ('61), professor of management at the University of California, Los Angeles, Anderson School of Management, wrote *Beyond Bullsh*t: Straight-Talk at Work* (Stanford University Press, 2008). He has received the American Association of Publisher's Best Management Book of the Year Award and the *Harvard Business Review*'s McKinsey Award.

Edward F. Voboril ('65), chairman of the board of the Analogic Corporation, was appointed independent lead director of IRIS International's international board of directors.

James F. Mann ('66), formerly at LNR Property Corp. in Atlanta, was named managing director and head of commercial development at HDG Mansur.

Dwight A. Beranek ('68) was named market services manager for the Department of Defense programs of Michael Baker Jr. Inc., an engineering unit of operations and maintenance services provider Michael Baker Corporation.

1970s

Richard W. Gochnauer ('72), president and chief executive officer of United Stationers, has been named to the board of directors of AmerisourceBergen Corporation.

Matthew Tirrell ('73) was appointed chair of the department of bioengineering at the University of California, Berkeley.

Donald P. Monaco ('74), owner of Monaco Air Duluth, was appointed to the Metropolitan Airports Commission of St. Paul.

Kenneth J. Zdunek ('74, MS '75), a research faculty member in electrical and computer engineering at the Illinois Institute of Technology, was elected a fellow of the Institute of Electrical and Electronics Engineers.

Paul G. Anderson (PhD '76) is president-elect of the Society of Plastics Engineers.

Meena Mutyala ('77) was recently promoted to the newly created position of vice president and business leader of India strategy at Westinghouse Nuclear Fuel. She also received an honorary doctor of engineering degree from Central Michigan University and is leading a delegation to India to begin pursuing the country's nuclear power market.

1980s

Donald Lee Hoffman ('80) has been named chief technology officer at Scayl, an early-stage software startup that he founded with two partners.

Michael Willett ('81) is chief engineer in the intelligence, surveillance, and reconnaissance systems division of General Dynamics in Chantilly, Virginia.

Richard D. Zorowitz ('81), chief of the department of physical medicine and rehabilitation at Johns Hopkins Bayview Medical Center in Baltimore, was named to the clinical advisory board at Victhom Human Bionics.

Stephen A. DeBacco ('82), formerly chief operating officer of Workbrain Incorporated, was hired as executive vice president of worldwide sales at Empathica, a provider of customer experience management programs.

Benjamin W. Slivka ('82, MS '85) launched DreamBox Learning K-2 Math, a web-based game that combines individual adaptations, an in-depth math curriculum, and game-like adventures to provide an engaging math-learning experience for children age four to eight.

Steve Bower ('83) is a freelance software developer specializing in the nascent software-as-a-service area. He left Oracle after 10 years as vice president of engineering.

Annetta M. Hewko ('83), most recently director of health and wellness, international, at PepsiCo, was named vice president, international, at Susan G. Komen for the Cure, based in Washington, D.C.

Rita D. Brogley ('87) was named a director and CEO of Amadesa, a web-site testing and personalization firm.

Send us your news!

Please e-mail your news to magazine@mccormick.northwestern.edu.

In memoriam

Don I. Hervig, '36
James H. Pomerene, '42
Donald O. Wilt, '44
Paul W. Koehler, '45
Sidney R. Collis, '47
Ned E. Mitchell, '47
Ralph V. Rentzsch, '48
Ernest M. Roth, '48
Charles O. Barnes, '49
Ralph E. Drewitz, '50
John J. Nimrod, '50
Robert L. Pasek, '50
Richard N. Williams, '50
Ferdinand G. Fender, '51
John Southey Wise Sr., '51
Philip C. Kauffmann, '52
Victor G. Whicher Jr., '53
John K. Cochran, '54
Paul W. Erb, '54
Robert J. Boram Jr., '59
Norbert F. Pasko, '59
Marvin C. Bergwall, '61
George F. Hauck, '64
Roderick P. Donaldson, '65
Jon A. Larson, '65
David B. Bandy, '68
Clarence E. Lowery, '74
Brad Bennett, '77
Cecilia A. Friskie, '83
Scott A. Baarman, '84
James S. Roberts, '95
Charles Joseph Sharp, '05

Terence L. Davis ('88), most recently president of U2 Mentoring, was named chief operating officer of Girl Scouts Heart of the South.

Sharon L. Harmsworth ('88) was promoted from assistant vice president of engineering and research to vice president of equipment at TTX Co. in Chicago.

William F. Stanczak Jr. ('89) was named director of commercial sales in the newly launched commercial division of Inspired Electronics Inc.

1990s

Todd Curry ('90), formerly president of e-marketing consultancy for Ascenda Partners LLC, was appointed vice president of marketing at Ifbyphone, a hosted telephone application platform company.

Michael A. Molano ('90), most recently a partner at Mayer Brown, was named a partner in the intellectual property practice group at Sheppard, Mullin, Richter & Hampton in Silicon Valley.

David L. Nichols ('91), a managing partner at Accenture, was named to the *Crain's Chicago Business* "40 under 40."

Milton M. Morris ('92), most recently director of program management and operations at InnerPulse Corporation, was named vice president of research and development at Cyberonics Inc.

Paul J. Brown ('94), formerly president of Expedia North America, was appointed president of global brands and shared services at Hilton Hotels Corporation, based in Beverly Hills.

John N. Ivan ('94) was promoted to professor of civil and environmental engineering at the University of Connecticut in August 2006. He is currently on sabbatical leave, working for the spring semester 2009 as a visiting researcher at Lund University in the department of traffic and roads.

Mark Price ('94) began a fellowship in sports medicine at Massachusetts General Hospital after graduating from Harvard Medical College's combined orthopedic surgery residency programs. He works with many local sports teams, including the New England Patriots, Boston Red Sox, and New England Revolution.

Brian Sabina ('95) is program director of the Chicago branch of Reach the World, an educational program that teaches inner-city students about other cultures and environments through interactive travel adventures. He is mentioned in an article published in the *Erie (PA) Times-News* about the program's beginnings and a sailing trip around the globe in which he took part.

Peter Banks ('97) was promoted to vice president of engineering at the Nickelodeon Kids and Family Games Group.

Lauren Levrant (civil and environmental engineering '05), project manager, Pinnacle Housing Group, Miami

On her career: At Pinnacle, a provider of affordable housing for low-income residents, Levrant assists in the process of acquiring undeveloped land, finding financing through federal funds, developing the land with engineers and architects, and serving as a liaison for construction. "I began at Pinnacle as an assistant project manager helping on statewide projects and eventually became a manager responsible for all developments in Miami-Dade County, where about a third of the company's projects take place. I feel like I am giving back. I help house low-income families. It means so much to see the appreciation in their faces."

What she learned at McCormick: Levrant cites McCormick as a place she learned about perspective when approaching a project. "I took project management and construction management, so there were many group projects that helped me develop a sense of how to work in a team."

She also gained some important life lessons. "Everyone has their specialty — something they're specifically good at. People who can recognize that and combine their talents and efforts harmoniously can work much more effectively."

Staying connected: She still keeps close ties with fellow McCormick alumni in the Miami area. "They are still close friends, and I am appreciative we have a network available to us to stay in touch."

Best McCormick moment: In a class taught by Joseph Schofer, professor of civil and environmental engineering, Levrant and classmates visited various prominent engineering sites throughout Chicago where McCormick alumni worked. "We visited the el and discussed transportation planning in depth. It was extremely helpful to see the practical application of engineering first-hand."

Most unlikely application of her engineering background: "I'm not sure if any application so far is unlikely. I'm fortunate to say I've used my degree quite a bit in my field."

Words of advice to current students: "Absorb what you're being taught even though, at first, you may not understand why it's beneficial."

—Lina Sawyer

Sam Pickerill (biomedical engineering '06, '08), Fulbright Research Scholar, Fudan Medical College, Shanghai, China

On his career: Pickerill resides in China, where he researches tuberculosis diagnostic design and public health. "I love being a part of idea creation and then seeing how it takes shape in reality. My hope is to bring more community-minded design solutions to underserved areas."

What he learned at McCormick: "While community development does not involve designing or engineering pieces of technology for automation or efficiency, it does involve organizing people, innovative thinking about how those people could form a movement of change within an organization or community, and motivating those groups in a sustainable way. McCormick taught me that there is a larger picture in engineering: technology development for social improvement.

"My experiences in Northwestern's first Global Health Technologies program in South Africa gave me a chance to bring technology design to underserved areas. I had to have a deep knowledge of social factors that would determine the use and usefulness of our designs, and McCormick prepared me for that."

Pickerill remained in South Africa after graduation and as a graduate student took part in a Whitaker International Fellowship studying public health disparities and associated factors including gender, development, health systems and HIV/AIDS and tuberculosis. "I examined cost analysis and quality of care. These experiences not only provided tools for health-related work, but helped me understand the various factors that determine the success of engineering design or community development projects. I went back to Northwestern and had the privilege of working and learning from some of the best engineers and designers in the country at Northwestern's Center for Innovation in Global Health Technologies. This experience required the development of specialized knowledge of engineering principles needed to bring a new product to market."

Staying connected: "I stay in touch through online communities such as the Northwestern LinkedIn group, and I keep abreast of events through listservs and my younger brother, who is a freshman."

What Northwestern means to him: "At the root of what it means to be an engineer is the passion to solve problems or to adjust the world for the better. This is what Northwestern has taught me."

—Lina Sawyer

Daniel Boss (PhD '97), previously with USG Corporation, was named vice president of engineering at Serious Materials, a manufacturer of green building materials.

Craig Witsoe ('97), former president and chief executive officer of Tyden Group, was named chief executive officer of Lineage Power Corporation.

Jose Adrian Bayardo ('98) was promoted from vice president of corporate development and investor relations to vice president and chief financial officer of Complete Production Services Inc.

2000s

David A. Liebelt ('01) began an orthopedic surgery residency at Montefiore Medical Center in July. He received his medical degree and doctorate from the Albert Einstein College of Medicine of Yeshiva University in June.

Scott Van Broekhoven ('01) became a staff member in the aerospace engineering group at the Massachusetts Institute of Technology's Lincoln Laboratory after receiving a master of science degree in engineering systems from MIT in June.

Jerome L. Budzik (PhD '03), founder and chief technology officer of MediaRiver and a former McCormick faculty member, was elected to the board of directors of the Illinois Mathematics and Science Academy.

Jay P. Goyal ('03), an Ohio state representative, was the featured speaker at the National Honor Society induction ceremony in November 2008 at Lexington High School in Lexington, Ohio, from which he graduated in 1999.

Mark Kevin Klossner ('04) was promoted from managing director to vice president and general manager at Altra Holdings Inc., an automotive parts manufacturer.

Mary Beth Holden ('08) was named a research associate at Abelson Taylor, an independent advertising agency in the healthcare field.

Kelly Koenig (MITP '08), a Chicago-based consultant, had her research findings on quantum nanotechnology as a means of preventing identity theft featured in an article in the *Chicago Sun-Times*.

Danielle Latoya North ('08) was appointed a technical sales representative at Schulke Inc.

Rodney Priestley (PhD '08) won the Quadrant Award (first prize) for his thesis titled "Effects of nanoscale confinement and interfaces on the structural relaxation of amorphous polymers monitored at the molecular scale by fluorescence and dielectric spectroscopy." He also joined the department of chemical engineering at Princeton University as an assistant professor.

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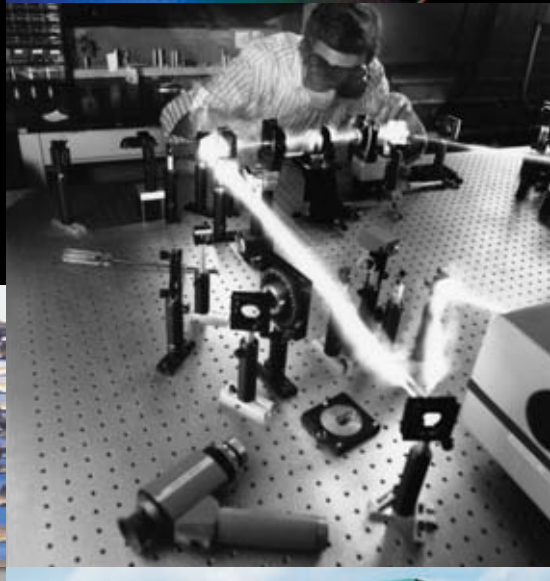
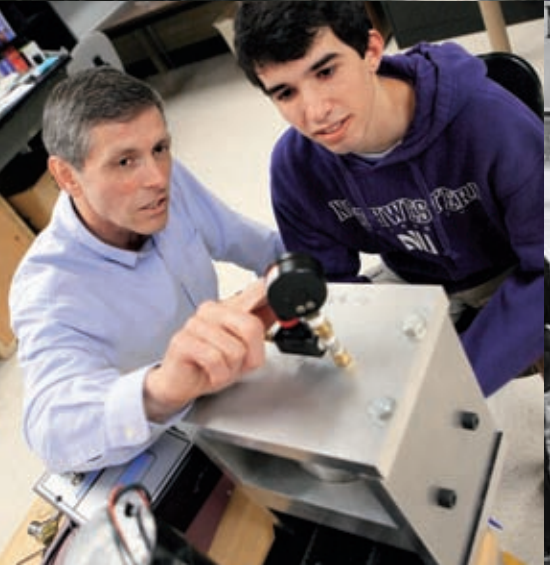
McCormick celebrates its Centennial during the 2009–10 academic year. Look for more details soon!





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of Engineering and Applied Science
Northwestern University
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2145 Sheridan Road
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Students in McCormick's study abroad program in global health technologies spend the spring quarter in Cape Town, South Africa, for a design-intensive, immersive experience in technology development for resource-poor environments.