Northwestern University

McCormick by Design

Robert R. McCormick School of Engineering and Applied Science

Fall 2005

A new center for design

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ON THE COVER: The new Ford Motor Company Engineering Design Center at the McCormick School

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Greetings from McCormick

As this issue of *By Design* goes to press, we in the McCormick community have just celebrated the opening of the new Ford Motor Company Engineering Design Center. This landmark is not simply a matter of facilities or infrastructure — though it is certainly a milestone on those terms. The new structure also makes concrete our commitment to design at all levels and throughout the curriculum.

In my first months as dean I have had the privilege to meet with students, faculty, parents, donors, and friends to discuss the importance of design at the McCormick School. Doing so has made clear the importance of design not just to the McCormick curriculum but also to our nation. In the past we had a magic formula: knowledge, technology, capital. But as knowledge becomes more rapidly diffused, it no longer gives us the competitive advantage it once did. The importance of design in fostering innovation cannot be overstated. Innovation is the greatest competitive edge that this country has right now. The ability to innovate is key — and design sharpens that creative edge.

Just how we help hone that edge at McCormick is the subject of the suite of stories "All about Design" at the undergraduate, graduate, and institutional levels — notably through the Ford Motor Company Engineering Design Center. These stories illustrate how thoroughly design is incorporated into the life of our school.

Another significant development is the merger of faculty in computer science and electrical and computer engineering into the new Department of Electrical Engineering and Computer Science. This move facilitates the interdisciplinary collaborations that are a hallmark of research and teaching at McCormick and make us a stronger school.

As we welcome a new department, so we also celebrate the 50th anniversary of our Department of Materials Science and Engineering. The story and timeline in this issue show that Northwestern's material scientists have been and remain true pioneers of the field. One of those pioneers is Morris Fine, the subject of another story describing his longstanding research into high-strength steel and how it came to fruition in a railroad bridge near Chicago.

A newer generation of researchers is making its mark in McCormick's labs as well. Whether it is Mark Hersam working at the frontiers of nanotechnology, Annelise Barron exploring the use of peptoids for biomedical applications, or Sascha Hilgenfeldt harnessing the power of bubbles, our young faculty members bring credit to our school and its reputation for discovery.

In a time of growth and change we are keenly aware that so much of what we have accomplished at the McCormick School grows from the support of our donors. Perhaps the most direct examples of this support are the projects funded each year by the Walter P. Murphy Society, making unique educational opportunities available to our students. Two such projects — the Mechatronics Design Laboratory and an initiative to create courses on information and communication security — are profiled in our "Giving Report."

It is with gratitude that we acknowledge all of last year's donors to the McCormick School in this issue of *By Design.* We look forward to your support as we push ahead.

Julio M. Ottino, Dean | November 2005

All about DESIGN

Too many people think that design means putting a pretty face on a finished product," says Julio M. Ottino, dean of the McCormick School. "But that's only the tip of the iceberg. Design is much bigger than that," he says, stretching his arms wide to illustrate. "It is all embracing. It's a way of thinking, a pathway to creativity and innovation."

Design begins where it ends — with a concentration on the user. "Design should be based on consideration for use — by people and society," says design guru Don Norman, professor of electrical engineering and computer science at McCormick and author of *Emotional Design: Why We Love (or Hate) Everyday Things.* "Design should fulfill our needs, be easy to understand, be easy to use, and work the way we want it to."

Design infuses everything at McCormick, from the sequence of courses taken by all incoming engineering undergraduates to the advanced research under way in laboratories across campus. And now, with the completion of the Ford Motor Company Engineering Design Center, design has a sleek new home at McCormick.

Rewarded, amply, with a smile

Last winter, when Sara Wang (biomedical engineering '08) enrolled in Engineering Design and Communication (EDC), a two-quarter sequence taken by all new engineering undergraduates, she had been thinking about transferring out of McCormick into Northwestern's Judd A. and Marjorie Weinberg College of Arts and Sciences. But as soon as Wang and her EDC teammates became engaged in designing a walker that would offer increased mobility to a five-year-old with cerebral palsy, any doubts about engineering went out the window.

"EDC made me want to stay in engineering," says Wang. "The best parts were refining the design and contacting the client. I really liked the little boy, and I liked being able to help his family."

Wang and her three teammates dubbed the Spider-Man–themed walker they created Everywhere Riley, reflecting their hope that it would enlarge their young client's world. Their achievement was remarkable, says Riley's mother, Diane Ganka. "We realized that we were asking for a lot," she says. The wish list included making the

Diane and Riley Ganka (at left) with their EDC design team

walker maneuverable over uneven surfaces like grass or carpeting, collapsible for easy transport, and small enough to fit through the kitchen door — Riley's old walker was too wide for that — yet sturdy enough to support the weight of a growing boy.

"The students addressed every single requirement," says Ganka, "and on their own they thought of ways to make the walker even better. Instead of putting arm straps on both sides, they realized that because Riley's left side is weaker, they could design an armrest for the left side instead of a strap. It was very clever and sensitive of them." The students asked Riley to name his favorite superhero and then put Spider-Man fabric on the armrests. "They personalized it," says Ganka, "which is another reason Riley likes it. They went above and beyond engineering."

In fact, personalizing design is at the heart of engineering. Jeanne Herrick, lecturer with the Weinberg College Writing Program and an EDC coinstructor, calls the Everywhere Riley project "a good example of how students learn that, by doing innovative design based on sound user-centered research, they have the potential to make a positive difference in a person's life." Herrick says that when the students "saw Riley's smile as they showed him his new walker for the first time, their hard work was richly rewarded, far more than any grade can do."

Kevin Chou (materials science and engineering '08), one of Wang's teammates, liked the hands-on challenges of EDC. He signed up for much more than the required 4 hours of machine shop training and spent another 30 hours helping to fabricate the walker. "Before I took EDC I thought I was pretty good at design," he says, "but after some group brainstorming I learned that design is teamwork. One person can't come up with ideas as good as the team's."

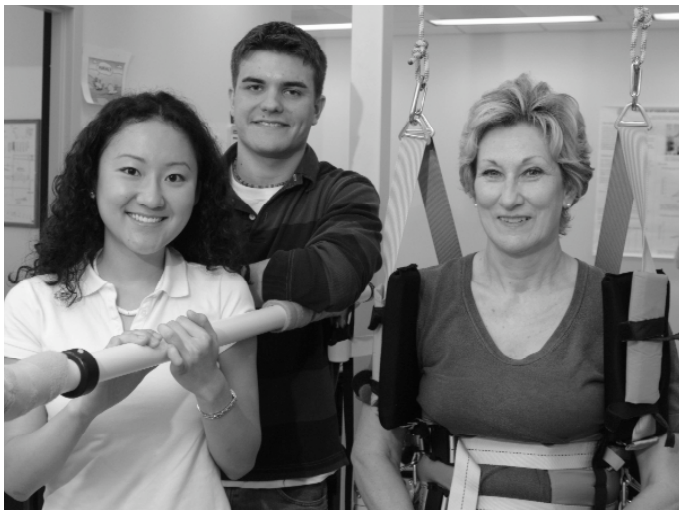
Hooked on design

EDC gets students revved up about design, but what happens after freshman year? Taking the excitement of EDC and extending it throughout the curriculum — and throughout McCormick — is the mission of the Institute for Design Engineering and Applications at Northwestern. "We want to build on EDC and provide opportunities for increasingly sophisticated work," says IDEA director J. Edward Colgate. "We're here to support a culture of design at McCormick." Colgate, who is also professor of mechanical engineering, adds that IDEA's new home in the Ford Motor Company Engineering Design Center provides the perfect environment for that mission.

In talking about design Colgate makes a distinction between creativity and innovation. "Creativity must be fostered. Innovation means applying creativity to solve real problems." Colgate says that students can learn a structured process for innovation, a way of ensuring that their ideas meet real needs. "It starts with a client and an unmet need," says Colgate, "and proceeds through research, creation of prototypes, testing, user feedback, and refinement to the finished product."

IDEA has several components and is not meant to replace what departments do, says Colgate. Participation in IDEA programs is optional. Undergraduates may choose to earn a certificate in engineering design — akin to a minor in design — by completing course work and an engineering design portfolio. The portfolio has become one of the most exciting parts of the program, says Colgate. "It gives students a creative opportunity to reflect on what they've learned and a powerful way to communicate about themselves with prospective employers," he says.

Students Linda Zhang (biomedical engineering '05) and Carl Allen (industrial engineering and management sciences '04) with a patient who is using NÜberwalker (below). A very early prototype of the device was constructed with an erector set (right).



Also under the aegis of IDEA is the Manufacturing and Design Engineering (MaDE) Program, which grants bachelor's degrees to students focusing on product and process design, manufacturing systems, and manufacturing management. IDEA also oversees a graduate-level version of MaDE, the professional Master of Product Development Program (see next section).

Any McCormick student may take IDEA courses in design or join one of the ongoing Institute Projects, which resemble those in EDC but are larger in scope and open-ended, with students dropping in for a quarter or two at any point during their development, while faculty members maintain continuity. "The incoming teams have a lot of respect for the work done by previous teams," says Colgate. "They build on that work and come up with more clever ideas, ones that have taken me by surprise."

One Institute Project launched in fall 2003 and now nearing completion is the NÜberwalker, a body-weight support treadmill training system for home use by stroke or spinal cord injury patients attempting to regain normal gait patterns. The project was requested and funded by the Rehabilitation Institute of Chicago, with Colgate and Stacy Benjamin, senior design engineer and adjunct lecturer in IDEA, serving as faculty advisers. After observing patients on Rehabilitation Institute equipment, students began designing a home version that would be far less expensive and bulky. When it was time to mock up early concepts, the students turned to the favorite toy of budding engineers: an erector set.

David Wei (mechanical engineering '06), who will earn a certificate in engineering design, worked on the NÜberwalker team this past summer, designing and refining several key components, such as the motorbox, folding hinge, handlebars, and setting display. Wei is enthusiastic about his experience: "I learned that engineering, especially the design aspect, is something that simply cannot be learned from a textbook. The subtleties of the design process can only be learned by doing it."

Dan Brown and Walter Herbst

Building on that "wow!" moment

Walter Herbst, director of the Master of Product Development (MPD) Program and adjunct professor of mechanical engineering, knows design and product development firsthand. Early in his career he invented some of the most famous Popeil products, including the legendary Pocket Fisherman and the Kitchen Magician. At Herbst LaZar Bell, the largest privately held design and product development firm in the country, he worked on products such as the Roomba® robotic floor vacuum.

MPD codirector Richard Lueptow, professor of mechanical engineering, started his career in biomedical product development before joining Northwestern's faculty.

With the support of a corporate advisory board drawn from industry leaders, Herbst and Lueptow have shaped Northwestern's MPD program into the top one of its kind in the nation.

Participants in the two-year master's degree program are engineering and technical professionals who continue in their careers while learning the fine points of product development from experts in the field. The students spend one day a week on campus attending intensive five-week courses that include many team-based projects, supplementing that experience in study groups with classmates. The 22-course curriculum reflects a 50-50 split in content between McCormick and the J. L. Kellogg School of Management, with faculty drawn from both schools as well as from industry.

In courses like Essentials of Industrial Design students learn about the emotional side of design, what product developers refer to as the "wow!" moment. "If you're presenting a new product to a potential customer — whether it's a gizmo for consumers or a defensive missile system for the Pentagon — if they don't say 'Wow!' you'd better go back to the drawing board," says Herbst.

Completing the program in 2005 with the MPD's second graduating class was Dan Brown, president of Consul-Tech Concepts, a product design and development firm, and founder and president of a new company, LoggerHead Tools, in Chicago. With 27 U.S. utility patents to his name, Brown is an inventor and product developer with years of experience, but he wanted to learn more. "My passion is product development," says Brown. "I wasn't interested in becoming the biggest product development business. I went to the MPD program because I wanted to be the best."

Brown entered the program with a prototype product in progress, one sure to evoke a "wow!" His patented Bionic Wrench™ automatically sizes and grips 16 different U.S. and metric-sized nuts and bolts, distributing force equally around the workload. The design increases the contact area of the fastener, enhancing the user's gripping force. A self-described "toolaholic," Brown says that the design for the wrench's adjustment mechanism was inspired by the shutter of a single lens reflect camera.

But even with an appealing product in hand, Brown knew that without excellent product development it would not realize its commercial potential. So, as he progressed with his development, Brown brought his wrench to his MPD classes to share his progress with his classmates. Getting their feedback proved helpful. "The women in my Human Factors class said the handle was designed for men," says Brown. "Having focused on the gripping mechanism, I had relied on a traditional handle design. I reevaluated the ergonomics and came up with a much better handle." The Bionic Wrench™ won the *Popular Mechanics* award for "Outstanding Achievement in New Product Design and Innovation" at the 2005 National Hardware Show. Wow!

Design for designers

Offspring tend to look like their parents — only fitter and sleeker, ready to take on the challenges of a new age. Such is the case with the stunning new Ford Motor Company Engineering Design Center, dedicated on October 6 and located just south of venerable Tech.

The new building, clad with smooth limestone blocks, pays architectural homage to the older building, with its rugged Lannon limestone. But the new structure is lighter and airier, with large windows that provide natural daylight to more than 75 percent of the building's interior spaces — a neat trick, given that two of the building's six floors are below ground. Much of the light reaches the interior through a glass-roofed atrium and filters through glass-block stairs and flooring to brighten a café area. In contrast to Tech's dignified interior, the Ford Motor Company Engineering Design Center is more playful, its sleek fixtures warmed by cherry wood trim.

The center is chock-full of special features tailored to the design work McCormick students have been struggling to undertake in less elegant surroundings. Projects that students once completed in any space they could commandeer now occupy dedicated parts of the building, like the auto bay with overhead door that accommodates student teams working on solar-powered cars for national competitions. Other spaces in the building are multiuse, like the collaborative learning space that accommodates 64 students grouped in changing configurations.

The Ford Motor Company Engineering Design Center is shared by several notable tenants:

- Computational Biology and Bioinformatics Program
- Department of Biomedical Engineering Teaching Lab
- Department of Chemical and Biological Engineering Teaching Lab
- Department of Electrical Engineering and Computer Science
- Department of Mechanical Engineering shops and labs
- Engineering Design and Communications classrooms
- Infrastructure Technology Institute
- Institute for Design Engineering and Applications
- Master of Product Development Program
- Master of Management and Manufacturing Program
- Walter P. Murphy Cooperative Engineering Program

There are two principal ways to enter the center, and each reveals something about how the building functions. The most obvious way is through the front door and into a glassed-in antechamber that overlooks an immense two-story fabrication room, where students have ample space to turn their designs into reality. The placement of the fabrication space at the entrance is telling: "The shop is the front door," says Jay Baehr, senior project manager for Northwestern, who oversaw construction and acted as a liaison to the New York architectural firm of Davis Brody Bond. "It tells you that creation is central to the building's purpose."

The other way to enter is through the glass-walled bridge that joins the center to the second floor of Tech. The bridge is not only convenient but also symbolic of the important connection between Tech and the new building. Even the programs that are now officially housed in the new building — EDC, IDEA, the MPD, and the Master of Management and Manufacturing — draw on faculty with offices in Tech, and easy movement between the two buildings is a must. Tech and the Ford Motor Company Engineering Design Center share a mission, and traffic over the bridge promises to be heavy.

—Leanne Star

Nancy and Ronald Church (both '58), donors to the Ford Motor Company Engineering Design Center, view the annual McCormick Design Competition course with students at the opening of the center in October.

The Department of Electrical Engineering and Computer Science is born

Two departments hardwire their ties to become one

September 1 marked a marriage of sorts at McCormick, a merger between two departments whose overlapping interests have long joined them as common-law partners. The newly created Department of Electrical Engineering and Computer Science facilitates and strengthens the interactions that were taking place between what were the Departments of Electrical and Computer Engineering, focusing on hardware, and of Computer Science, focusing on software. It also coincided with a move for computer science faculty from their previous off-campus location into offices in Tech and the new Ford Motor Company Engineering Design Center, where some faculty from electrical and computer engineering will join them. The center is joined by a bridge to Tech, home to the remainder of the electrical and computer engineering faculty, which put both groups, previously separated by more than a mile, near one another.

Robert Dick and Peter Dinda

"A 15-minute walk might not sound like much," says Robert Dick, an assistant professor in the former electrical and computer engineering department, "but you also miss those unexpected collaborations that happen when you run into someone in the hall."

For Dick, those collaborations also include more structured and formal arrangements in the classroom and the lab. Last winter he partnered with Peter Dinda, the Lisa Wissner-Slivka and Benjamin Slivka Junior Professor of Computer Science, to teach Introduction to Real-Time Systems, the study of how to build hardware and software systems that deliver timely responses — an effort that involved trips back and forth for the faculty members as well as their students. He is also lending a hand to Fabián Bustamante, an assistant professor in the department formerly known as computer science, on a project titled "Car-to-Car Cooperation for Vehicular Ad Hoc Networks," which explores distributed systems on large-scale, intervehicle networks, where moving vehicles equipped with sensors communicate with each other to create, for example, traffic advisory systems that inform drivers of current conditions in real time.

"Two different backgrounds are often better than one," notes Dick in explaining these collaborations. "Peter and I learned from each other when we taught the class together, and the same is happening as I collaborate on research with Fabián."

Dick says that the merged department also more accurately reflects his own interests. "Half of my work is electrical and computer engineering and half is computer science," he says. "The merger will make it easier to coordinate classes and will result in less overhead for the collaborations that are already taking place."

Divisions of labor

With the merger, the titles of faculty from the two former departments have changed slightly to include both areas. Not only are Dick, Dinda, and Bustamante now in the same department, but all three are in the computer engineering and systems division — one of six divisions in the new department:

- **Solid state and photonics** explores the design, analysis, and proof-of-concept development of solid-state and photonic devices and systems.
- **Signals and systems** covers signals, including images and other forms of information and their acquisition, representation, processing, analysis and interpretation, coding, transmission through networks, wireless, and other channels and the control of linear and nonlinear dynamic systems.
- **Computing, algorithms, and applications** focuses on the development and application of computational and algorithmic tools useful in ever more powerful computing environments.
- **Computer engineering and systems** addresses architecture, operating systems, distributed and parallel systems, compilers, the interface with software systems, robotics, databases, VLSI, networking and security, and performance analysis.

- **Cognitive systems** examines how the mind works and creates systems for education, performance support, and entertainment that exploit principles of cognitive science and artificial intelligence.
- **Graphics and interactive media** explores how people interact with the data, information, and images that are gathered, processed, and presented by a computational system.

Just as the subject matter of the two former departments overlapped, the divisions themselves — while providing necessary structure — will overlap in some areas. Furthermore, some faculty may belong to more than one division or move from one division to another as their research interests evolve.

"The reorganization has the potential to dramatically expand the research and educational coverage of systems and computer engineering at Northwestern," says Dinda. "For the first time, the faculty of the new computer engineering and systems division has expertise that spans hardware — from the transistor to the Internet — and software — from the tools that make chips possible to tools that enable planetary scale computing and communication. In learning how to create these most complex of human artifacts, we also are well poised to discover the underlying general properties and design and analysis principles of complex artifacts."

A critical mass

Leading the new department is Bruce Wessels, Walter P. Murphy Professor of Materials Science and chair of electrical engineering and computer science. "Bruce is a highly accomplished researcher whose interests intersect closely with those of his colleagues in the Department of Electrical Engineering and Computer Science," said McCormick Dean Julio M. Ottino, who cited Wessels's leadership experience as chair of the General Faculty Committee of the University Senate at Northwestern and as national president of the Minerals, Metals, and Materials Society (TMS). Wessels has been a member of the Northwestern faculty since 1977 and is internationally recognized for his research on electronic, magnetic, and photonic materials and devices. He is the author of 255 articles and coauthor of five books and has been awarded 13 patents.

Bruce Wessels

"A great engineering school like ours must have a great electrical engineering and computer science department, and this merger moves us toward that goal."
—Dean Julio M. Ottino

Wessels is enthusiastic about his new role. "The merger gives us critical mass, which in turn helps attract talented students and faculty," he says. "It will also facilitate scholarly dialogue and aid in the development of new initiatives across the divisions and throughout McCormick. Electrical engineering and computer science are among the most dynamic areas in engineering, and this merger adds to the excitement."

The merger should lead to opportunities for increased collaboration, says Wessels, citing two examples: Electrical engineering faculty working to advance image processing should benefit from collaborating with computer science faculty with interests in graphics and interactive media; and electrical engineering faculty with interests in nanoelectronics might work with computer engineers to develop new architecture and operating systems. Wessels says that collaboration, already a hallmark of McCormick, is especially important for the new department and its broader mission: "Educators and their students need to collaborate to develop the complex systems required for the 21st century."

Ottino seconds this. He notes that the vision emerging from the faculty of the department indicates that the old disciplinary boundaries are breaking down. Faculty members predict that in the 21st century the creation of new substrates for computing will require photonics and nanotechnology. Computation will be embedded everywhere, which in turn will require transparent communication between the panoply of devices in the environment. Communication will expand to include systems that understand human language and gesture to make them capable of interacting more naturally with people. New networked computational infrastructures will lead to the development of software that educates, trains, enlightens, and entertains.

In a letter to the McCormick community, Ottino summarized the hopes for the merged department: "This restructuring represents a new opportunity for all of us — a way to move toward a bright future for computer science and electrical and computer engineering research at McCormick. A great engineering school like ours must have a great electrical engineering and computer science department, and this merger moves us toward that goal."

—Leanne Star

Get a Grip!

Middle school program teaches design

Siobhan Donati, an eighth grade science teacher at Martin Luther King Jr. Laboratory School in Evanston, waits as her students find their seats and calm down after recess. She will start a new science unit today. Students will be challenged to design a prosthetic arm for an amputee using materials that would be readily available in the developing world. The science unit Donati is implementing — called Get a Grip! — was developed by Northwestern faculty and students and was chosen to be integrated into the King Lab curriculum because it supports instruction in a variety of disciplines — math, science, social studies, and language arts — while engaging students in a hands-on activity.

A Get a Grip! student demonstrates her design for a prosthetic arm.

In order to effectively meet this challenge, students must apply problem-solving and teamwork skills. "This program was exceptional in that it built self-esteem in students who had never taken pride in their work prior to this project," says Donati. "They became critical thinkers while strengthening their cooperative learning ability. Not only did the students talk about the program outside of the classroom, but they had other students, in other grades, also talking about the program."

To complete the project students must create conceptual models, perform online research, draw diagrams, test ideas, communicate results, and weigh conflicting priorities as they work collaboratively to design and build their final prosthetic arm prototype. James Finley, a McCormick graduate student in biomedical engineering and Get a Grip! volunteer, says, "It was amazing to see how innovative the students were, considering the small amount of supplies that we provided. The students have virtually no limitations on themselves at this age; some of the student designs were probably better than what we would come up with as engineers." Finley has a long-standing interest in programs that involve mentoring or teaching younger students, and he welcomed the opportunity to introduce engineering to students at King Lab and other schools throughout Chicago.

The Get a Grip! program began in September 2001 and is funded through the National Science Foundation. It was developed by Suzanne Olds, assistant chair of biomedical engineering, and David Kanter, research assistant professor of education and social policy, at Northwestern in consultation with middle school science teachers, student volunteers from Northwestern, and engineers at the Center for International Rehabilitation, a Chicago-based international humanitarian network.

"This program equips young people to think as global citizens," says Olds. "It informs students about the worldwide land mine situation, it increases their cultural awareness, and it generates respect for their disabled peers. It challenges young people to consider the needs of others and allows them to understand the difficulties some face — all while assuming the role of an engineer." Olds observed that a successful implementation of the program requires a good teacher and a supportive administration — and that both were present at the King Laboratory School.

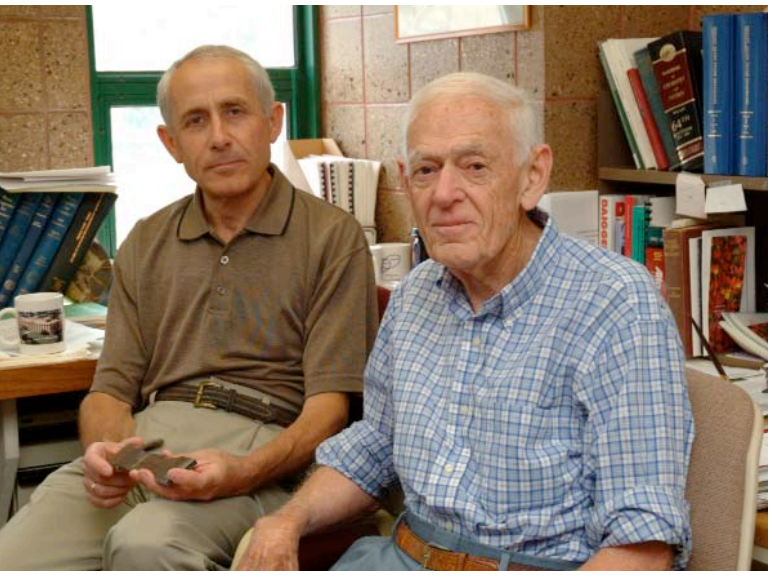
Donati says the program definitely made her students excited about science. "They had a lot of fun during Get a Grip!" she says. "The students learned to work cooperatively with their peers to accomplish a goal. They learned cost effectiveness and how the design of a product affects its usefulness. This program opened their eyes to more career options."

The Northwestern faculty and students who developed Get a Grip! clearly hope that engineering is one career these students will consider.

—Kelly Janura

500 tons of (Northwestern University) steel find a home

Emeritus Professor Morris Fine was inspecting a bridge under construction in Lake Villa, Illinois: "his" bridge, built with his new steel — NUCu (Northwestern University copper) steel. "I've been waiting for this day since Research Associate Professor Semyon Vaynman, Shrikant Bhat of Inland Steel, and I finished developing this steel eight years ago," says Fine. "This steel is cost effective because its processing is cheaper than competing structural steels of the same strength, its weathering resistance is best, and it's easier to weld."



Semyon Vaynman and Morris Fine

In 1965 Fine — who joined Northwestern's Technological Institute (the predecessor of today's McCormick School) in 1954 — began a fundamental study of steels containing copper with his students. This basic knowledge was then used to develop improved steels. His angle of attack: alloys strengthened with nanoscale precipitates. High-strength steels such as these do not require carbon for their strength and are much easier to weld than quenched and tempered high-strength steels. Copper also gives weathering resistance to steels, and the tiny copper precipitates make the fracture resistance better.

But there was a problem beyond simply the formulation of this superior new steel. The American steel industry is infected with the "not invented here" syndrome, and bridge designers are reluctant to make changes. Thus, both designers and manufacturers are reluctant to embrace new products. So Fine and Vaynman became salesmen, too. Beyond tinkering with the steel formula and testing it in their lab, they joined federal committees, succeeded in getting standards-setting bodies to accept NUCu, pestered steelmakers to make sample "heats" of it, proselytized to bridge owners and designers on its advantages, and finally found a receptive audience in the Illinois Department of Transportation (IDOT).

As a first step, IDOT specified NUCu steel to be made into beams for a seismic retrofit and rehabilitation of a bridge in southern Illinois over the New Madrid Fault. Forty-five tons of NUCu were installed side by side with a competing high performance steel, and the results were carefully monitored. NUCu was a winner, which led IDOT to convince the Federal Highway Administration to use NUCu steel for an entire bridge as a demonstration project.

The Lake Villa bridge was chosen. Five hundred tons of steel plates were cast, rolled, and welded into girders. This high-traffic structure over the Metra and Canadian National Railway lines in Lake County would provide a good demonstration of the new steel. "Not only is this steel strong, tough, and easy to fabricate, but the fact that you don't have to paint it eases construction and significantly reduces long-term maintenance costs," says Chris Hahin, IDOT materials engineer, who has worked with the Northwestern researchers for over a decade.

Since the early 1990s Fine and Vaynman have partnered with Northwestern's Infrastructure Technology Institute (ITI), a federally supported transportation center of excellence now housed in the new Ford Motor Company Engineering Design Center. ITI's mandate includes developing innovative infrastructure technologies and helping researchers transfer them into practice. "ITI has successfully demonstrated innovative technologies at over 60 locations in 19 states and the District of Columbia," said Dave Schulz, ITI's director and adjunct professor of civil and environmental engineering. "But Professor Fine's NUCu steel project may be our most satisfying — especially watching him oversee the installation of 500 tons of his NUCu steel on this bridge, after so many years of hard work."

Fine, 87, was the first chair of McCormick's Department of Materials Science and Engineering and served as associate dean for research and graduate studies. He retired from Northwestern in 1988 but has remained active in research, working with graduate students and serving as a senior counselor to many faculty at McCormick.

When asked about the length of the project's development from inception, Fine says simply, "It is always rewarding to see something useful come from one's research."

A shrinking field

Nanotechnology promises electronic devices the size of a molecule

Mark Hersam

The increasingly fine focus of nanotechnology is enabling a world of scientific advances. But as the subjects under study shrink, nonscientists may find it harder and harder to picture what is happening at the atomic level. Coming to the rescue with a metaphorical pair of high-tech bifocals is Mark Hersam, assistant professor of materials science and engineering. Not only has Hersam built the devices that allow researchers to "see" matter on the atomic level, but he is also very good at explaining things.

For example, consider Hersam's explanation of how he and his colleagues are able to measure the chemical identity of individual molecules by gauging vibrational energies: "It's analogous to a mass on a spring — pull it, and it will vibrate. The frequency of that vibration is a function of the mass of the object. On the molecular level, the atoms in the molecule are held together by chemical bonds that act like springs. By measuring the frequency of those vibrations we can determine the identities of the atoms pulling on the springs."

Hersam makes it sound simple — or at least understandable. In fact, measuring those vibrational energies involves ultrasophisticated equipment as well as expertise outside of his field, which is why he is teaming with Richard Van Duyne, Morrison Professor of Chemistry in Northwestern's Judd A. and Marjorie Weinberg College of Arts and Sciences, on a project to study single-molecule sensing, characterization, and actuation. Van Duyne is an expert on laser spectroscopy, a technique that offers high spectral resolution but poor spatial resolution. Hersam's group has built several scanning tunneling microscopes (STMs), devices that offer high spatial resolution. "Combining the very high special resolution of STMs with the advantages of lasers allows us to measure the vibrational energies and identify the atomic makeup of molecules," explains Hersam.

To fabricate the silver tip of the microscope's probe, Hersam called on Teri Odom, assistant professor of chemistry in Weinberg College. "She's an expert in fabricating nanowires," says Hersam, "and she's developed unique strategies for our project."

That interdisciplinary approach marks much of Hersam's research. In addition to his collaboration with Van Duyne and Odom, Hersam is working closely on several other projects with faculty members from Weinberg College and the McCormick School. "That's the beauty of Northwestern," says Hersam. "You hear about the work your colleagues are doing, you get together with them, you toss around crazy ideas — and often you're able to turn those ideas into reality."

A diverse bunch

For research on silicon-based molecular electronics, Hersam is teaming with Mark Ratner, Charles E. and Emma H. Morrison Professor of Chemistry. For a project on nanoscale organic light-emitting diodes, he is tapping the expertise of Tobin Marks, professor of materials science and engineering and Vladimir Ipatieff Research Professor in Organic Chemistry. With Michael Bedzyk, professor of materials science and engineering and of physics and astronomy in Weinberg College, Hersam is exploring conductive scanning probe microscopy nanopatterning.

Indeed, all seven areas of Hersam's ongoing research involve collaborators from Northwestern and universities around the world as well as from industry. Working alongside Hersam are five post-doctoral fellows — "a diverse bunch," says Hersam, with degrees in chemistry, materials science, and electrical engineering — plus a dozen graduate students and nine undergraduates.

The interactions work both ways. When Hersam collaborates with chemists, for example, not only does he take advantage of their specialized knowledge, but he may also be contributing to a revolution in the way chemistry is studied. "Instead of mixing substance A and B together and guessing about what's happening

at the molecular level," says Hersam, "we will actually be able to see it. STMs will become tools for doing fundamental science."

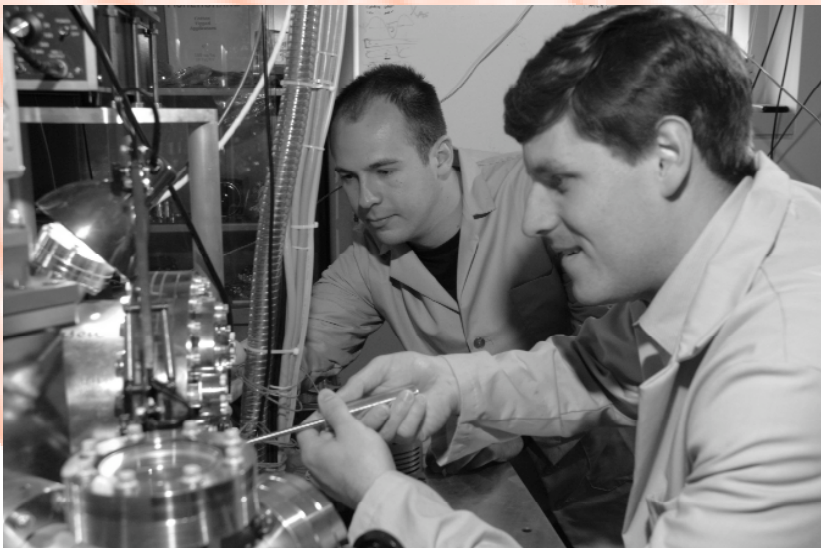
One area of Hersam's ongoing work that has generated special interest of late is molecular electronics, which offers the potential of using individual molecules as tiny electronic devices. "A single-molecule device likely represents the ultimate scalability of electronic technology," says Hersam, who is collaborating with Ratner in this research.

Sharing the credit

Although most researchers in the field of molecular electronics study the electronic properties of individual molecules with metallic contacts — such as thiol molecules on gold — the approach of Hersam's group has been to replace one of the metallic contacts with a semiconductor, silicon. The semiconductor contact has several significant advantages, says Hersam:

- It builds on existing covalent binding chemistry for organic molecules on silicon.
- Semiconductors possess an energy band gap that enables novel modes of charge transport.
- The electronic properties of the semiconductor contact can be tailored easily via doping.
- Since silicon is the dominant material in the microelectronics industry, molecular-scale devices built on silicon substrates can be directly integrated with preexisting technology.

The interface between organic and inorganic molecules that is at the heart of Hersam's approach to molecular electronics increases the functionality of potential devices and multiplies possible applications. "Organic molecules have selective reactivity, whereas silicon reacts with many things," explains Hersam. "The idea isn't for organic molecules to replace silicon but to add value to it, to complement the silicon." Attaching organic molecules to silicon substrates promises to capitalize on the advantages of both materials. One application that may result from this research is the development of tiny sensors sensitive to subtle shifts in the environment, a potential application that has attracted interest and funding from the U.S. government.



Graduate student Nathan Yoder and Mark Hersam. Background: Three-dimensional rendering of an ultra-high vacuum scanning tunneling microscope image of individual molecules on an Si(100) surface.

To study the structure and properties of individual organic molecules on silicon surfaces, Hersam and his team have custom-built three ultra-high vacuum STMs. The team uses atomically precise feedback-controlled lithography to pattern the assembly of organic molecules on the silicon surfaces. Unlike other fabrication processes, which are performed at cryogenic, or very low, temperatures and are impractical for consumer goods, this process works at room temperature, paving the way for eventual integration with conventional silicon microelectronics.

The richness of Hersam's research — along with his knack for explaining it — has garnered the 30-year-old professor a spate of prestigious awards and grant money of late: an Alfred P. Sloan Foundation Research Fellowship; an Army Research Office Young Investigator Award; an Office of Naval Research Young Investigator Award; and the 2006 Robert Lansing Hardy Award from the Minerals, Metals, and Materials Society (TMS).

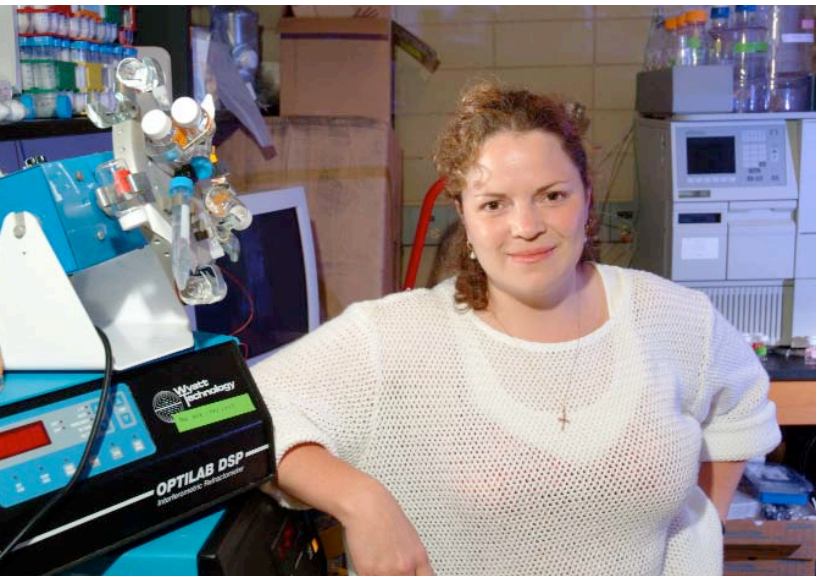
"The fact that I'm winning these awards reflects upon the high quality of the students and postdocs who are in this group," says Hersam. Sharing the credit comes naturally to Hersam, perhaps because he finds research rewards him amply all by itself. Research, says Hersam, offers "the excitement of generating new knowledge."

Having worked closely with Hersam, Ratner believes the recognition is well deserved. "Mark Hersam has championed the use of scanning probe techniques to answer important questions in materials science, chemistry, physics, and electrical engineering," says Ratner. "I think his work is the best of its kind in the world. He's a tremendous resource and an exciting presence at Northwestern."

—Leanne Star

By mimicking nature in the laboratory,

Annelise Barron aims to beat nature at its own game



Ask Annelise Barron, associate professor of chemical and biological engineering, about her research, and her first response is: "I am really excited about several projects ongoing in my lab, but in fact the most important products of my research are my graduate students. As professors, we develop the next generation of researchers. I'm a mentor first, and the recognition I get for research is shared with my graduate students."

Her second response is: "Which research project?"

Barron has many irons in the fire. She has a joint appointment in the Weinberg College Department of Chemistry, and in five associated labs and three offices, she oversees some two dozen PhD candidates, four postdoctoral fellows, and a handful of master's students and undergraduates conducting research in three major areas: biomimetic oligomers, novel polymeric materials for genetic analyses by microchannel electrophoresis, and free-solution conjugate electrophoresis for microchannel DNA separations.

That first area — biomimetic oligomers, or nature-imitating compounds that consist of a finite number of monomer units (as opposed to polymers, which consist of many units) — includes three subgroups that focus on the use of peptoids for biomedical applications: lung-surfactant protein mimics, antibacterial peptide mimics, and novel "foldamers" that mimic folded proteins. Peptoids are chainlike molecules strung together in the laboratory to create new compounds designed to mimic naturally occurring peptides. In the case of the second subgroup, antibacterial peptide mimics, that means copying a model from nature — antibacterial peptides from frog skin — to create novel molecules that promise to wage a selective fight against bacteria in the human body without being rapidly degraded or harming mammalian cells.

Barron was working with peptoids and looking for molecules she could mimic in the laboratory when she came across an article about the antibacterial properties of magainin-2, a peptide found in the skin of the African clawed frog. Barron's hunch was that if she and her students could mimic the structure of magainin-2, they might be able to mimic its function, a supposition that has succeeded in her related research on lung surfactant. "Our goal is to copy the ability of magainin-2 to kill bacteria but create a molecule with greater stability, which is less likely to be rapidly proteolyzed or recognized by the immune system," says Barron.

Because Barron and her team are trying to create mimics, they do not work with actual frog skin but with one of three peptide synthesizers in her labs. The process of creating an antibacterial peptoid takes two to three days and yields perhaps 100 milligrams of compound, sufficient for research purposes, Barron says, because "very tiny amounts can be used to kill bacteria."

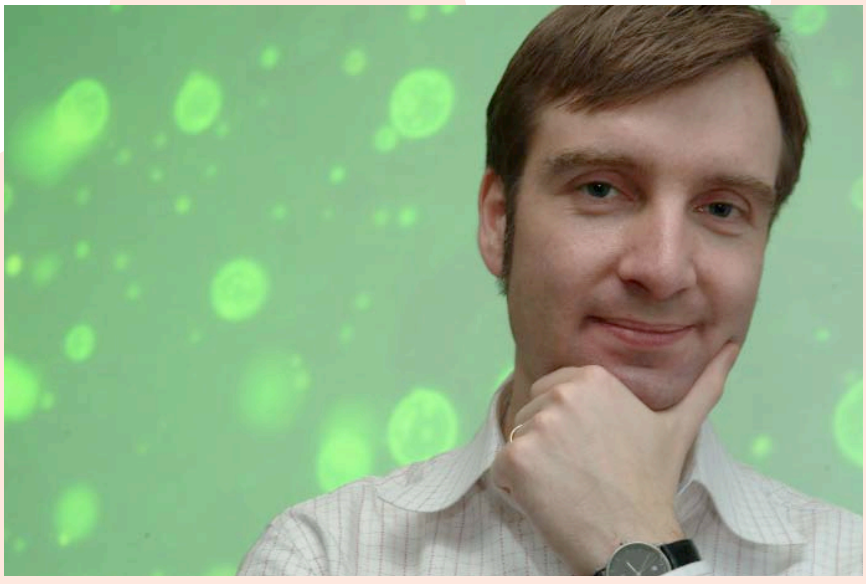
The project is highly innovative and interdisciplinary. "Students on the project are developing their skills in organic, analytical, and physical chemistry, as well as a bit of microbiology and biophysics when they characterize and test the peptoids," says Barron. The promise of its applications has attracted funding from industry giants such as DuPont as well as from the U.S. government and, more recently, interest from 3M and Pfizer. The Department of Homeland Security awarded a fellowship to Nathaniel Chongsiriwatana, a graduate student of Barron's who is focusing on the antimicrobial peptoid research. Chongsiriwatana sees many possible applications for their research, from combating resistant bacteria to creating antibacterial surfaces.

Just as Barron is quick to credit her team members for their contributions, Chongsiriwatana praises the way Barron supports her students. "She's a strong believer in having students work independently," says Chongsiriwatana. "She's always calling or e-mailing to share new ideas, which she allows us to analyze and develop. That's been an important learning experience for me."

—Leanne Star

Sascha Hilgenfeldt harnesses the surprising

power of bubbles



"Bubbles are powerful little machines," says Sascha Hilgenfeldt, associate professor of engineering sciences and applied mathematics and of mechanical engineering. To prove his point, Hilgenfeldt cites the well-known example of damage to huge metal ship propellers caused by cavitation, the collapse of bubbles flowing around the propellers at high speed.

Even when they do not cavitate, warns Hilgenfeldt, those bubbles can pack a punch simply by inducing shear forces in the fluid around them. Intact bubbles as power tools? That paradox becomes stranger still as bubbles become smaller: "As you miniaturize the set-up, the shear forces become stronger," reports Hilgenfeldt, who uses high-speed cameras to study the flow generated by microscale bubbles. This phenomenon opens up a world of possible applications, especially in medicine, promising advances in drug delivery, gene therapy, and the diagnosis of diseases like cancer.

To harness the power of these tiny bubbles, Hilgenfeldt and fellow researchers are working to better understand the mechanisms that govern their behavior, a focus that has surprised Hilgenfeldt himself. After doing undergraduate work in physics and math and earning a PhD in physics in his native Germany, Hilgenfeldt went to Harvard University as a postdoctoral fellow to continue his research on sonoluminescence, the emission of light by bubbles in a liquid excited by sound. In 2000 he joined the faculty of the University of Twente in the Netherlands, where he began to study how bubbles interact with biomaterials. He joined Northwestern's faculty in fall 2004.

Researchers knew that bubbles are capable of delivering drugs and genes to cell membranes but did not understand the mechanism of delivery. Possible explanations included shock waves, heat, jet impact, and shear flow. Of those possibilities Hilgenfeldt and his colleagues decided to study shear flow first. "We thought that would be the boring part and that we'd get it out of the way," he says. "Needless to say, I've been on it ever since."

What captivated Hilgenfeldt was the movement of the bubbles. "We knew that bubbles focus ultrasound energy and that an ultrasonic field would excite small bubbles to oscillate," explains Hilgenfeldt, "but instead of periodic jiggling, we observed a steady flow." That shear flow promised to offer more control in applications, but the mechanism of control eluded Hilgenfeldt until he made a fortuitous observation during an experiment: "A new player entered, a solid particle, which turned out to be a piece of quartz debris." That debris interacted with the bubbles and completely changed the flow. Breaking the flow symmetry, the particle created a steady transport motion that Hilgenfeldt believes could be used to penetrate cell walls to deliver drugs or gene therapy. Interestingly, the bubbles themselves do not burst even as they penetrate vesicle membranes.

The next step for Hilgenfeldt has been to recreate that accident through microfabrication, etching onto a substrate such as a silicon wafer a bump that acts as a stationary solid particle as well as tiny holes that retain air pockets. When these "holes and bumps" are submerged in water and excited by ultrasound, they act "as little directional motors," says Hilgenfeldt, who dubs the effect "dancing bubbles."

Hilgenfeldt is working to solve problems posed to him by researchers from Northwestern's Feinberg School of Medicine and interacts regularly with faculty from mechanical engineering, materials science, and chemical and biological engineering. "I try to talk to people from many different backgrounds and see what their needs are," he says. Hilgenfeldt sees many potential applications for his research, from a chemical-lab-on-a-chip system to a way of mixing and sorting materials on the microscale — all from unleashing the power of tiny bubbles.

—Leanne Star

Getting their hands dirty

McCormick students find real solutions to today's problems

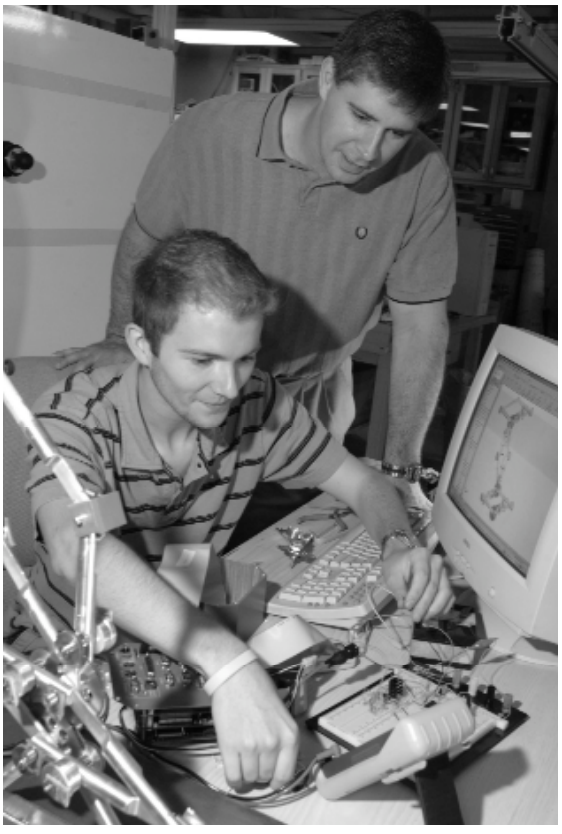
Walter P. Murphy had a vision for engineering students at Northwestern University. Rather than simply solving theoretical problems, Murphy believed that students were capable of important hands-on achievements. His gifts of $35 million to Northwestern between 1939 and 1942 established the Technological Institute, the cornerstone of a pragmatic approach to engineering that makes graduates of the Robert R. McCormick School of Engineering and Applied Science valuable to firms around the world. Today, that tradition continues with grants from the Walter P. Murphy Society that are awarded to McCormick faculty members who offer practical curricula for tomorrow's problem solvers. Here are two Murphy Society projects from faculty members who endeavor to do just that.

Making machines that work

When asked what she liked most about the course Introduction to Mechatronics, Jamie Wright (mechanical engineering '06) is unrestrained in her enthusiasm. "I'm finally getting my hands dirty," she says, smiling broadly.

After numerous classes that were entrenched in the textbook theories of mechanical engineering, Wright savored her time in the Mechatronics Design Laboratory, an initiative headed by Kevin Lynch, associate professor of mechanical engineering, and made possible by a grant from the Murphy Society.

Throughout the year various McCormick students can be seen working at the Mechatronics Design Laboratory — which they often call their "second home" — building microprocessor-controlled electromechanical systems. Projects include an automatic plant waterer, a robot that moves chess pieces, an automatic card-dealing machine, and others. Even when students hit bumps on the road and their machines fail, says Lynch, they love what they're doing. "There's no easy way to learn debugging," he says. "You have to experience actual problems in a design of your own, so that you are really invested. Only by struggling with problems you care about do you learn to isolate and fix them. Students also learn time management through this process as they learn to anticipate problems that might arise."



Kevin Lynch checks in with student Benjamin Stephens in the Mechatronics Design Laboratory.

"Actually, I think we learn more from our failures than we do from our successes," adds Wright, a native of Dallas who has already enrolled in Advanced Mechatronics, taught by Professor Michael Peshkin. "It's actual learning," she says, "because you're doing all the debugging yourself. In fact, this was the first time I learned how to apply the theories I learned in my other engineering classes."

Popularity is proving to be the greatest challenge for Lynch and the Mechatronics Design Laboratory. "Introduction to Mechatronics and Advanced Mechatronics have gotten so popular that we were running out of room," he says. In addition to those taking the courses, more than 50 students sign out keys to the MDL for independent projects each year — including, for example, robots for McCormick's annual Design Competition. That puts a strain on both space and equipment. "Equipment has a finite life," says Lynch. "Just to keep the lab running costs money, but then you're also seeking upgrades."

Both challenges are being addressed. "Fortunately, we'll have 50 percent more space this fall," says Lynch, "because the lab is moving to the Ford Motor Company Engineering Design Center." Murphy Society

Yan Chen and Justin Moles

funds will provide more and newer equipment to optimize the new space. Adds Lynch, "Continuous support — especially from alumni — is absolutely critical."

Thanks to the Murphy Society, McCormick students are getting hands-on experience developing machines that incorporate several aspects of engineering, from mechanical to electrical to computer science. It's no wonder that some students have even switched their major to mechanical engineering due to their experience in the Mechatronics Design Laboratory. "Students are excited to see the fruits of their labor in a working device," explains Lynch.

Making information technology secure for everyone

In 2003 computer viruses and worms were responsible for more than $28 billion in economic losses, and that number will likely exceed $75 billion a year by 2007. Yet the devastating damage inflicted by acute computer infections causes far greater problems than monetary loss. Due to a lack of information security, Social Security numbers are stolen, private records are manipulated, and bank accounts are compromised — all of which plagues information security systems and violates the privacy of individuals.

Unfortunately, most engineering schools at top-tier universities don't provide adequate training for tomorrow's information technology professionals — those who will be on the front lines of the battle against hackers. McCormick is preparing students for real-world IT problems, however, thanks to Yan Chen, assistant professor of electrical engineering and computer science, and funding from the Walter P. Murphy Society.

"Internet attacks are increasing in frequency, severity, and sophistication, so it's really critical that universities convey the importance of information security to their students."

—Yan Chen

According to Chen, students can't afford to be complacent about worms, viruses, and other threats to information security — and neither can universities. "Internet attacks are increasing in frequency, severity, and sophistication, so it's really critical that universities convey the importance of information security to their students," he says.

"We do much better than most peer institutions, because Northwestern is a well-funded, elite university," says Chen. "Before I came here, there was a gap in our curricular offerings because we didn't have an information security course sequence. Now, the Murphy Society grant allows us to prepare students for what they will face when they leave Northwestern."

Murphy Society funds allowed Chen to create a course sequence in information security through his Information and Communication Security Curriculum Development Program. The first new courses have been well received by McCormick students, and Chen plans to maximize their interdisciplinary impact by opening the door to students in the rest of the University.

"Computer security is a relatively new field, and many of the concepts that form its groundwork are being challenged or expanded on a continual basis," says Justin Moles (computer science '06), who benefited from the Chen's project when he took the new course Introduction to Computer Security. "The format of the class enables students to see how the field is developing and form their own opinions about where it is going," he says. "I would strongly recommend that anyone interested in computer technology take this course."

"We really want to have a basic class that is taught in plain language," adds Chen, who has received national and international attention for his focus on information security, including a prestigious Department of Energy CAREER Award and a Microsoft Trustworthy Computing grant. "Information security is not just for the engineers who are solving the IT problems; it's for all professionals who run into security problems — especially business owners and those who are in charge of health care operations."

Nevertheless, there is an increasing need for security specialists, making Chen's program all the more relevant. "The number of full-time information security professionals will rise almost 14 percent per year around the world, going past 2.1 million in 2008," he says. "There has been an explosion of concern in information security over the past decade, so we're trying to make sure students understand the issues."

—Alex Runner

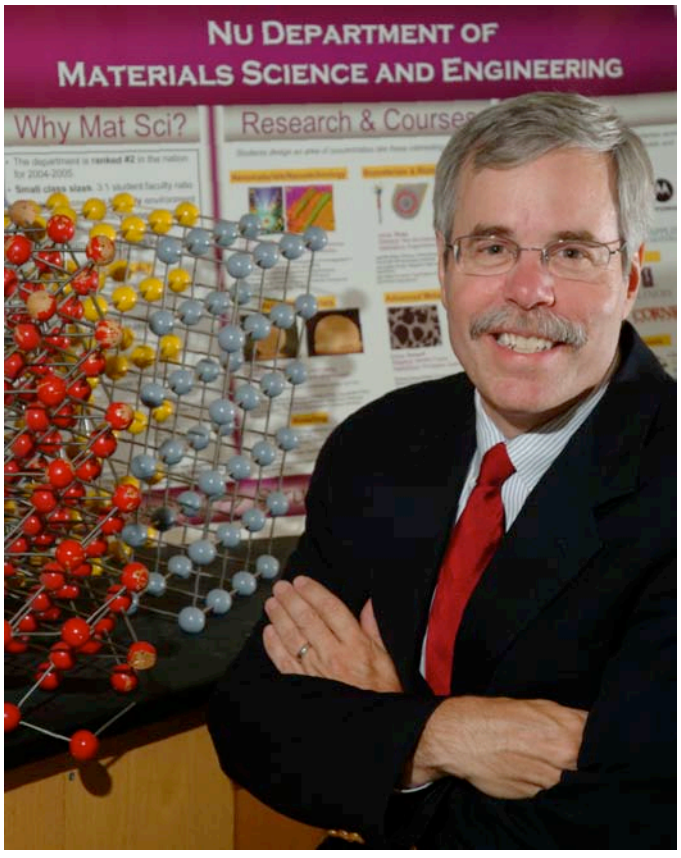
50 YEARS OF INNOVATION

The Department of Materials Science and Engineering celebrates its birthday

Peter Voorhees, Frank C. Engelhart Professor of Materials Science and Engineering and chair of the department, was charged with planning a special event this year — an obligation he found to be a labor of love.

"It was a privilege planning the 50th birthday celebration of the Department of Materials Science and Engineering," he says. "We were the first such department, and we continue to define the field. It was a great opportunity to bring together such a group of distinguished scholars and celebrate the incredible advances in our field."

The golden jubilee of the department included a two-day symposium held at McCormick on October 27 and 28, culminating in a banquet and keynote speech. The symposium featured sessions that reviewed the emergence, current frontiers, and future perspectives of materials science and engineering. Speakers included such alumni as Teruaki Aoki, Didier de Fontaine, Joshua Jacobs, Anne Mayes, and Lyle Schwartz. Faculty members involved in the symposium included Scott Barnett, Mark Hersam, Gregory Olson, David Seidman, Samuel Stupp, Julia Weertman, Bruce Wessels, and Morris Fine, the first chair of the Department of Materials Science and Engineering. (See related articles on Fine, page 9, and Hersam, pages 10–11.)



Peter Voorhees

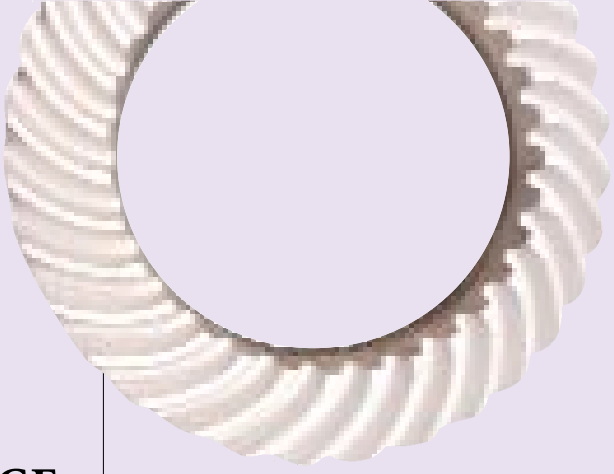
The presentation by keynote speaker Stephen Sass of Cornell University was especially of interest, since it emphasized the importance of the McCormick School's recent collaboration between materials scientists and conservators from the Art Institute of Chicago. (See *By Design,* spring 2005.)

Northwestern's Materials Science and Engineering Department was the first such department in the world when it was established in 1955. Voorhees explains that 50 years ago the department's approach to research and teaching — one that stressed concepts that applied to all materials — was quite novel.

"Today the approach that we developed has become the standard for the field," says Voorhees.

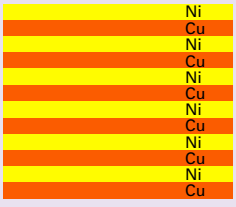
The department continues to expand the boundaries of materials. From materials that can be used to make quantum computation a reality; to fuel cells that promise cleaner, more efficient energy sources; to life-enhancing and life-saving biomaterials, materials science and engineering has the potential to address society's greatest concerns and to develop new generations of technologies.

"It is inspiring to reflect upon our faculty members' accomplishments and to envision what more we will be able to contribute to scholarship in the field in the decades to come," says Voorhees.



milestones

IN MATERIALS SCIENCE



1960s

John Hilliard creates the first metallic superlattices (above). The impact of this work continues today due to the novel properties of these nanoscale structures.

1970s

Stephen Carr was among the first to show how natural polymers can be engineered, by combinations of physical and chemical modifications, into useful biodegradable plastics.

Johannes Weertman published one of the most influential early studies on the stability of the West Antartica ice sheet. His conclusion that the sheet is on the way to collapse has been the subject of great interest since.

1980s

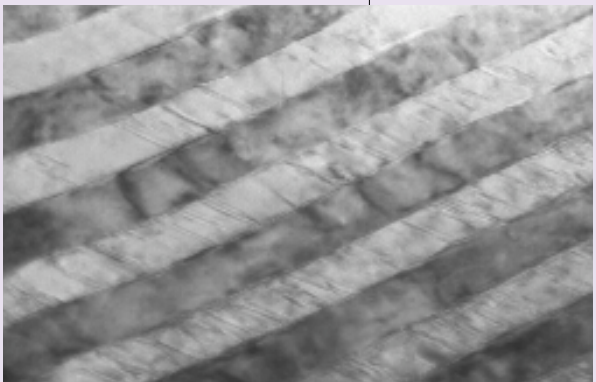
The late **Jerome Cohen** (who would become dean of the McCormick School) developed a portable x-ray stress analyzer, used to determine how much stress a metal is supporting.

Morris Fine begins his work on NUCu steel — a project that spans almost 20 years and, in 2005, is used in a railroad bridge in Lake Villa, Illinois (above). See related article on page 9.

1990s

Yip-Wah Chung pursues work on nitrogenated carbon coatings. These are used as a protective overcoat for nearly all computer disk drives, including those in Apple iPods (left).

Scott Barnett and **Bill Sproul** work on ultrahard coatings based on nanoscale superlattices (below). These materials can be used for coatings on cutting tools and other materials to increase the hardness of the material's surface.

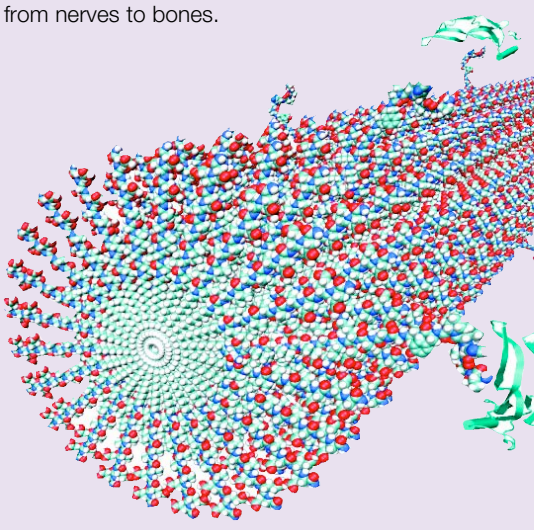


1995

Greg Olson and **Charles Kuehmann** design the C61 "Ferrium" gear steel (above). It is now used in more than a third of all 1600-class race cars.

2000s

Samuel Stupp's nanoscale polymer ampiphiles (below) are promising routes for regenerating human tissues from nerves to bones.



Mark Hersam designs prototypes of sensors and electronic and mechanical devices on the scale of a single molecule using the cryogenic variable temperature ultra-high vacuum scanning tunneling microscope that was custom designed and built in his laboratory (below). See related article on pages 10–11.

Christopher Campbell, PhD candidate in chemical and biological engineering, receives a stamp of approval from Northwestern

How did you choose your area of research?

I graduated from the University of North Dakota in chemical engineering and came to Northwestern in fall 2002, planning to go into catalysis. Before school started, I went on a department retreat where faculty talked about their research projects. I was excited by the work of Bartosz Grzybowski, assistant professor of chemical and biological engineering, and the idea that you can choose from interacting natural phenomena to engineer working devices. We select the components and let the process of dynamic self-assembly do the building.

Can you describe your research?

We've developed a technique to study chemistry in microscale in confined spaces. Reaction diffusion — two chemicals coming together to form a new chemical during the process of diffusion — has been well studied on a large scale but not at smaller scales. We've created a stamp the size of a penny with microfeatures that we load with one chemical before stamping it on a thin layer of gelatin that's doped with another chemical. We follow the progression of the reaction by observing the production of a brightly colored pigment. The stamp technique is versatile. It can be used to deliver chemicals in a controlled manner or to modify surfaces, etching or cutting them.

What are the potential applications for your work?

A medical group posed a problem to us about how to image living cells, and in the stamp we were able to provide an etching technique that allows them to image living cells in real time.

What's it like to work with people in cell biology and medicine?

Even though I don't have a background in biology, I'm able to communicate with those who do and be part of their research. Our lab is very interdisciplinary, with people working in theoretical and applied math, physics, organic chemistry, and chemistry. We can tell a more complete story when we collaborate.

How does that collaboration take place?

We might do an experiment and then need help modeling what's going on. There's a lot of back and forth between the experimental and theoretical.

In May you were inducted into Northwestern's prestigious Society of Presidential Fellows, one of only seven graduate students to receive the honor. How does that affect your work?

The fellowships are intended to promote scholarship across disciplines. I enjoyed the interview process, which involved 10 professors from different disciplines. We had stimulating conversations about all their work; it wasn't only about presenting my work but about gaining something from the experience of being part of the larger university.

How is being a graduate student different from being an undergraduate?

In addition to doing my research, I've taught both undergraduates and graduate students. I like being able to help others learn, and I learn by teaching them. My personal life is different, too. I got married last summer. My wife, Talia, works as a college counselor and learning specialist. Our families live in Montana, North Dakota, Michigan, and Minnesota, and we enjoy visiting them.

Any advice for incoming graduate students?

Choose a research topic that truly interests you, because you'll be spending 60 hours or more a week in the lab working on it.

—Leanne Star

For James N. Farley, the world is his office

Retired as chair and chief executive officer of the multinational corporation SpeedFam–IPEC, James N. Farley still travels around the world. His global perspective helped his company grow from a small U.S. firm in Des Plaines, Illinois, selling lapping and polishing machines, to a manufacturer of equipment for the semiconductor industry with outposts throughout Europe and Asia.

After graduating from McCormick in 1950 with a major in electrical engineering, Farley was a test engineer for General Electric. After serving in the Korean War at White Sands, New Mexico, he worked as a sales engineer for a Milwaukee motor control manufacturer. After Farley sold a control to the inventor of a new lapping and polishing machine in 1960, he joined the inventor's company as a minority investor. The business grew rapidly when Farley expanded it abroad, first to France, Germany, and Switzerland and then to Japan, Taiwan, Korea, and India.

When the company reorganized in 1974, Farley took ownership of the machine-tool side of the business, then named SpeedFam Corporation and later SpeedFam International; it was named the Chicago-Area Best Small Business in 1987 by the University of Illinois at Chicago and Arthur Andersen. To accommodate the growing demand for semiconductor equipment, Farley opened an Arizona office in 1980. In 1999 SpeedFam International merged with IPEC (Integrated Process Equipment Corporation) to become SpeedFam–IPEC, which Farley led until he retired in 2002.

Farley lives in Arizona with his wife, Nancy. They have five children and 16 grandchildren. His daughter Sarah earned a master's degree in audiology from Northwestern, and his granddaughter Meghan Farley graduated from Weinberg College in 2005. The Northwestern University Alumni Association honored Farley with its Alumni Merit Award in 1996.

What brought you to Northwestern?

I was a Kansas farm boy who was good in math and science. A half-tuition scholarship — $75 every quarter — made it possible for me to attend.

You've paid back the scholarship and then some, haven't you?

Northwestern played a big part in my success, and I'm happy to contribute. When I joined the McCormick Advisory Council in 1986, I noticed that not much had changed in Tech since the 1940s. In 2001 my wife and I named a wing in Tech and donated 10 machines to establish the Undergraduate Machining and Prototype Lab [now in the Ford Motor Company Engineering Design Center]. We also endowed a professorship in manufacturing and entrepreneurship.

James Farley (center) with McCormick students

What about the McCormick scholarship in your name?

That was a complete surprise to me, a gift from our five kids. I was more than pleased.

What prompted you to take your business international in the 1960s?

We decided we had to be in the world, not just in the United States. We went to Europe first and made some mistakes, but we learned from them and moved into Asia. We ended up selling more out of our joint venture in Japan than in the United States.

How did you foresee the growth of the semiconductor industry?

We made machines to polish raw materials, including the germanium used in the first semiconductors before silicon became the material of choice. The machines were capable of producing very flat, smooth, accurate materials, which I knew would be important as the demand for memory disks grew.

You're retired. Why are you still accumulating frequent flyer miles?

I rarely had time to sightsee on business trips. Since I've retired my wife and I have toured Africa twice and taken a trip around the world.

What's your advice for engineering students?

Take as many business classes as you can, fit in as many extracurricular activities as you can, and develop your people skills.

—Leanne Star

New faculty

One new faculty member will join the McCormick School in 2005. She is listed below, followed by her academic rank, department, and areas of research interest:
Xu Li: assistant professor; biomedical engineering and electrical engineering and computer science; bio-optics and photonics

Faculty honors

Guillermo Ameer, assistant professor of biomedical engineering, and **Vadim Backman,** assistant professor of biomedical engineering, received 2005 Wallace H. Coulter Foundation Early Career Awards in translational research.

Zdeněk P. Bažant, Walter P. Murphy Professor of Civil and Environmental Engineering, received the 2005 Theodore von Kármán Medal from the American Society of Civil Engineers.

Cate Brinson, Jerome B. Cohen Professor of Mechanical Engineering, started a five-year term on the National Materials Advisory Board of the National Academies in January 2005.

Robert P. H. Chang, professor of materials science and engineering, received a National Science Foundation (NSF) Director's Award for Distinguished Teaching Scholars.

Yan Chen, assistant professor of electrical engineering and computer science, won a Department of Energy Early Career Award.

Dudley Childress, professor of biomedical engineering, was awarded the 2005 da Vinci Lifetime Achievement Award by the National Multiple Sclerosis Society.

Alok Choudhary, professor of electrical engineering and computer science, is the director of Northwestern's new Center for Ultra-Scale Computing and Information Security. He also received an IBM Faculty Award.

Mark Daskin, professor of industrial engineering and management sciences, won the Fred C. Crane Distinguished Service Award from the Institute of Industrial Engineers (IIE).

Horacio Espinosa, professor of mechanical engineering, received the 2005 Hetenyi Award, given annually for an outstanding paper published in *Experimental Mechanics.*

Richard J. Finno, professor of civil and environmental engineering, was presented with the Thomas A. Middlebrooks Award by the American Society of Civil Engineers.

Ken Forbus, Walter P. Murphy Professor of Electrical Engineering and Computer Science, cochaired both the 18th International Workshop on Qualitative Reasoning and the 26th Annual Conference of the Cognitive Science Society. He has also been appointed conference chair of the American Association for Artificial Intelligence.

Robert E. Gallamore, director of the Transportation Center, was appointed chair of the Committee for a Study of the Feasibility of a Hazardous Materials Cooperative Research Program. He also was made a lifetime National Associate of the National Academies.

Bruce Gooch, assistant professor of electrical engineering and computer science, was one of three winners in Microsoft Research's Computer Gaming Curriculum RFP Awards. He also cochaired the Midwestern Computer Graphics Conference.

Bartosz Grzybowski, assistant professor of chemical and biological engineering, and his research group received the 2004 Cover of the Year award from *Advanced Materials.*

Abraham Haddad, Henry and Isabelle Dever Professor of Electrical Engineering and Computer Science, received the International Federation of Automatic Control Outstanding Service Award and was appointed vice chair of the IFAC Administrative and Finance Committee.

Mark Hersam, assistant professor of materials science and engineering, received the 2006 Robert Lansing Hardy Award from the Minerals, Metals, and Materials Society (TMS).

Wallace Hopp, Breed University Professor of Industrial Engineering and Management Sciences, won the Technical Innovation Award in Industrial Engineering from the IIE.

Raymond J. Krizek, Stanley F. Pepper Professor of Civil and Environmental Engineering, presented the 12th Spencer J. Buchanan Lecture at Texas A&M University in October 2004.

Prem Kumar, SBC Communications Inc. Professor of Information Technology, was elected program chair for the 2006 Quantum Electronics and Laser Science Conference (QELS06).

Lincoln Lauhon, assistant professor of materials science and engineering, received an NSF CAREER Award.

Phillip B. Messersmith, associate professor of biomedical engineering and of materials science and engineering, will serve as a member of the Biomaterials and Biointerfaces Study Section in the National Institutes of Health Center for Scientific Review.

Don Norman, professor of electrical engineering and computer science, received the American Psychological Association's 2005 Franklin V. Taylor Award and has been named the Franklin Institute's 2006 Benjamin Franklin Medalist in Computer and Cognitive Science.

Greg Olson, Wilson-Cook Professor of Engineering Design, was recognized when QuesTek, the company he started, was named one of 25 "breakout" companies of 2005 by *Fortune* magazine.

Terry Papoutsakis, Walter P. Murphy Professor of Chemical and Biological Engineering and professor of biomedical engineering, received the Amgen Biochemical Engineering Award and was elected a fellow of the American Society of Microbiology.

Thrasos Pappas, associate professor of electrical engineering and computer science, presented a plenary talk at the Institute of Electrical and Electronics Engineers' International Conference on Image Processing. He was also technical cochair for the Third International Symposium on Information Processing in Sensor Networks and cochair of the Society for Imaging Science and Technology/International Society for Optical Engineering's 17th annual symposium on electronic imaging.

Manijeh Razeghi, Walter P. Murphy Professor of Electrical Engineering and Computer Science, was a winner in the 2005 Defense University Research Instrumentation Program competition.

Hermann Riecke, professor of engineering sciences and applied mathematics, received a Humboldt Research Prize from the Alexander Von Humboldt Foundation in Germany.

David N. Seidman, Walter P. Murphy Professor of Materials Science and Engineering, was elected a 2005 fellow of ASM International.

Selim Shahriar, associate professor of electrical engineering and computer science, was a winner in the 2005 Defense University Research Instrumentation Program competition.

Lonnie Shea, associate professor of chemical and biological engineering, was recently selected to participate in the National Academy of Engineering's Frontiers of Engineering program.

Randy Snurr, associate professor of chemical and biological engineering, was elected vice chair of the American Institute of Chemical Engineers' Computational Science and Engineering Forum.

Ford Motor Company Engineering Design Center off to fast start

On October 6 the McCormick community marked the dedication of the Ford Motor Company Engineering Design Center with a ribbon-cutting ceremony, speeches, and an open house featuring student design presentations. Top left: Wallace Hopp, Breed University Professor of Industrial Engineering and Management Sciences; Vaughn Koshkarian ('67, Kellogg '68), former vice president of Ford Motor Company and president of Ford Asia Pacific; and Northwestern University President Henry S. Bienen. Bottom right: Tom Cohlmia (mechanical engineering '07) stands by the sculpture he created for the building. The sculpture spells out "form" and "function" from different angles, reflecting the core purpose of the new center.

1940s

Lester Crown ('46) was named cochair of Children's Memorial Hospital's $400 million campaign.

1950s

James F. Gibbons ('53) will step down from the board of Cisco Systems Inc. after the company's annual meeting in November.

Brian Baldwin ('54, MS '55), founder of medical device company Baxa Corp., was profiled by the *Denver Business Journal* when he received its Entrepreneur of the Year Award.

Tony M. Ridley (MS '56), a transportation engineering professor in Britain, was profiled in *Debrett's People of Today.*

1960s

John F. Carney III (MS '64, PhD '66) became chancellor of the University of Missouri at Rolla in September.

Oded Ben-Dov (MS '65, PhD '68) received the National Association of Broadcasters (NAB) 2005 Television Engineering Achievement Award, presented at the NAB 2005 Technology Luncheon last April in Las Vegas. He is president of the TV Transmission Antenna Group, which develops broadcast technology and design and provides consulting services to broadcasters and television manufacturers.

Scott Filstrup ('65, Kellogg '67) was appointed a director of National Coal Corporation, a coal producer operating in Appalachia. He was one of 15 people in the world to win the 2005 JuniorAchievement Gold Leadership Award.

David J. Werner (MS '66, PhD '69), chancellor emeritus of Southern Illinois University, was named interim president of Mansfield University in Pennsylvania.

Robert Wayman ('67, Kellogg '69) was named interim CEO and director of Hewlett-Packard Company after Carly Fiorina stepped down as the company's chairman and CEO.

Abhijit Acharya (MS '68, PhD '75) was appointed to the board of directors of Stereotaxis Inc., a producer of cardiology instrument systems.

Richard I. Brown (MS '69) received the Inventor of the Year Award from the Intellectual Property Law Association of Chicago last May in recognition of his work in the field of automated blood collection and the separation of blood components.

Joel P. Ettinger (MS '69) was appointed executive director of the New York Metropolitan Transportation Council.

1970s

Michael T. Abbene ('70) was elected vice president and chief information officer of Arch Coal Inc. by its board of directors, effective July 1. He is responsible for information systems operations, applications, and infrastructure for the entire corporation, including subsidiaries. He has worked as director of application services at Arch for five years. He will continue to live in the St. Louis area with his wife, Patricia (Trish) Maloney Abbene (Weinberg '71).

Kenneth Dulaney ('72) and his wife, Linda, celebrated their 19th year of marriage in August. For the past 12 years Dulaney has worked for Gartner Inc. as a vice president covering the field of mobile technology. He provides strategic advice on mobile computing issues and has participated in several patents.

Sidney A. Simon (PhD '73) of Durham, North Carolina, is a professor of neurobiology at Duke University.

Edmund Cheng ('74) is deputy chairman of the real estate development company Wing Tai Holdings in Singapore and has a strong interest in architecture and the arts. He is chairman of the Design Singapore Council, the Esplanade Company, and the Arts House at the Old Parliament. He was profiled extensively as the new chairman of Singapore's National Arts Council.

Maureen "Moe" Grzelakowski ('76, MS '79, Kellogg '88) recently wrote *Mother Leads Best: 50 Women Who Are Changing the Way Organizations Define Leadership* (Dearborn Trade). She is a senior adviser to Investor Growth Capital of New York and owns the nine-hole Oak Hills Country Club in Palos Heights, Illinois.

Michael D. Meyer (MS '76), a professor of civil and environmental engineering at the Georgia Institute of Technology, wrote an article about safety-conscious transportation planning and development.

Maximillian Fiore ('77, '77) was named senior vice president of research and development and operations at OmniSonics Medical Technologies Inc.

Gabriel Raviv (MS '77, PhD '79) is chairman and CEO of Bio-logic Systems Corp., which has signed a three-year deal with Novation to serve as the sole supplier of infant heart diagnostic equipment supplies to VHA Inc. and the University Health System Consortium.

Mary Ann Fialkowski ('78, Kellogg '80) was promoted from chief financial officer to president of Technicolor Entertainment Services, which is responsible for Technicolor's worldwide film, postproduction, and theatrical logistics operations.

Gregory Shipp ('79, MA/MS '82) has joined Nanosphere Inc., a nanotechnology life sciences company, as its first vice president of medical affairs.

1980s

Frederick R. Ferrin (MS '80), executive director of the Jacksonville Port Authority, was one of six people honored by the *Florida Shipper* for excellence in leadership in their respective industries.

Jeff McClelland ('80), chief operating officer of America West Airlines, was the subject of an extensive article about how he continued working through treatment for colon cancer.

Catherine Aimone-Martin (PhD '82), an engineering consultant, recently wrote a study for the city of Henderson, Nevada, regarding housing in the area. She is a professor at New Mexico Institute of Mining and Technology in Socorro.

Robert Kunimura ('82) is the senior vice president and chief technology officer at Calamos Asset Management in Naperville, Illinois.

Jeanne Beacham ('83) was profiled as CEO of Delphon Industries, a provider of materials and services for shipping, processing, and packaging high-value

What's happening in your life?

Please let us know by sending an e-mail to bydesign@mccormick.northwestern.edu.

technology components. She is a member of the McCormick Advisory Board and the MMM Advisory Board.

Neil Wyant ('83), head of O'lala Foods, has developed a chocolate-flavored gum.

Richard Faris ('84) was appointed director of marketing at Real Intent Inc., a supplier of verification software.

Gauthier "Walter" Belhomme (MS '85, PhD '89) joined the international environmental firm ENSR as a general manager of its Paris operations.

Anju Holay ('85), founder of Next Step Marketing Research in Barrington, Illinois, authored an article in *Prepared Foods* about children's snacks.

Terry Nicola ('78, Feinberg '82, MS '85, GME '87) served as a medical director of the 2005 Hustle Up the Hancock race for charity, held in February.

Ken Glickstein ('86, MEM, Kellogg '92) was named vice president of planning and analysis at Corporate Express Inc.

Katrina Helmkamp ('87, Kellogg '92) was profiled as the new president of pest control at Terminix.

Bob Kiep ('88) and his wife, Maggie, had their first child, Jack, on October 14, 2004.

Daniel Lipinski ('88), a Democratic representative from Illinois's Third District, was profiled as a member of the House freshman class of 2004 in the *National Journal* in August.

P. M. Ajayan (PhD '89) has been named to the scientific advisory board of the Nanotech Company.

Norman Bridge (MEM, Kellogg '89) is director of control and electrical systems design at GM's Electro-Motive Division. He was interviewed regarding what electrical engineers need to know about locomotive electronics.

Cheuk Chan (MS '89, PhD '93) is PacketVideo's vice president of multimedia applications.

Todd Kuiken (PhD '89, Feinberg '91, Feinberg '95), director of amputee programs at the Rehabilitation Institute of Chicago, has a patient who lost both arms but recently received a prosthetic hand and arm that allows him to sense touch and hold items.

Kathryn Ruffalo-Farnsworth ('89) has joined the team of Montana Senator Max Baucus as senior policy adviser on the Environment and Public Works Subcommittee.

1990s

Mark Banham (MS '90, PhD '94) moved to San Diego to help start PacketVideo.

Sizwe Mncwango ('90, MS '90) was appointed director of South African packaging company Consol.

Kam Tim Chau (PhD '91) was promoted to chair and professor of the Department of Civil and Structural Engineering at Hong Kong Polytechnic University in January 2005. In addition, he became president of the Hong Kong Society of Theoretical and Applied Mechanics in March 2004.

Vinod K. Dasari (MEM, Kellogg '92) joined the Indian company Ashok Leyland as chief operating officer. He will head manufacturing, strategic sourcing, and corporate quality engineering.

Matt McCall (Kellogg '91, MEM, Kellogg '92) is a partner at Portage Venture Partners Inc., a private equity firm based in Northfield, Illinois.

Nicole Morris ('92) joined the Minnesota law firm Robins, Kaplan, Miller & Ciresi as an associate in intellectual property litigation.

James Brailean (PhD '93), president and CEO of PacketVideo, was profiled in connection with the company's success and his early vision to transmit video over wireless networks. He is a member of the McCormick Advisory Council and the Electrical Engineering and Computer Science Advisory Board.

Charlene Shaw ('70), Dean Julio M. Ottino, Bob Shaw ('70, Kellogg '81), and Sarah Pearson, vice president for alumni relations and development, at the opening of the Ford Motor Company Engineering Design Center

Helen Leljeda Dotson ('93) was promoted to global process control technology leader of the Specialties and Ventures Technology Center of the Dow Chemical Company in May 2004. She also serves as the Northern Division governor for District 62 of Toastmasters International.

Jung Kim ('93) was featured in an article about practitioners of integrative medicine.

Ernest R. Roberts III ('93) recently married Tanya S. Danner. The couple lives in Matteson, Illinois.

Raj Shah ('93) was featured in an article about practitioners of integrative medicine.

Rita D. Beckford ('94), an Ohio physician, leads motivational programs to help people improve their physical fitness.

Patrick S. Jensen (MS '95, PhD '97) was named vice president of engineering for Stinger Medical in Murfreesboro, Tennessee.

Brian (Peck-Sheng) Wee (MS '95) joined the NEON Project Office as an associate. He is involved with designing a continental-scale ecological observatory network.

Andrew E. Fano (PhD '96), a partner and senior researcher at Accenture Technology Laboratories, is helping to develop the Intelligent Shopping Assistant, a computerized technology for grocery stores that provides each shopper with a shopping list based on previous purchases and offers related promotional discounts.

Mindy Rittner (PhD '96) has joined Brinks Hofer Gilson & Lione as a scientific adviser in the Nanotechnology Practice Group of the firm's Chicago office.

Michael P. Johnson (PhD '97) is an associate professor of management science and urban affairs at Carnegie Mellon University's H. John Heinz III School of Public Policy and Management. He was profiled in *Black Issues in Higher Education* in January 2005.

Robert Taylor (MEM, Kellogg '97), an Arizona triathlete and founder of venture capital consultancy the Laurus Consulting Group, is competing in the Ironman Florida competition in honor of his late uncle who had prostate cancer. He has raised more than $7,750 towards his goal of $25,000 for prostate cancer research.

Julie Hasenwinkel (PhD '99) of Syracuse, New York, is an assistant professor of bioengineering and neuroscience at Syracuse University's L. C. Smith College of Engineering and Computer Science. She received a Watson Grant from the New York State Office of Science, Technology, and Academic Research in June 2004 that supports her research in neural tissue engineering.

2000s

Scott B. Koester ('00) married Jolsen T. Wigert in May 2005.
Melissa Zubris ('00) married Paul J. Williams on April 9 in Helen, Georgia. They live in Atlanta.
John C. Peterson (MITP '01) was named president of the EPSIIA unit of Fiserv Inc.
Andrew J. Kim ('02) and **Judy Kang** ('03) were married at Northwestern's Alice Millar Chapel in July. They are living in the San Francisco Bay Area, where Kim recently joined biotech start-up Evalve Inc., and Kang is pursuing PhD research at the Lawrence Berkeley and Livermore National Labs.
Jerome Budzik (PhD '03) is cofounder and chief technology officer at Intellext, a start-up company whose software helps people write reports by looking at what they are entering on their computers and searching online for more information that may be relevant to the project. The software was originally developed in Northwestern's Devlab incubator program.
Michael Blake (MITP '03), chief financial officer of IT at Kaiser Permanente, was the subject of an article about the increasing demand for executives with both business and technical skills.

In Memoriam

Ralph W. Janetz, '28
William A. Johnson Jr., '33
Alexander R. Railis, '34
Bruce Warren, '34
Edward C. Blomeyer Jr., '36
Sam Papich, '36
Edward T. Steigelman, '38, NavSci '38
Martell F. Tuntland, '42
Oliver J. Kendall, '43
Alfred Bambula, '44
Robert Diekman, '44, MS '48
Walter W. Johnson, '45
Donald G. Wells, '45
Richard C. Herchenrider, '46
C. Bruce Sharpe, '46
Richard A. Stewart, '46
John W. Loeding, '48
Jack A. Selesemeyer, '48
Lee F. Shrader Jr., '48
David E. Starrett, '48
Robert W. Zimmerman, '48
Earl R. Allen, '49
Harry N. Cantrell, '49
Donald A. Dahlstrom, '49
William M. Harman, '49
Harold D. Ross Jr., '49
James F. Wagner, '49
Jay H. Ashley, MS '50, PhD '52
Lyford L. Lorch, '51
William C. Pike, '51
Donald P. Kurtz, '52, MS '55
Alan P. Volkmar, '52
Robert D. Dikkers, '53
James F. Culverwell, '55
James D. Jenson, '55
George H. Martin, PhD '55
Guy Porter Smith, '55, Law '59
James H. Kogen, '56
Wilbur C. Peterson, PhD '57
Jerry L. Herzog, '58
Stewart M. Harris, '60, '65
Thomas T. Shen, MS '60
Donald W. Woehrle, '60
Robert T. Malmgren, '61, Law '64
Robert E. Akins, '69, '70
Richard J. Welsch, MS '71, PhD '73
James M. Zima, '72
Cynthia J. Panos, '83
Jose C. Araneta, PhD '84
Alisha N. Campbell, '01
Frederick Lieb, '06
Yehuda N. Yudkowsky, '07

At the opening of the Ford Motor Company Engineering Design Center, University President Henry S. Bienen announced plans for a new alliance among the University, the Boeing Company, and the Ford Motor Company for the purpose of conducting nanotechnology research. Representatives from the three institutions (left) were on hand for the announcement.

Walter P. Murphy Society

The Murphy Society comprises dedicated alumni and other friends who make contributions of $1,000 or more during the fiscal year (September 1, 2004, to August 31, 2005) for unrestricted use by the McCormick School of Engineering and Applied Science.

These funds support innovative faculty-initiated projects to improve the undergraduate experience. In the past, funds have supported curriculum innovations such as Engineering First© and the Institute for Design Education and Applications and hands-on design projects such as the solar car competition. Murphy Society members are invited to attend one of the selection committee meetings held each fall in Evanston and the San Francisco Bay Area, or they can vote on proposal recommendations via the Murphy Society web site. This unique opportunity assists the dean in making decisions on worthy projects to fund for the year.

An asterisk (*) indicates members who have died.

Life Fellows

Life Fellows are recognized for their extaordinary support of the mission and goals of the school through their gifts of $500,000 or more.

William R. Blackham ’52
Johnnie Cordell Breed, H ’97
Stanton R. Cook ’49, H ’85
Lester Crown ’46
John A. Dever ’51
James N. Farley ’50 and Nancy J. Farley
Robert J. Fierle ’45
Lavern Norris Gaynor ’45
Leonard G. Ginger ’39
Melville H. Hodge ’52 and Jane K. Hodge ’52
James N. Krebs ’45
Estate of Margie Mitcheson Krebs ’52*
Estate of Nye F. Morehouse Jr. ’50*
Richard S. Pepper ’53 and Roxelyn Miller Pepper ’53
Patrick G. Ryan ’59 and Shirley Welsh Ryan ’61
Benjamin W. Slivka, BSAM ’82, BSCS ’82, MS ’85 and Lisa Wissner-Slivka ’85
Harold B. Smith, MBA ’57 and Denise Smith
Chu Tull
William J. White ’61 and Jane Schulte White

Dean’s Circle

$10,000 or more

A. Craig Asher, MMgt ’93, MS ’94
Peter J. Barris ’74 and Adrienne Barris
William J. Bliss ’87
Harold E. Bond ’46, MBA ’64 and Pauline June Bond
Estate of A. Ballard Bradley ’36*
June E. Brewer ’34
Felix Y. Chen
Alfred C. Eckert III ’71
David Alan Eckert ’77
Donald N. Frey
Wilbur H. Gantz and Linda Theis Gantz
Al Innis
James R. Lancaster ’55 and Patricia Lancaster
Erick A. Reickert ’58
Estate of Heather Ross Reickert*
David A. Sachs ’81 and Karen R. Sachs
Samuel A. Sperry ’65 and Susan J. Sperry
Edward R. Vrablik ’56 and Mrs. Edward R. Vrablik
Robert P. Wayman ’67, MBA ’69 and Susan H. Wayman

Innovators

$5,000 to $9,999

James S. Aagaard ’53, MS ’55, PhD ’57 and Mary-Louise Aagaard
Elizabeth Toof Anderson ’59
Robert E. Basta ’53 and Mary Keller Basta
John W. Bliesznер ’74 and Constance Knope Bliesznер ’74
Adrian P. Brody, PhD ’69 and Pauline N. Brody
Lee A. Dayton Sr. ’65 and Mrs. Lee A. Dayton
Don J. Howard ’63
Vaughn A. Koshkarian ’67, MBA ’68 and Stella M. Koshkarian
J. D. Marvil ’57 and Bonnie Ellis Marvil ’58
Estate of Wallace W. Mojden ’45*
Warren W. Rasmussen ’53, MBA ’56 and Nancy Rasmussen ’53
George L. Schneider ’60 and F. Monier Schneider ’61
David N. Seidman
Robert E. Shaw ’70, MMgt ’81 and Charlene Heuboski Shaw ’70
William A. Streff Jr. ’71, JD ’74 and Kathleen Streff
Alan R. Swanson ’71 and Janet E. Rassenfoss
Alan Wolfson ’80

Designers

$2,500 to $4,999

Irene H. De Sanctis
Elizabeth K. Dean
Robert E. Leigh ’54, MS ’59 and Elaine Leigh
Estate of Joyce R. Lietz*
Michael S. Lurey ’67
Ann Marie Mayes, PhD ’91
Ethan Meister and Mary Cheang Meister ’98
Daniel D. Mickelson ’63 and Sandra P. Mickelson
D. Eugene Nugent ’51 and Bonnie L. Nugent ’49
William B. Olson ’51 and Jeanne Olson ’50
E. Terry Papoutsakis
Kenneth J. Porrello ’78, MMgt ’82 and Sherry L. McFall ’78
Philip D. Robers, PhD ’68 and Sandra Robers
Thomas F. Rosenbaum and Katherine T. Faber
Edward G. Sheppard Jr. ’63
Patricia Timpano Sparrell, MS ’82
Robert B. Taggart ’67, MS ’68 and Donna Bledsoe Taggart
Thomas C. Tyrrell ’67 and Melanie Tyrrell
James E. Van Ness, MS ’51, PhD ’54 and Mary Ellen Van Ness
Alan J. Wasserstrom ’62
Roger G. Williams and Molly Wells Williams ’63

Members

$1,000 to $2,499

Theodore D. Ahlgren ’57, MS ’65, PhD ’67 and Marjorie R. Ahlgren
Thomas P. Anderson ’69
George E. Bailie ’48 and Virginia Louise Bailie
Debasis Baral, PhD ’83
Eric R. Barnett ’94
Robert L. Barnett
Ted Barnett and Amy Lindburg Barnett ’84
Ralph W. Behrens ’62
Michael W. Belin
Louis M. Brock Jr. ’66, MS ’67, PhD ’72 and Carolyn Pratt Brock, PhD ’72
Wesley Burghardt
John A. Campbell, GMEF ’79 and Katherine Foss Campbell ’62, MA/MS ’68
David L. Carney, MS ’68, PhD ’72 and Carol R. Carney
Stephen H. Carr and Virginia McMillan Carr, MS ’71, PhD ’76
Peter S. Castro ’51, MS ’56, PhD ’59 and Patricia Ludeman Castro ’59
Kin-Sheng J. Chang, MS ’76, PhD ’77
Yip-Wah Chung
Norman J. Clemetsen ’62
Edmund U. Cohler ’49, MS ’51, PhD ’53 and Marilyn Dixler Cohler ’51
James A. Cunningham ’61, MS ’63 and Beverly Cunningham
Robert K. Dean ’77 and Susan L. Dean
Peter F. Decker Sr. ’59
Donald A. Dobson ’50, PhD ’55
Richard K. Dompke ’55 and Gayle Kenney Dompke ’58

William R. Drake ’77
Jeffrey L. DuRocher ’67 and Marie DuRocher ’67
William L. Firestone, PhD ’52
Kathleen R. Flaherty ’73, MS ’75, PhD ’79
Gary L. Frederick ’68 and Mary A. Frederick ’66, MMUS ’67
Marvin E. Garrett ’63, MBA ’65 and Judith Wasilko Garrett ’64
Stephen D. Garrity, MS ’76, PhD ’81
Edwin P. Garst ’70 and Karen Patton Garst ’72, MS ’74
Leonard L. Garver ’56, MS ’58, PhD ’61
J. Jeffrey Geldermann, ’72
M. Frederick V. Glock Jr. ’67 and Holly Kuruce Glock ’70
Marilyn O. Goll ’46
Michael N. Goodkind, PhD ’73 and Mary E. Goodkind, MS ’70, MMgt ’81
Alvin L. Gorman
Philip H. Graham ’60 and Linda R. Graham ’60
Daniel G. Green, MS ’61, PhD ’64 and Norma A. Green
Alan K. Greene ’58
James E. Greenlee ’66, MD ’70, GMER ’76 and Raylene Benson Greenlee ’69
Kevin John Gross ’77 and Susan Luerssen Gross ’79
Donald G. Gwinn ’65, PhD ’72 and Joanna H. Gwinn ’66, MSED ’67, MMgt ’83
Ronald H. Haas ’61, MS ’62 and Catherine E. Haas
Steven J. Hampton and Margaret M. Bertelsen Hampton ’80, MMgt ’84
Gene M. Handel ’68
Ruth Mullen Harenchar, MPH ’76
Edward T. Harley ’49
Gilbert A. Harter ’52, MS ’54 and Miriam Knox Harter
Warren R. Haug, MS ’63, PhD ’65
John H. Heckmueller ’70 and Virginia Hemelt
Clyde E. Henderson ’73
Howard N. Henry ’71, MMgt ’78
Henry G. Herzing ’59
David C. Hilliard and Celia V. Hilliard ’64
Cynthia S. Hirtzel, MS ’77, PhD ’80
Roy Y. Hori, MS ’73, PhD ’81
James E. Hovis ’67, MS ’69 and Catherine Hovis
Kiyoji Ishida, MS ’68
Troy R. Karlsson ’84
Dale A. Keister ’62
Mark E. Kelly ’50 and Doris K. Kelly
Robert J. Kiep ’88
Kenneth C. Kirsch ’75, MS ’78, PhD ’80
Kimball Kniskern, MS ’04
Tom C. Krejcie ’74
Gary Kremen ’85’85
P. Noel Kullavanijaya ’82, MS ’85, MMgt ’86 and Wendalyn M. Williams ’84, MD ’86
Harold H. Kung, MS ’72, PhD ’74 and Mayfair C. Kung, MS ’71, PhD ’75
Edward A. Labahn ’51
John Lazar ’48
Donald R. Lee ’63, MS ’65
Shiu-Mei Lee
Jeffrey Richard Lefebvre, MS ’86, PhD ’92 and Julie A. Lefebvre ’87
Jenny Leung
Sek Hon A. Leung ’80 and Jenny Leung
John T. Leyland, GMER ’76 and Marilyn Voss Leyland, MSJ ’68
Robert A. Long ’81 and Sheryl Loyd Long ’81
Steven D. Look ’73
Herbert Malin, MS ’51
Kent A. Mallquist ’60 and Marti Mallquist
Grayson W. Marshall Jr., PhD ’72, DDS ’86 and Sally Rimkus Marshall ’70, PhD ’75
Joseph S. Martinich ’72, PhD ’80 and Vicki Lynn Sauter ’75, MS ’77, PhD ’80
Jeffrey D. McClelland ’80 and Lori Jacobucci McClelland ’83
Capers McDonald and Marion McDonald
Mark W. McGlothlin ’77, MEM ’81
Myron J. McKee Jr. ’48
Gregory W. McKinney, MS ’83 and Nancy Lubich McKinney
Joel D. Meyer and Enid Meyer
William M. Miller
David Mintzer and Justine Mintzer
Lyle F. Mockros ’56, MS ’57 and Glenda H. Mockros
Mark J. Morton ’66
Charles G. Nevaril ’63, MBA ’71
Robert E. Noyes ’45
E. Terry Papoutsakis
Robert L. Peskin
Gerald T. Petersen ’57, CERT ’74 and Carol Krametbauer Petersen ’56
Robert A. Phillips ’63, MS ’65, PhD ’72
Robert J. Piros ’49, MS ’79
Nicholas G. Polydoris ’54
David M. Poydock ’71
Robert L. Puette ’64 and Mrs. J. P. Puette
Vivek Ragavan
Donald E. Rathbone, MS ’57
W. Carlton Reckling ’84
Linda B. Rekoske
Donald J. Rippert and Annette Nicosia Peterson ’86, MMgt ’94
John David Rittner, PhD ’96 and Mindy N. Rittner, PhD ’96
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The opening of the Ford Motor Company Engineering Design Center at the McCormick School (from left): Dean Julio M. Ottino; Charles Wu, director, Manufacturing and Vehicle Design Research Lab, Ford Research Laboratory; Anne Stevens, executive vice president and chief operating officer, the Americas, Ford Motor Company; Joseph Hinrichs, vice president, North American Vehicle Operations, Ford Motor Company; and University President Henry S. Bienen. See stories on pages 5 and 21.

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