

McCormick

NORTHWESTERN UNIVERSITY ENGINEERING / *spring 2013*

**"EVENTUALLY WE WILL BE ABLE
TO SEE THE WHOLE PUZZLE"**

MCCORMICK RESEARCHERS WORK
TO DECODE THE BRAIN'S MYSTERIES



On the cover: Using his expertise in molecular self-assembly, McCormick professor Samuel I. Stupp has developed a noodle-like construct that can help healthy brain cells survive and proliferate—and possibly help fight disease. In the image, neurons harvested from a mouse brain were cultured inside the aligned peptide amphiphile scaffold (the “noodle”) for seven days and stained. The green-colored cells are neurons; red cells are astrocytes. Nuclei are shown in blue.

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

Director of marketing: Kyle Delaney
Managing editor: Emily Ayshford
Editors: Nancy Liskar, Marianne Goss
Designer: Vickie Lata

Writers: Emily Ayshford, Megan Fellman,
Sarah Ostman

© 2013 Northwestern University.
All rights reserved. Produced by University
Relations. 4-13/27.5M/NL-VL/1449-1

FROM THE DEAN

Greetings from McCormick.

At McCormick we often say that we strive to develop whole-brain engineers. We want our students and faculty to have a strong foundation in mathematics, analysis, and logic—all considered “left-brain” skills—but we also want them to develop “right-brain” creativity, intuition, and imagination.

This is a metaphor, of course. The brain cannot be reduced to halves; it is vastly more complex. Humanity’s greatest achievements and its most shameless failures emerge from it, and yet we understand very little about it, how it works, or how it evolves. It is the ultimate complex system: even a perfect understanding of the smallest parts, neurons—an impossibility, of course—would not give us an understanding of the system as a whole and how consciousness emerges.

As you will read in this issue, several McCormick faculty members are tackling the brain from their niche research areas, from mathematical modeling of neurons to nanotechnology-driven thinking that may advance treatment of neurodegenerative diseases. Continued progress in this area will require a true meeting of minds, the ultimate cross-disciplinary collaboration. I am eager to see what our team does next.

We are also excited to feature several of our most talented undergraduate researchers. A growing number of undergraduates participate in research in our laboratories, often serving as essential team members and coauthors on published papers. I myself have worked

with mechanical engineering senior Marissa Krotter for four years, and in December she appeared as lead author on a paper that was featured on the cover of the *International Journal of Bifurcation and Chaos*. Even if students do not ultimately pursue careers as researchers, participating in research as undergraduates teaches them valuable lessons: how to ask questions and how to fail. As Marissa says, “In class, if you’re working on a project or doing homework, you have an answer set so you know if you’re on the right track. Research is completely open-ended. It’s all new terrain.”

When prospective students visit, they frequently ask where our recent graduates find jobs. We are lucky to have a base of alumni who chart their own courses, be it in large or small companies, in the United States or abroad. In this issue we feature six young alumni who have started their own companies or have risen quickly in their chosen fields. We teach engineers how to think and give them a toolset and a mindset to carry them over the span of their careers, and it is exciting to see young alumni using their education from day one.

I hope you will take some time to explore this magazine and learn more about how we think and where we are going.

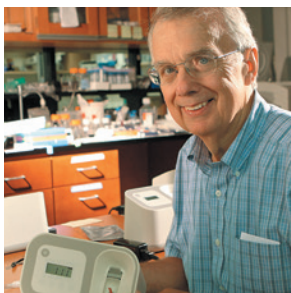
As always, I welcome your feedback.

Julio M. Ottino, Dean | April 2013

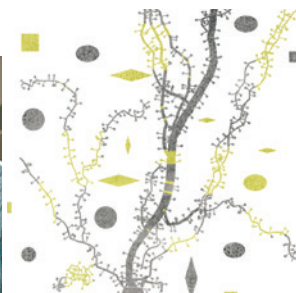
contents

- 2 **MCCORMICK NEWS**
Breakthrough in MS research, McCormick in the media, and more
- 8 **STORIES FROM THE INTERSECTION**
Energy and environment • Health and wellness • Materials • Systems • Creating leaders
- 10 **THE BRAIN**
Demystifying the body's most complex organ
- 18 **FACULTY PERSPECTIVE: CONSCIOUSNESS-ENHANCING TECHNOLOGIES**
Sustainability meets design
- 20 **QUANTUM LEAP**
Prem Kumar's career in quantum communication and computing
- 22 **THE SCIENCE BEHIND A MASTERPIECE**
Northwestern and the Art Institute of Chicago collaborate on scientific research
- 26 **CARBON CALCULATOR**
Eric Masanet uses mathematical models to understand the complexity of carbon emissions
- 28 **A SEAT AT THE LAB TABLE**
Undergraduates play a vital role in McCormick research
- 32 **GRADUATE STUDENT PROFILE: ROBERT VAN LITH**
Innovator reaches across disciplines and cultures
- 34 **ON THE JOB**
Young McCormick alumni take their skills far and wide
- 40 **ALUMNI PROFILE: MATTHEW LEVATICH**
Harley-Davidson's president on how the MMM program changed him
- 42 **MURPHY SOCIETY DONORS**
- 46 **CLASS NOTES**
- 48 **MCCORMICK ALUMNI AND FRIENDS HONORED**
- 49 **THE ART OF ENGINEERING**

2



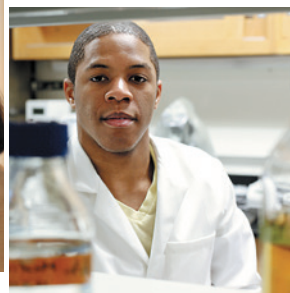
10



22



28

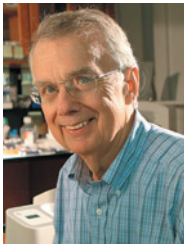


34



McCormick news

WWW.MCCORMICK.NORTHWESTERN.EDU



QUICK-RESULTS HIV TEST FOR BABIES TO DEBUT IN MOZAMBIQUE

Today, mothers in Africa sometimes walk more than 10 miles to a clinic only to learn that conventional HIV test results for their babies are not available yet. Many never come back or even get their infants tested in the first place.

Soon residents in Maputo,

Mozambique, will participate in the first evaluation of an HIV test that was developed at Northwestern University and differs dramatically from conventional tests that are complex and slow to produce results. The first-of-a-kind test will deliver a diagnosis in less than an hour while mother and child are still in the clinic.

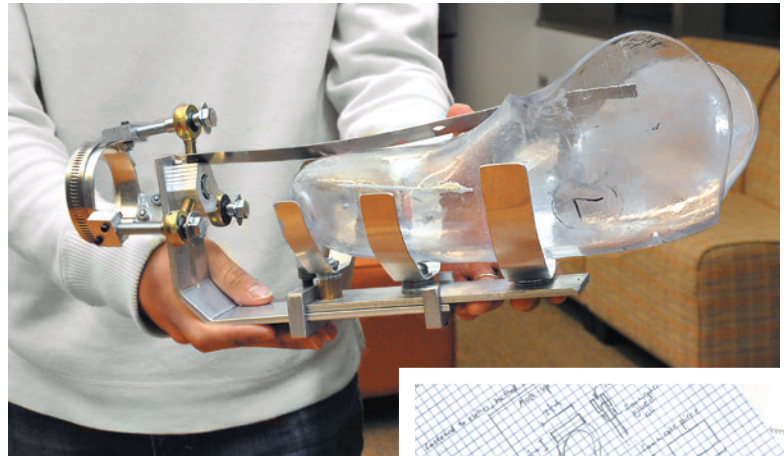
“Our test provides while-you-wait results, and if a child is

infected, he or she will begin treatment immediately, which is critical to survival,” says **David Kelso** (above), who led its development. Kelso is a clinical professor of biomedical engineering and director of McCormick’s Center for Innovation in Global Health

Technologies. His research team developed the technology with funding from the Bill & Melinda Gates Foundation.

A miniaturized, inexpensive version of the p24 antigen test, the easy-to-use test was designed for developing countries. A drop of blood is taken from the infant’s heel and inserted into a small processor. Results arrive within 30 minutes with a 94 percent accuracy rate. The test detects very low levels of core protein 24, which is made by the virus itself.

In 2010 Kelso and his partners, with support from Northwestern, established the Northwestern Global Health Foundation to combat infectious diseases in the developing world. It plans to establish a distribution company in Africa for the various tests and to train clinicians in their use. The foundation puts any profits back into research and low-cost manufacturing.

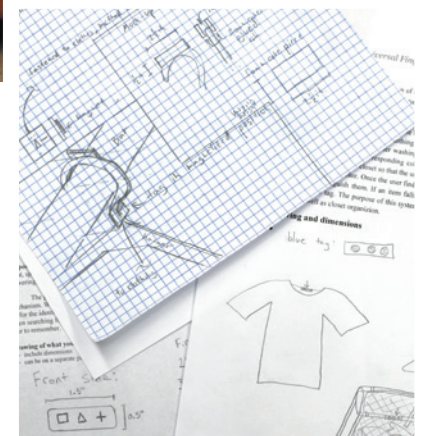


SIGNATURE DESIGN COURSE GETS A NEW NAME

For 15 years McCormick freshmen have completed a foundational course to learn special design problem-solving and communication skills, known as “design thinking” in business and academic circles: frame a problem, consider solutions, refine, execute. The course that teaches these skills, formerly known as Engineering Design and Communication, has been renamed Design Thinking and Communication to showcase its key outcomes.

“When we started teaching design at Northwestern 15 years ago, these were very forward-thinking ideas,” says **Bruce Ankenman**, codirector of the course and Charles Deering McCormick Professor of Teaching Excellence. “Now the term ‘design thinking’ has become commonplace in the business and academic worlds, and people have begun to recognize it as a vital part of the innovation process.”

Offered through the Segal Design Institute in collaboration with the Weinberg College of Arts and Sciences, Design Thinking and Communication allows freshmen and transfer students to work on real clients’ problems and to explain their designs to various audiences.



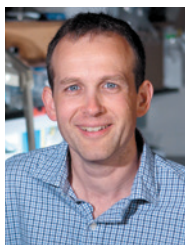
Each section is cotaught by faculty from McCormick and Weinberg’s Writing Program. “Since communication instruction is thoroughly integrated into the design process, students learn that better communication actually leads to better design,” says codirector Penny Hirsch of the Writing Program.

Through partnerships with the Rehabilitation Institute of Chicago, students spend the first half of the two-quarter course working with clients who have disabilities. Projects have included a device to help someone open a jar using only one arm and a pill dispenser for a man who cannot use his arms or legs. Second-quarter projects address a variety of healthcare, industry, and education problems.

BREAKTHROUGH NANOPARTICLE HALTS MULTIPLE SCLEROSIS

Delivering an antigen that tricks the immune system into stopping its attack on myelin, a biodegradable nanoparticle (pictured at right) developed at Northwestern represents a breakthrough in multiple sclerosis research. In MS the immune system attacks the myelin membrane that insulates nerve cells in the brain, spinal cord, and optic nerve. Electrical signals can't be effectively conducted, resulting in symptoms that range from mild limb numbness to paralysis or blindness.

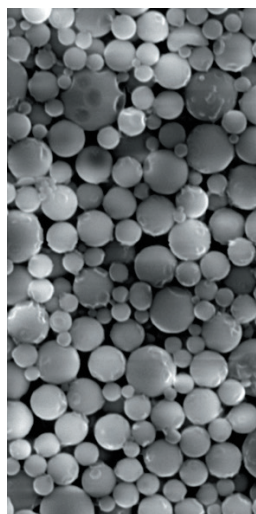
The nanoparticle developed by



Lonnie Shea, professor of chemical and biological engineering, does not suppress the entire immune system, unlike current MS therapies that increase susceptibility to infections and cancer. Shea found that the immune system is reset to normal when the nanoparticle, which is made from an easily produced and FDA-approved substance, is attached to

myelin antigens and injected into mice. This is especially beneficial for the 80 percent of MS patients who have the relapsing form of the disease.

"This is a highly significant breakthrough in translational immunotherapy," says Stephen Miller, a corresponding coauthor of the study and the Judy Gugenheim Research Professor of Microbiology-Immunology at Northwestern's Feinberg School of Medicine. This new technology can be used in many immune-related diseases, including Type 1 diabetes, food allergies, and asthma. "We simply change the antigen that's delivered," Miller says.



EVENTS STRENGTHEN CONNECTION BETWEEN RESEARCH AND THE MARKETPLACE

Late last year the McCormick School hosted two inaugural events for engineers, entrepreneurs, and business leaders, part of its ongoing efforts to strengthen relationships with Chicago's strong business and entrepreneurial community.

The McCormick Corporate Forum Meeting in October brought together McCormick faculty and students with Chicago-area research and development executives. It included talks about McCormick's strategy, global perspectives on engineering research and education, and a briefing by faculty from McCormick and Argonne National Laboratory on the Materials Genome Initiative. Forum members will continue to meet twice a year with McCormick leadership and faculty about engineering technology and education.

Private investors, venture capitalists, and scientists convened at McCormick in November for the NU Physical Sciences Investor Conference. The

event, which focused on innovations in engineering and chemistry, highlighted both startups spun out of Northwestern labs and ongoing research that may be ripe for commercialization.

Highlighted startups included NuGen Polymers, a company that provides polymer technology to enable next-generation recycling without separation; NuMat Technologies, designers of high-performance materials that store gases and can be produced on a large scale for industry; S2E Energy, makers of a platform component that enables low-cost solar energy; and Tangible Haptics, technology that brings tangible haptic reality to touch interfaces like smartphones.

The NU Physical Sciences Investor Conference was organized by McCormick, Northwestern's Innovation and New Ventures Office, the Farley Center for Entrepreneurship and Innovation, and Weinberg College's Department of Chemistry.



COMPUTATIONAL AND EXPERIMENTAL METHODS USED TOGETHER TO SOLVE ATOMIC STRUCTURE IN SOLIDS

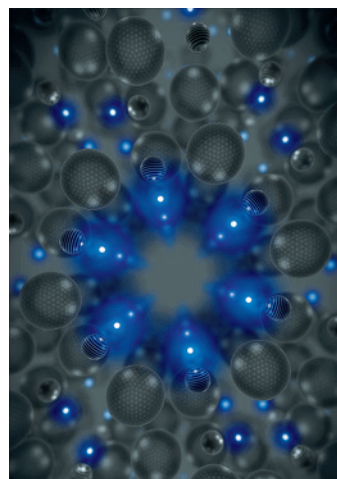
Understanding the arrangement of atoms in a solid is vital to advanced materials research. Two camps of researchers have been working for decades to develop methods to understand these so-called crystal structures. The "solution" methods of experimental researchers draw on data from diffraction experiments. The "prediction" camp bypasses experimental data in favor of computational methods. While computational scientists have made progress, they still cannot routinely make predictions about crystal structure.

Drawing on both prediction and solution methods, **Chris Wolverton**, professor of materials science and engineering, and his group have developed a new code to solve crystal structures automatically and in cases where traditional experimental methods struggle.

The researchers started with an important fact: While the precise

atomic arrangements for a given solid may be unknown, experiments have revealed the symmetries present in tens of thousands of known compounds. This database of information is useful in solving the structures of new compounds.

Wolverton's team revised the genetic algorithm, which mimics the process of biological evolution, to take those data into account. Wolverton and his group analyzed the atomic structure of four technologically relevant solids whose crystal structure has been debated by scholars—magnesium imide, ammonia borane, lithium peroxide, and high-pressure silane—and demonstrated how their method would solve the atomic structures. The algorithm that resulted from their study could allow researchers to understand the structures of new compounds for applications ranging from hydrogen storage to lithium-ion batteries.



KNIGHT LAB'S TWITTER-BASED VOTE PREDICTOR RECOGNIZED

What do your tweets say about your politics? Quite a bit.

TweetCast, an algorithm developed by Northwestern's Knight News Innovation Lab, could have guessed the presidential candidate you voted for by examining the words, hashtags, websites, and user name in your tweets. For example, Romney voters were more likely to tweet words like "libs," "terrorist," and "socialism," while Obama voters leaned toward words like "exactly," "equal," and "cuts."

TweetCast was named one of PBS MediaShift Idea Lab's "Picks for the Most Innovative Election Coverage."

Established in 2011, the Knight Lab is a joint initiative of McCormick and the Medill School of Journalism, Media, Integrated Marketing Communications. Its mission is to introduce smart and practical technology innovation to accelerate the transformation of the way news is discovered, analyzed, presented, and delivered.

NEW ANTIDEPRESSANT PROFILED BY SEVERAL NEWS OUTLETS

A revolutionary antidepressant developed by **Joseph Moskal**, research professor of biomedical engineering and director of Northwestern's Falk Center for Molecular Therapeutics, has been featured by several news outlets.

Moskal and his research team developed the drug GLYX-13, which controls the strength of NMDA (N-methyl-D-aspartate) receptors in the brain. The receptors affect the quality of connections between neurons, which are vital in regulating learning and memory functions and, it has been found, also have an impact on mental health. For more on this research, see page 15.

Moskal presented his findings at the 51st annual meeting of the American College of Neuropsychopharmacology in December. The new drug has since been profiled by CBS News, *U.S. News & World Report*, and *New Scientist*.

McCormick

IN THE MEDIA



MUSSEL-INSPIRED MEDICAL ADHESIVES FEATURED ON PBS

An adhesive developed by McCormick professor **Phillip B. Messersmith** that mimics the sticking power of marine mussels has been featured by PBS as well as the *Guardian*, the *Telegraph*, Yahoo!, and *Science*.

The glue could be used in medical procedures like fetal membrane repair.

Messersmith, the Erastus O. Haven Professor of Biomedical Engineering, studied the water-resistant glue that mussels produce to allow them to adhere to rocks and other surfaces. He reasoned that similar materials could be developed to replace existing surgical glues, which can be ineffective. He presented his findings at the American Association for the Advancement of Science's annual meeting in February.

In addition to fetal membrane repair, Messersmith's glue could be used in self-setting antibacterial hydrogels and polymers for cancer-drug delivery and thermal destruction of cancer cells.

TODAY SHOW REPORTS ON MCCORMICK-SHEDD AQUARIUM PARTNERSHIP

At McCormick's Segal Design Institute, students often work to solve problems they've never tackled before for people who need the solutions most. But when



the projects involve clients at one of Chicago's most revered institutions, the challenges go beyond the realm of humans.

Penguins that need shoes? Fish that need surgery?

McCormick students are up to the task. Their successful designs, and McCormick's seven-year-old partnership with the Shedd Aquarium, were featured on the *Today* show and on the front page of the *Chicago Tribune* earlier this spring.

The featured project, a "shoe" for penguins with sore feet, was designed by freshmen in McCormick's Design Thinking and Communication course, where student teams work with clients to solve problems. In the class, students learn to interview and observe the client, brainstorm possible solu-

tions, create prototypes, and ultimately communicate their ideas back to the client. The course is cotaught by faculty in the Weinberg College's Writing Program.

Students were tasked with designing a waterproof shoe that could protect a hurt penguin's foot while allowing the animal to walk, swim, and stand comfortably. The selected design, dubbed the Tuxedo, is less like a shoe and more like a six-winged bandage with a neoprene insert to protect the sore foot.

The Tuxedo is one of several helpful devices McCormick students have produced for the Shedd. Upper-level students also developed a decompression tank for sea horses and an anesthesia system for fish surgeries.

READ MORE AT WWW.MCCORMICK.NORTHWESTERN.EDU**PUBLIC-PRIVATE PARTNERSHIPS DISCUSSED AT TRANSPORTATION SYMPOSIUM**

A once-impressive railway system now ranked 18th in the world, and an air transportation system ranked 30th. Congested ports unable to accommodate today's mega-ships. The country's infrastructure "is crumbling as we speak," former Illinois state representative Jerry F. Costello told a packed audience at the sixth William O. Lipinski Symposium on Transportation Policy and Strategy in January, citing a recent study by the advocacy group Building America's Future. "We truly do have a crisis on our hands, and we cannot wait any longer to address our needs."

Costello says public-private partnerships (known as P3s) might address the crisis as public funding dwindles. P3s are not funding sources but financing arrangements from which private investors expect a reasonable financial return. Such arrangements offer financial incentives for private investment in public infrastructure and for sharing cost, revenue, and performance risks between business and government.

At the event, which was organized by the Northwestern University Transportation Center, three successful public-private partnerships were described: the Denver Regional Transportation District's Eagle P3 commuter rail line to Denver International Airport; the monetization of the Chicago Skyway and the Indiana Toll Road; and the East End Crossing of the Louisville-Southern Indiana Ohio River Bridges Project.

Thomas Lancot, partner and group head at William Blair & Company, said that the size of transactions must be substantial enough to warrant the expensive bid process. He also said that the risk of public partners backing away from projects after private investors spent large amounts of time and money needs to be minimized.

During lunch, the David F. Schulz Award, named for the late founding director of Northwestern's Infrastructure Technology Institute, was awarded to Chicago Transit Authority president Forrest Claypool for the CTA's aggressive infrastructure repair program.



ematics fields at top US research universities shows that bias against women is ingrained.

The quantitative study of the complete publication records of more than 4,200 professors in seven STEM fields confirms that female faculty in some fields do publish fewer papers than do male faculty, but not for lack of talent or effort. The research, led by **Luis A. Nunes Amaral**, professor of chemical and biological engineering, found that in fields that require more resources, women publish less. The gap may exist, therefore, because academic departments historically have not invested equal resources in female faculty from the start of their careers.

The researchers found that for a discipline where research

STUDY FINDS GENDER BIAS IN RESEARCH RESOURCES FOR STEM FACULTY

resource requirements are low, such as industrial engineering, the gap essentially is absent; male and female faculty publish papers at similar rates. But for a discipline such as molecular biology, where resource requirements are very high, the gap is quite wide, with male faculty publishing at significantly higher rates than their female colleagues.

The research team also found that in disciplines where pursuing an academic position incurs greater career risk, such as in ecology, female faculty tend to have higher-impact publications than males, suggesting that their papers are of higher quality. "You have to be really, really good to be a female in ecology," says study coleader Teresa K. Woodruff, the Thomas J. Watkins Memorial Professor of Obstetrics and Gynecology at the Feinberg School. "Women are self-selecting—they are not allowed to be as risky when choosing an academic career. We are losing talented women

in the STEM fields because they are choosing to go elsewhere."

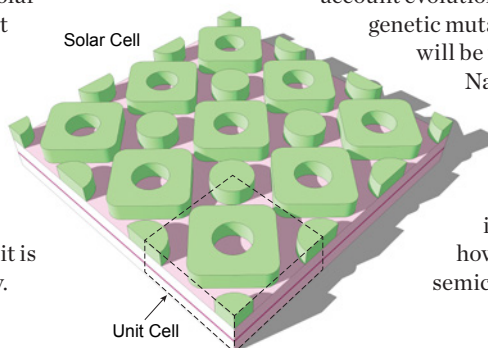
Amaral says he believes the results represent what is happening to all underrepresented groups in science and engineering, such as African Americans and Hispanics, and possibly in workplaces outside academia, such as business, politics, and the legal profession.

"I expect it would cost very little to bridge the gap and take bias out of the system," Woodruff says. "Our goal is to understand the productivity gap so we can intervene."

**EVOLUTION INSPIRES MORE EFFICIENT SOLAR-CELL DESIGN**

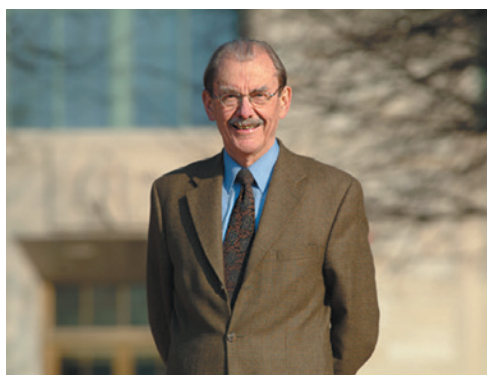
Harnessing the sun's energy with today's single-crystal silicon solar cells is extremely expensive. Polymer solar cells that use organic materials to absorb light and convert it into electricity could be a solution, but they have less-than-optimal electrical properties.

Northwestern researchers have developed a new design for more efficient, less expensive organic solar cells. Using a mathematical search algorithm based on natural evolution, the researchers pinpointed an optimal geometrical pattern for capturing and holding light in organic solar cells. In their design, light first enters a "scattering layer," a 100-nanometer-thick, geometrically patterned dielectric layer that maximizes light transmission. The light is then transmitted to the active layer, where it is converted into electricity.



"We wanted to determine the geometry for the scattering layer that would give us optimal performance," says **Cheng Sun** (pictured at left), assistant professor of mechanical engineering, who coauthored the research with **Wei Chen**, Wilson-Cook Professor in Engineering Design and professor of mechanical engineering. "With so many possibilities, it was difficult to know where to start, so we looked to the laws of natural selection."

Using the evolution-mimicking genetic algorithm, the researchers "mated" random design elements and analyzed the offspring to determine light-trapping performance. This process was carried out over more than 20 generations and took into account evolutionary principles of crossover and genetic mutation. The resulting design, which will be fabricated by partners at Argonne National Laboratory, exhibited a threefold increase in light-trapping performance over the Yablonovitch Limit, a thermodynamic limit that was developed in the 1980s to statistically describe how long a photon can be trapped in a semiconductor.



NEW LECTURE SERIES HONORS ACHENBACH

The McCormick School has created a new lecture series in honor of longtime faculty member **Jan D. Achenbach**, a preeminent researcher in solid mechanics and quantitative non-destructive evaluation.

The Jan D. Achenbach Lecture recognizes Achenbach for his extraordinary contributions to the field of mechanics as well as his profound impact on McCormick's Departments of Mechanical Engineering, Civil and Environmental Engineering, and Engineering Sciences and Applied Mathematics.

An endowment for the series was provided through the generous contributions of McCormick alumni and friends and by the scientific publishing company Elsevier. A high-profile speaker will lecture on campus each year.

"We are grateful for the support of the alumni and friends who wished to honor Jan's distinguished career," said McCormick's Dean Julio M. Ottino. "Jan has made significant contributions to McCormick and to mechanics research over the past five decades, and this lecture is a fitting tribute to his impact."

In 2012 Achenbach received the American Society of Mechanical Engineers' Medal, the organization's highest award, "for his groundbreaking contributions to the theory and applications of waves and solids." He received the 2005 National Medal of Science, the nation's top honor for innovation in technology and science, and a 2003 National Medal of Technology. A member of the National Academy of Engineering and the National Academy of Sciences, he is also a fellow of the American Academy of Arts and Sciences and a corresponding member of the Royal Dutch Academy of Sciences. His other awards include the Timoshenko Medal, the William Prager Medal, and the Theodore von Karman Medal. In 2011 he was awarded a rare honorary doctorate from China's Zhejiang University.

FOUR MCCORMICK PROFESSORS NAMED AAAS FELLOWS

Four McCormick professors were among six Northwestern faculty members elected fellows of the American Association for the Advancement of Science, the world's largest general scientific society, in 2012.



Luís A. Nunes Amaral, professor of chemical and biological engineering, was selected for distinguished contributions to the theoretical and computational study of complex systems, particularly the development of a cartographic framework for characterizing large networks.



Michael J. Bedzyk, professor of materials science and engineering, was chosen for innovative experimental and theoretical contributions to the physics of materials, using novel synchrotron x-ray scattering, and spectroscopy techniques influencing several scientific and technological fields.



Ajit C. Tamhane, professor of industrial engineering and management sciences and senior associate dean, was honored for excellence in statistical research, for substantive collaboration in the chemical engineering discipline, for excellence in communicating statistical science, and for broad administrative accomplishments.



John M. Torkelson, Walter P. Murphy Professor of Chemical and Biological Engineering and of Materials Science and Engineering and Charles Deering McCormick Professor of Teaching Excellence, was chosen for outstanding contributions to the field of polymer science and engineering and for formulating core principles underlying dynamics in confined



KLABJAN RECEIVES 2012 WATSON AWARD FROM IBM

Diego Klabjan, director of McCormick's Master of Science in Analytics program and professor of industrial engineering and management sciences, has received an IBM Watson Solutions Faculty Award to implement a course based on a new class of analytical systems—the likes of which created Watson, the artificial intelligence computer that clinched a victory on *Jeopardy!* in 2011. He is one of 10 university professors from across the country to receive the grant.

The awards are designed to strengthen students' understanding of cognitive systems like Watson, including big data and analytics, in order to meet the growing demand for highly skilled analytics workers. At Northwestern the award will support a new course in the MSiA program that focuses on big-data analytics.

READ MORE AT WWW.MCCORMICK.NORTHWESTERN.EDU



STRUCTURAL MECHANICS MEDAL BEARS BELYTSCHKO'S NAME

The US Association for Computational Mechanics has recognized **Ted Belytschko**, McCormick Professor and Walter P. Murphy Professor of Mechanical Engineering and professor of civil and environmental engineering, by renaming one of its top medals in his honor. Belytschko was one of the founding directors of the USACM.

The Belytschko Computational Structural Mechanics Medal will recognize outstanding and sustained contributions to the field of computational structural mechanics, with a focus on important research results that advance theories and methods in the field.

A member of Northwestern's faculty since 1977, Belytschko is interested in the development of computational methods for engineering problems. He is one of the most cited researchers in engineering science and the recipient of numerous honors, including membership in the National Academy of Engineering, the National Academy of Sciences, and the American Academy of Arts and Sciences.

This is the second award named for Belytschko. In 1997 the American Society of Mechanical Engineers' Applied Mechanics Award was renamed for him.

COLE-HIGGINS AWARDEES HONORED FOR TEACHING AND ADVISING EXCELLENCE



Dirk Brockmann (top photo), associate professor of engineering sciences and applied mathematics, has won McCormick's 2012 Cole-Higgins Award for Excellence in Teaching, and **Aaron Packman**, professor of civil and environmental engineering, has won the Cole-Higgins Award for Excellence in Advising.



Students nominate professors for the annual honor, and a committee chooses the winners. Students praised

Brockmann for his tough but clear classroom teaching style as well as his willingness to give extra help, often one on one, outside of class time. On his award certificate Brockmann, an expert in complex systems, was cited "for having an outstanding capacity to give personal attention to individual students . . . whether they are enrolled in foundational or advanced courses."

Advising award winner Packman, who studies environmental and microbial transport processes, was cited "for service to students seeking advice related to career progress, laboratory research, and student professional societies."



BAŽANT RECEIVES ASME HONOR

Zdeněk P. Bažant, McCormick Institute Professor and Walter P. Murphy Professor of Civil and Environmental Engineering, Mechanical Engineering, and Materials Science and Engineering, has received honorary membership in the American Society of Mechanical Engineers. First awarded in 1880, honorary ASME memberships recognize a lifetime of service to engineering or related fields.

Bažant, an expert in solid mechanics and structures, was honored by the organization last year for his contributions to engineering science, including his size effect law, which is widely used in determining safety factors for large structures made of concrete and other composite materials. He is also an honorary member of the American Society of Civil Engineers and the American Concrete Institute.

STUDENT RECOGNIZED FOR NANOTECHNOLOGY RESEARCH

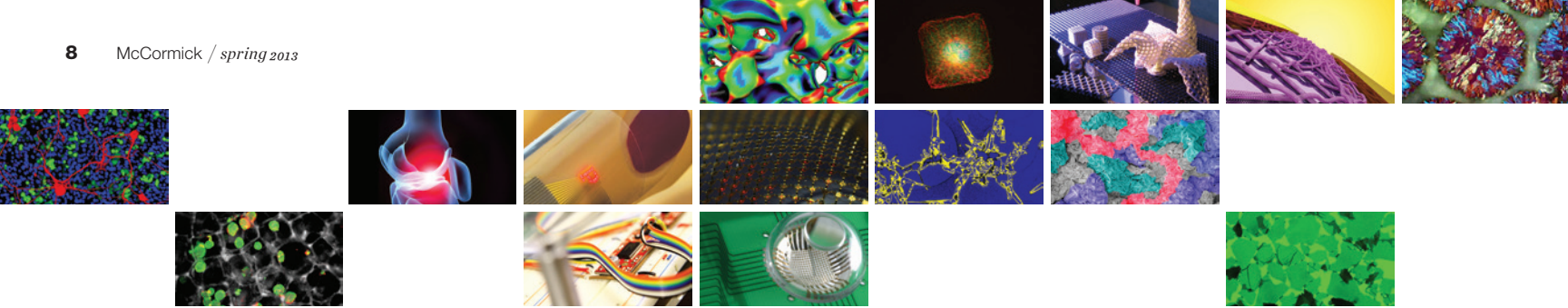


David A. Walker, a PhD candidate in chemical and biological engineering, has been awarded the 2012 Distinguished

Student Award by the Foresight Institute, a leading think tank that advances transformative technologies. The award recognizes a student for notable nanotechnology work.

Walker is researching nano-scale electrostatic interactions and their ability to precisely assemble nano-objects to within a few nanometers. His adviser is **Bartosz A. Grzybowski**, Kenneth Burgess Professor of Chemical and Biological Engineering and director of the Non-Equilibrium Energy Research Center.

Walker is the first Northwestern student to be granted the award since its inception in 1997. Several Northwestern professors have received Foresight Institute recognitions, including Chad Mirkin, Mark Ratner, George Schatz, and Sir Fraser Stoddart.



stories from the intersection

WWW.THEGREATINTERSECTION.COM



Health and wellness

New method improves delivery of gene therapy

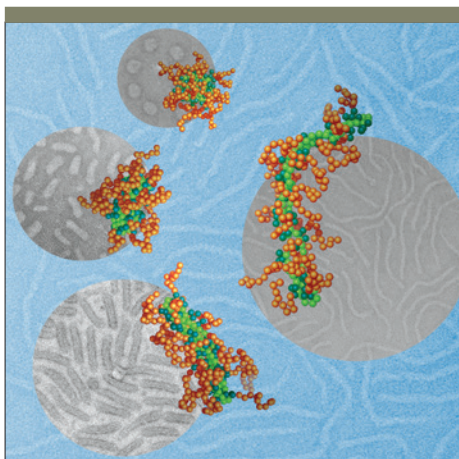
Targeted gene therapy could be a promising step toward engineering and of applied mathematics at Northwestern, led the computational analysis of the findings to determine why the nanoparticles formed into different shapes.

the treatment of numerous genetic disorders, but its complexity has made execution a challenge. To be effective, a “carrier” particle must transport snippets of healthy DNA through the patient’s bloodstream and deposit them inside cell nuclei in a specific part of the body. But too often the DNA arrives at its target damaged—or it doesn’t arrive at all.

A new method for transporting DNA molecules to controlled locations in the body has been developed by researchers at Northwestern and Johns Hopkins University. It takes advantage of a significant finding: that different parts of the body absorb different nanoparticles depending on the nanoparticles’ shapes.

Johns Hopkins researchers found a way to regulate the shape of DNA-containing nanoparticles, and Erik Luijten, associate professor of materials science and

Simulations were performed on Quest, Northwestern’s high-performance computing system. Some of the computations were so complex that they required 96 computer processors working simultaneously for one month.



DNA molecules (light green) are packaged into nanoparticles by using a polymer with two different segments. One segment (teal) carries a positive charge that binds it to the DNA, and the other (brown) forms a protective coating on the particle surface.



Creating leaders

Companies recognized for innovations

Three firms with roots at McCormick were honored as “Up-and-Comers” at the 2012 Chicago Innovation Awards held in October 2012. The annual awards recognize the most innovative new products or services brought to market or to public service in the Chicago region. Nine winners were selected from 180 candidates.

The Northwestern Global Health Foundation was recognized for its HIV test for infants in developing countries. (See page 2.) The independent nonprofit biotech company develops and distributes medical diagnostics for global health applications, based on technologies developed at McCormick.

NuMat Technologies was recognized for software that makes gas storage more efficient by analyzing and quickly suggesting ideal metal-organic-framework structures for custom storage applications. MOFs have the potential to transform products such as natural gas vehicles. The NuMat team represents four Northwestern schools: McCormick, the Kellogg School of Management, the School of Law, and Weinberg.

BriteSeed was recognized for SafeSnips, technology that can be integrated into surgical tools to detect blood vessels during surgery and prevent unintended bleeding. Students in Northwestern’s NUvention: Medical Innovation course founded the medical device startup. Team members pictured here are (left to right) Paul Fehrenbacher, Mayank Vijayvergia, Jonathan Gunn, and Muneeb Bokhari.

Energy and environment

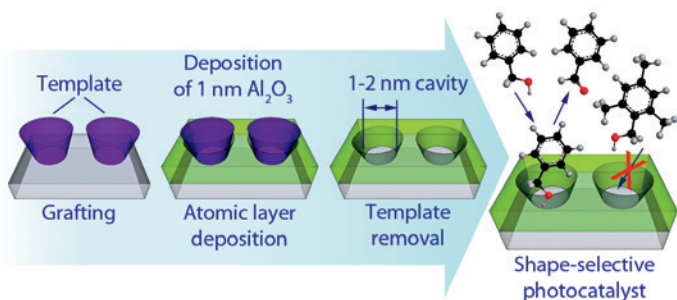
New process blocks unwanted reactants in oxide catalysis

Oxide catalysts, typically formulated as powders, play an integral role in many chemical transformations, including cleaning wastewater, curbing tailpipe emissions, and synthesizing most consumer products.

Greener, more efficient chemical processes would benefit greatly if solid oxide catalysts were choosier about their reactants. Researchers from Northwestern and Argonne National Laboratory have developed a straightforward and generalizable process for making reactant-selective oxide catalysts by encapsulating the particles in a sieve-like film that blocks unwanted reactants.

The process, developed at Northwestern by Justin Notestein, assistant professor of chemical and biological engineering, could find applications in energy, particularly the conversion of biomass into sugars and then fuels and other useful chemicals.

In testing their method the researchers focused on photocatalytic oxidations, such as the notoriously unselective conversion of benzyl alcohol into benzaldehydes. They coated a core particle of titanium dioxide, a harmless white pigment, with a nanometer-thick film of aluminum oxide pitted with tiny “nanocavities” that allowed only the smaller reactants to slip through and react with the titanium oxide.



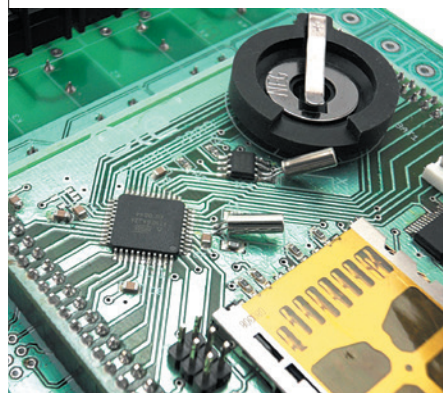
Systems

Tool could speed web performance by 40 percent



A research team led by Fabián Bustamante, associate professor of electrical engineering and computer science, has developed namehelp, a tool to improve the performance of public domain name systems.

DNSs translate domain and host names into Internet protocol addresses; computers perform DNS lookups before establishing website connections. Users presumably are directed to the geographically closest version of the website replicas on thousands of worldwide servers. But Bustamante's team found that public DNSs may send users to replicas three times farther away than necessary, slowing web surfing.



The team's large-scale study involving more than 10,000 hosts across nearly 100 countries found a relationship between slow web performance and a trend toward public DNSs. Although public DNSs offer better security, privacy, and resolution time than the “private” services offered by Internet service providers, Bustamante's group found that the hidden interaction of

public DNSs with content delivery networks can hurt web performance.

To solve the problem, the researchers developed namehelp, a tool that may speed web performance by 40 percent. The tool, which determines a user's optimal DNS configuration, can be downloaded from <http://aqualab.cs.northwestern.edu/projects/namehelp>.



Materials

Model predicts movement of charged particles in complex media

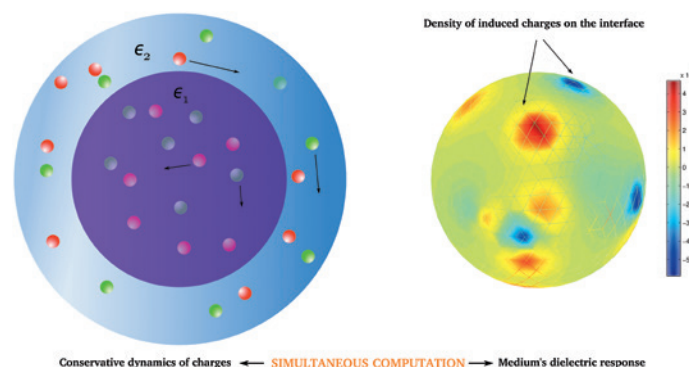
Thanks to the laws of elementary electrostatics, the force that two charged particles in a vacuum exert on one another can be easily calculated and their resulting movements predicted. But real biological and material systems, such as plant cells and blood cells, are less predictable because they are made up of several media and may be oddly shaped.

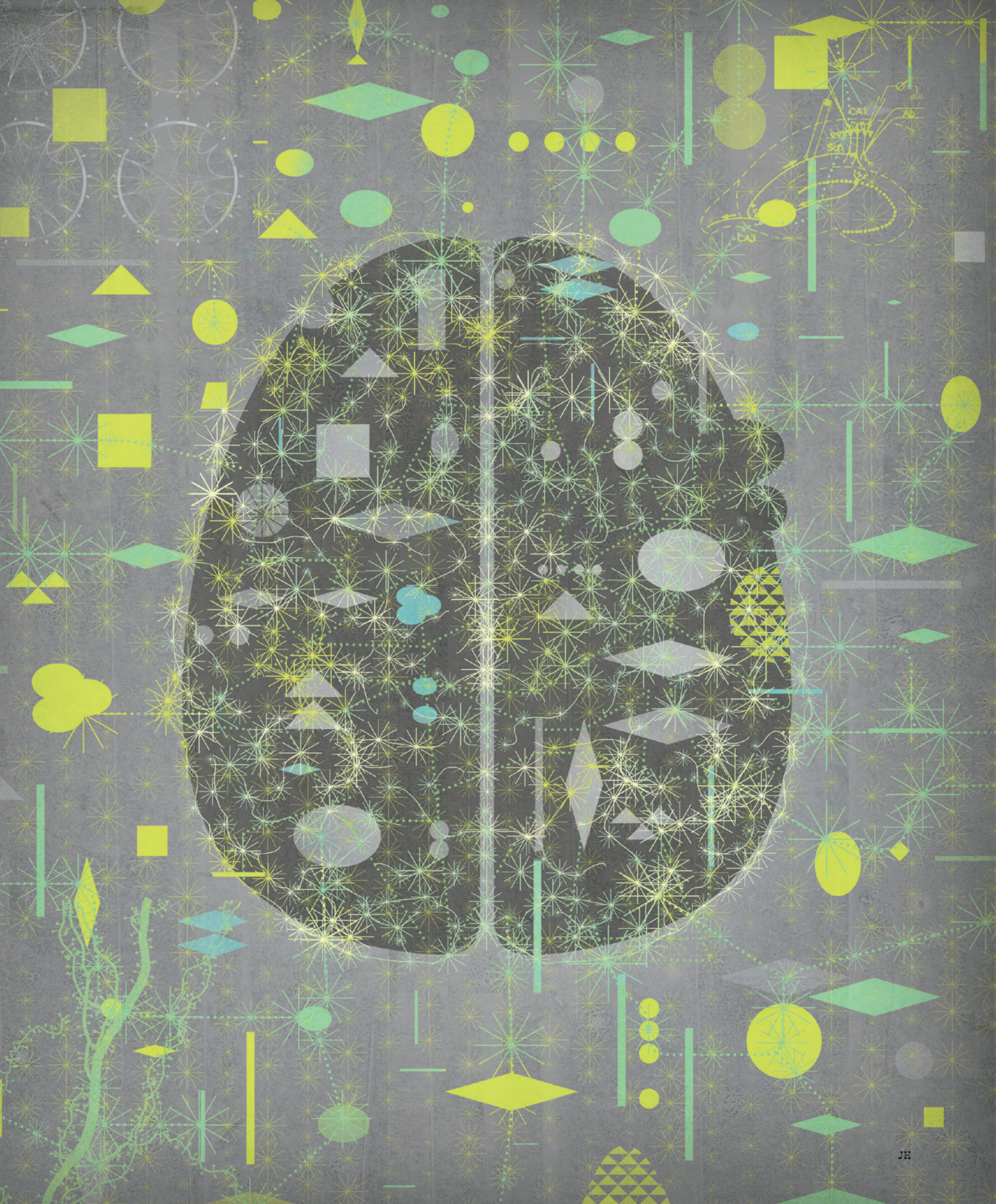
Monica Olvera de la Cruz, Lawyer

Taylor Professor of Materials Science and Engineering and of chemistry, and partners from Arizona State University have developed a model that can predict the reactions of any charged particle.

Creating molecular simulations in heterogeneous media requires measuring the effects of a medium's dielectric response and the charged particles on one another. In previous simulation attempts the two effects were

calculated separately using a differential equation. By dispensing with the equation and reframing the challenge as an energy-minimizing problem, the researchers were able to calculate the position of the charged particles and the medium's response in the same simulation time step. The discovery could have applications in biology, medicine, and synthetic materials research.





The brain

DEMYSTIFYING THE BODY'S MOST COMPLEX ORGAN

IT'S THE LEAST UNDERSTOOD ORGAN IN THE HUMAN BODY—A THREE-POUND, JELLYLIKE MASS OF TISSUE THAT CONTROLS OUR EVERY IMPULSE, MOVEMENT, AND EMOTION. IT ENDOWS US WITH PERSONALITY, LEADS THE BODY'S RESPONSE TO DANGER, AND SILENTLY MANAGES EACH BREATH AND HEARTBEAT.

IT ENABLES THE GREAT FEATS OF CONSCIOUSNESS, LEARNING, AND MEMORY THAT MAKE OUR SPECIES UNIQUE.

But how does the brain work?



hroughout the ages the brain has been a source of mystery—and often confusion—for scholars. Ancient Egyptians thought the heart, not the brain, was the source of wisdom, emotion, and the soul; while other organs were preserved during embalming rituals, the brain was discarded. Later, pre-Incans bored large holes in patients' skulls, attempting to treat headaches, mental illness, and epilepsy. In the 19th century phrenologists claimed that measurements of the skull could determine character.

It wasn't until the turn of the 20th century that researchers began to see the brain for what it is: a massive network of electrically excitable neurons connected through a web of treelike axons and dendrites that relay messages from cell to cell. The amount of information in that network is astounding; at 90,000 miles long, the brain's nerve fibers could circle the perimeter of the continental United States nine times. At the gaps between neurons are synapses, structures that allow brain cells to send and receive the billions of electrical signals and chemical neurotransmitters that create our thoughts, memories, and movements.

For all that scientists have learned about the brain, there is far more they still don't know. Eager to change that, McCormick researchers are using their problem-solving skills to decode the mysteries of an organ that in many ways far surpasses the most complex of computers. These efforts are timely, with the Obama administration eager to invest millions in a decade-long scientific effort to map the brain.

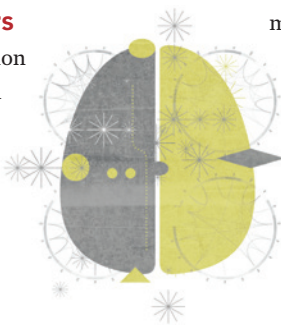
The rewards from better understanding the brain would be enormous: improving the lives of people with brain disorders, designing materials and electronics that draw upon the brain's amazing properties, and even answering fundamental questions about who we are.

From fish brains, a better grasp of ours

With an estimated 100 billion neurons and 100 trillion synapses, it's no wonder the human brain remains a mystery; its complexity is, simply, overwhelming. Many brain researchers therefore opt to study the brains of animals that have fewer neurons and are more experimentally accessible.

Most of these researchers focus on rodents or primates, but Malcolm MacIver argues that a lowly fish—measuring just four millimeters in length and with one one-millionth the number of neurons that a human has—can teach us volumes about our own minds. It's not such a stretch, says the associate professor of biomedical engineering and mechanical engineering. “We learned nearly 100 years ago that fruit flies can teach us a lot about genetics. There has been a similar realization about fish in brain research,” says MacIver. “Even though our last common ancestor with fish lived 420 million years ago, our current brain is basically a fish brain with some bells and whistles added.”

MacIver's species of choice is the larval zebrafish, a fish native to the streams of the Himalayas. What the fish lacks in size it makes up for with a wealth of other characteristics. It is a “model organism,” a widely researched animal whose genome has been completely mapped by scientists. The fish's simplicity also allows researchers to more easily and quickly breed fish with genetic

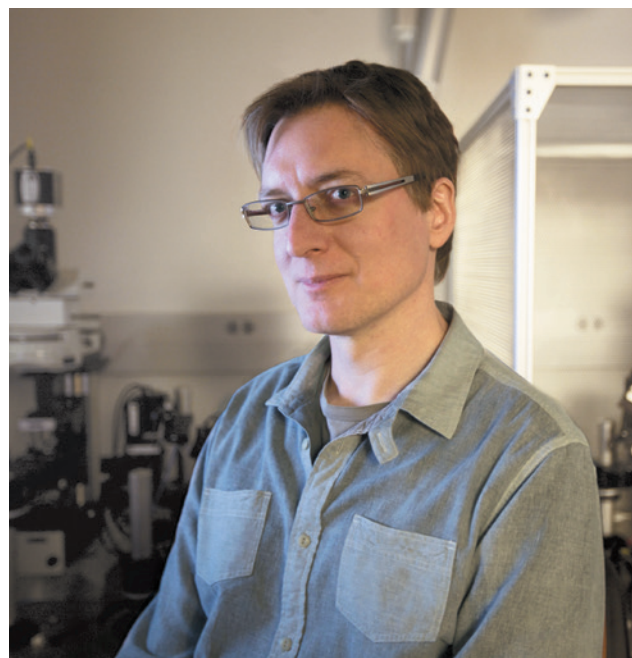
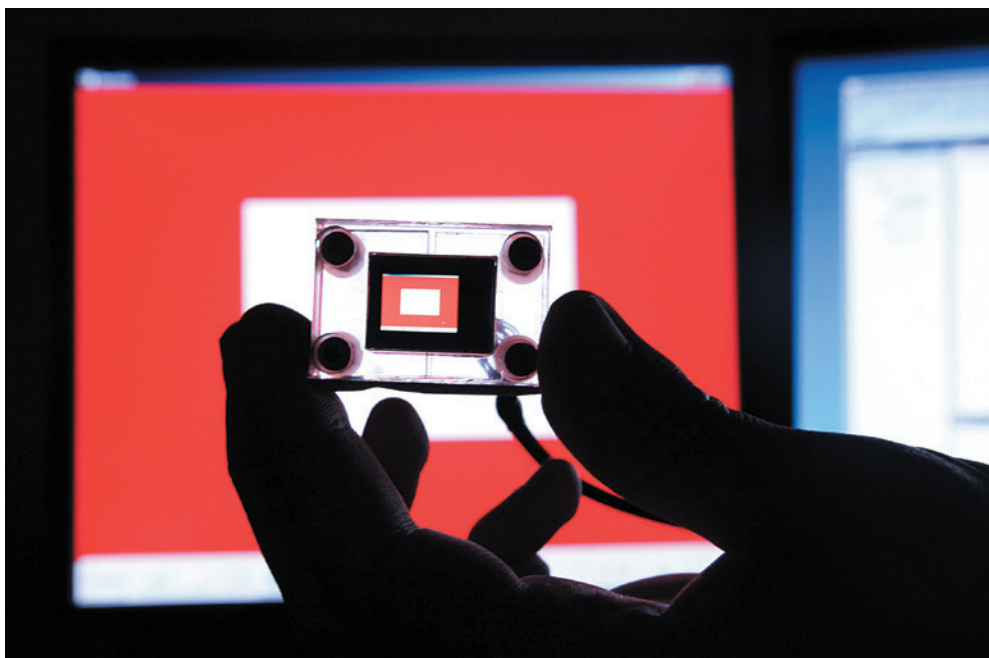


modifications. One genetically modified zebrafish has neurons that emit light when they are activated, which are easily seen through the fish's transparent body.

MacIver is most interested in goal-dependent behaviors—complicated activities, like stalking and capturing prey, that require a sequence of behaviors to achieve a result. “These behaviors are under intense evolutionary pressure. If you don't get [them] right as a species, you die,” MacIver says. “They are among the most refined and carefully coordinated behaviors that an animal like the larval zebrafish can perform.”

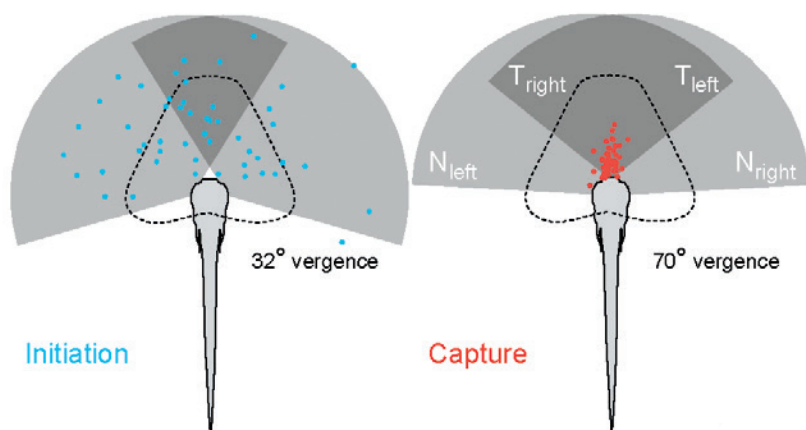
For the past year MacIver has worked with collaborator David McLean from the Department of Neurobiology at Northwestern's Weinberg College of Arts and Sciences to quantify exactly how the fish's body moves as it hunts paramecia, its 200-micron (0.2-millimeter)-long, single-celled prey.

The next step is to understand the brain circuitry that supports this complex behavior. The brain commands come from the optic tectum, a part of the fish's midbrain that takes in sensory data and generates motor output. (The same structure exists in the human brain, where it is called the superior colliculus.) The researchers will record directly from neurons in the optic tectum to analyze the exact sequence of neuronal firings that occur when the fish spots its prey, initiates motion toward it, and eventually engulfs it.



Using video games he designed for the four-millimeter-long zebrafish, Malcolm MacIver (upper right) simulates prey and measures the fish's brain response.

MacIver and his collaborators have shown that larval zebrafish move their eyes to maximize binocular overlap shortly after detecting their prey. Following detection (below left), a combination of body and eye movements results in prey being clustered in a small "capture zone" before the fish initiates a final attack movement (below right). These observations form the basis for work now under way on how the brain transforms sensory information into goal-directed movement, a fundamental question in neuroscience.



“Our current brain is basically a fish brain with some bells and whistles added.”

MALCOLM MACIVER

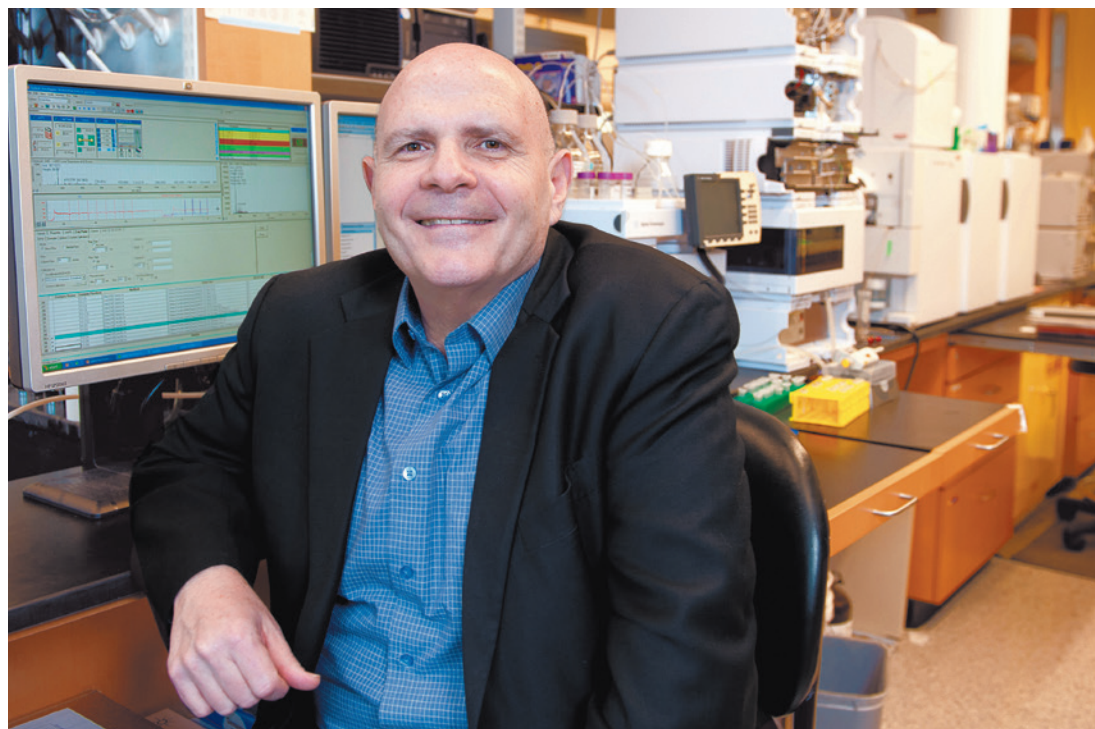
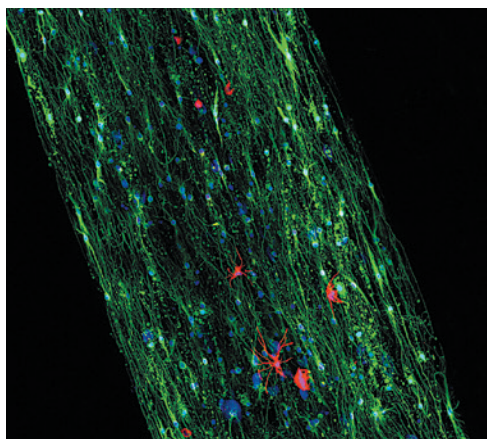
Getting these data isn't easy; researchers must use tiny glass pipettes precisely inserted into a single neuron approximately 5 microns (.005 millimeters) in diameter. It is impossible to access those neurons when the fish is swimming, so MacIver and McLean have developed a plan to elicit a natural response from an immobilized fish: fish video games.

While temporarily contained in a jellylike substance, the fish will be shown tiny, true-to-life virtual images of paramecia approaching on a one-inch-wide display screen. “These screens have as many pixels as my computer, so we can display the paramecia at their actual size,” MacIver says. “We're pretty sure, based on a variety of evidence, that we can get these fish to think they are hunting prey.”

MacIver hopes that the experiments, which he plans to start running this spring, will provide a clearer understanding of how the brain takes in sensory data and translates them into behavior. “With this organism, we and other researchers may obtain the first mechanistic understanding of a complex goal-directed behavior for any animal, from sensory input to motor output,” MacIver says.

Building highways in the brain

If you've ever wondered how mice sniff out crumbs in the dark, consider this: nature has gifted the rodents with a constantly regenerating sense of smell. Inside mice's brains, not far from their noses, sits a structure filled with neural stem cells, a type of cell that is able to morph into any type of brain cell. Each day, hundreds of these shape-shifters migrate through a mouse's brain to its olfactory bulb, where they transform into specialized brain cells called olfactory neurons.



Humans have a store of neural stem cells, too. Researchers aren't exactly sure what they do, but Samuel I. Stupp is sure of their incredible potential.

"These neural stem cells can do anything. They could repopulate the site of a brain injury with healthy neurons. They could regenerate damaged cells at the site of a stroke. They could become specialized, dopamine-generating brain cells to help treat Parkinson's disease. All we need is a method to transport them from their current location in the human brain, where they may not do much, to places where they can be useful," says Stupp, Board of Trustees Professor of Materials Science, Chemistry, and Medicine and director of Northwestern's Institute for BioNanotechnology in Medicine and the Simpson and Querrey Center for Regenerative Nanomedicine.

Transporting neural stem cells is not as easy as inserting a needle and physically moving them to another part of the brain. Stem cells rarely take root in new homes without a support system. So Stupp has called on his expertise in self-assembly,

a process by which molecules arrange themselves in a useful structure without any outside help, to try to solve the problem.

Stupp's research hinges on his

discovery a decade ago that certain molecules can self-assemble into nanofibers in water and mimic those found naturally outside of cells in the human body, in the so-called extracellular matrix of all tissues. The tiny nanofibers—less than 10 nanometers in diameter, tens of thousands of times thinner than a human hair—are able to provide a scaffold that can signal cells for many purposes, or simply help them survive and proliferate.

Stupp has found that these nanofibers have amazing properties. In 2008 Stupp and John Kessler, Ken and Ruth Davee Professor of Stem Cell Biology in the Feinberg School of Medicine, discovered that injecting the nanofibers into mice could partly reverse paralysis from spinal cord injury in just six weeks. (How the nanofibers accomplish this feat is not completely understood, but Kessler and Stupp suspect they suppress or remove scarring on nerve fibers at the site of a spinal cord injury, allowing regeneration of nerve fibers and thus movement to return.)

More recently Stupp discovered how to create a liquid crystal made of bundles of the nanofibers and water that forms a gel when it is squeezed out of a syringe into salty water or living tissues. "The construct looks like a transparent cooked noodle," Stupp says.

Inside the "noodles" millions of nanofibers self-align, forming a lattice that can guide the direction in which axons grow or the direction

"Neural stem cells can do anything.... All we need is a method to transport them from their current location in the brain to places where they can be useful."

SAMUEL I. STUPP

in which cells migrate. Stupp partnered with neuroscientist Georg Khun in Gothenburg, Sweden, to use the aligned scaffold to guide neural stem cells.

"We thought that if we could form this noodle in the brain, starting from the place where the neural stem cells are present and ending in the location where we would like them to be, it would be like creating a highway in the brain," Stupp says. "The neural stem cells could travel on that highway to precisely where they are needed. Then you have lots of possibilities."

The research results are promising so far. Stupp and graduate student Eric Berns have worked jointly with Khun to create the noodle in the brains of mice, originating at the location of neural stem cells near the olfactory bulb. The experiment demonstrated that the neural stem cells do, in fact, migrate into the noodle structure.

If perfected, the process may open doors to a variety of treatment options for injuries and neurodegenerative diseases. "The dream would be to introduce these procedures in non-invasive ways and use nanomedicines to direct the stem cells and also to promote their differentiation into the right neurons in the correct part of the brain," Stupp says.

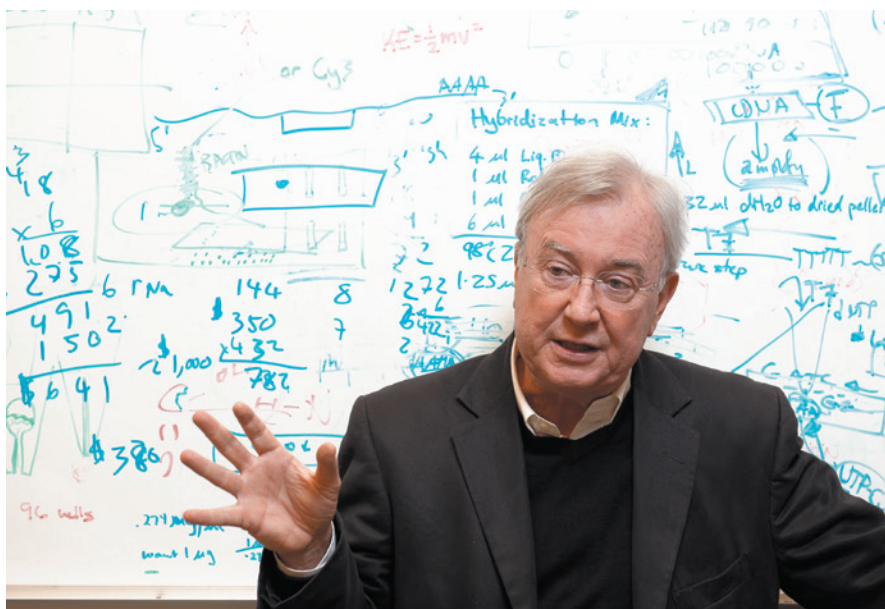
Link between learning and depression leads to a new drug

Depression affects an estimated 19 million Americans, and for many of them treatment is a bumpy road. Today's antidepressants can be addictive, cause unpleasant side effects, or take weeks to be effective—if they work at all; only half of patients with depression respond to any given drug.

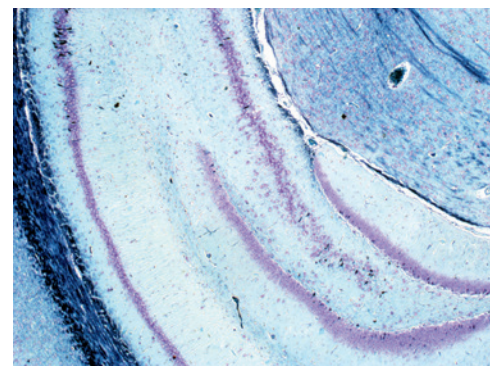
For the past two decades Joseph Moskal, research professor of biomedical engineering at McCormick and director of Northwestern's Falk Center for Molecular Therapeutics, has been working to translate basic research on the mechanisms of learning and memory into therapeutics for the treatment of neuropsychiatric disorders. His work has recently led to the development of a program for the treatment of major depressive disorder. His goal is a drug that can be effective within hours and remain effective for weeks—with no toxic side effects.

Moskal's research stems from his interest in synaptic plasticity, the quality of the connection at the synapses between neurons. In the past several decades, researchers have learned that the strength of synapses changes over time through use or disuse, a process that is now believed to be central to learning and memory. Moskal found that these functions also have an impact on mental health. "It turns out that learning and memory are quite strongly linked to depression," he says.

Moskal began exploring this avenue by developing monoclonal antibodies that modulate learning and memory processes in animal models. He later was able to convert one of these antibodies into GLYX-13, a small molecule that mimics the antibody and could be further developed for therapeutic use. GLYX-13 works by targeting NMDA (N-methyl-D-aspartate) receptors on neurons' surface. These receptors help



Opposite page: A noodle-like construct developed by Samuel Stupp (top) contains millions of nanofibers that may be able to guide the growth of healthy cells in the brain. Above: Learning and memory—processes largely regulated by the hippocampus (shown at right)—appear to have an important connection to depression, Joseph Moskal has learned.





control synaptic plasticity, the neurochemical foundation of learning and memory—and perhaps depression, too.

In clinical trials at 12 sites across the country, a single intravenous dose of GLYX-13 was found to reduce depressive symptoms in subjects for whom other antidepressants had failed. Its side effects were negligible and its results nearly immediate. After a single dose the drug’s “effect size,” a measure of the magnitude of its antidepressant efficacy, was nearly double that seen with most other antidepressants that typically require two to four weeks to show their effects. GLYX-13’s results lasted an average of seven days.

Now that GLYX-13 has been shown to be efficacious, a second round of clinical trials is under way to find the optimum dose and dosing interval. These studies will be finished by year’s end, and Moskal hopes GLYX-13 will be on the market within four years; as the founder and chief scientific officer of Naurex Inc., the Evanston-based biotechnology company that conducted the clinical study, Moskal and his business development team recently secured \$38 million in funding. He is also exploring GLYX-13’s effect on schizophrenia, Alzheimer’s disease, stroke, bipolar disorder, and even cognitive failure due to normal aging.

“While the results we are seeing with GLYX-13 are very encouraging, I believe the most

important research is yet to come,” Moskal says. “We have only scratched the surface of its therapeutic potential.”

Keeping watch on brain aneurysms

While many of them don’t know it, about five percent of Americans are living with a brain aneurysm, an abnormal bulge that develops when the wall of a brain artery is weakened. The majority of these people will go through their lives without experiencing any ill effects, but about 30,000 will experience a rupture this year, and the results can be catastrophic.

Ruptured brain aneurysms are fatal in about one-half of cases, and two-thirds of the survivors suffer permanent neurological damage. “When a brain aneurysm ruptures, you have a 50–50 chance of being alive in 24 hours,” says Timothy Carroll, associate professor of biomedical engineering at McCormick and of radiology at the Feinberg School of Medicine. “It’s a huge, huge problem.”

Treatments do exist, but they are risky. The long-standing approach has been to “clip” the ballooning arterial wall, a process that entails cutting through the skull to locate the site of the bleeding

and clamping it. A newer option is “coiling”—threading a thin catheter from the patient’s groin through the neck and into the brain so that wire coils can be inserted inside the aneurysm, causing blood to clot and sealing off the blood supply.

Early detection can make the difference between life and death, but even when detected, which aneurysms are likely to rupture? One of the most disconcerting aspects of an aneurysm diagnosis is uncertainty. “A patient may have a brain scan performed for some other reason and learn he has a ballooning artery in his brain,” Carroll says. “It may never rupture, or it may rupture tomorrow. Our goal is to develop a way to determine which aneurysms are stable and which need to be closely watched.”

Through a process he developed that measures the slow leakage of an MRI-based contrast agent or “dye,” Carroll can determine the thickness of the aneurysm wall and the severity of the problem; the thicker the wall, the less likely the aneurysm is to burst. He injects a contrast agent into the subject’s arm and collects MRI images as the colored substance makes its way out of the brain artery and into the fluid surrounding the

brain. “It turns out that the contrast agent can leak out of the wall of the aneurysm. Some leak very quickly, some more slowly,” Carroll says.

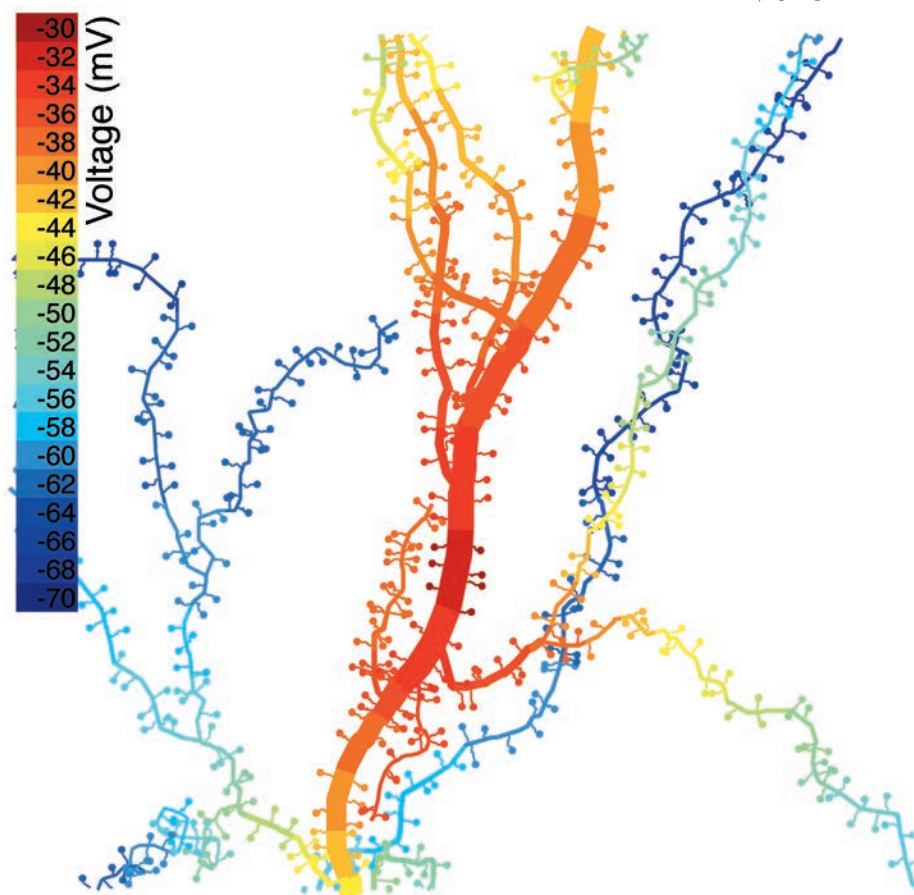
“We are trying to determine if

“When a brain aneurysm ruptures, you have a 50–50 chance of being alive in 24 hours. It’s a huge, huge problem.”

TIMOTHY CARROLL



Right: Timothy Carroll is working on a way to measure the severity of aneurysms before they burst. Opposite page: William Kath creates computational models to understand how brain cells work together. One model describes the activity of dendrites (upper right), tiny structures that protrude from neurons.



the ones that leak more quickly tend to indicate more dangerous cases.”

Awareness of the severity of a brain aneurysm will allow many patients to worry less, and others with serious cases can take precautions to prevent a rupture. Instead of surgery, Carroll foresees a future in which physicians may recommend managing high blood pressure and quitting smoking to mitigate the risk with an aneurysm that has proven to be stable. “My goal,” Carroll says, “is to provide information so patients and physicians can determine the best course of action to mitigate the risk of having an aneurysm.”

Filling in the blanks

The field of neuroscience has advanced more in the past two decades than in perhaps any other period in history. Thanks to both improved experimental techniques and computing capabilities, experimental researchers are able to study the brain as never before. The deluge of data they have acquired begs for computational models to help bring it all together.

For the past 14 years, applied mathematician William Kath has partnered with experimental researchers, using their lab data to create computational models of brain activity. “Experimental researchers can do so much today. They can

record the activity of individual neurons and groups of neurons, and they can collect that data much more rapidly,” says Kath, professor of engineering sciences and applied mathematics at McCormick and professor of neurobiology at Weinberg. “The question then becomes, what does all this data tell us about the neural system as a whole?”

Kath is currently working with Nelson Spruston, a former Northwestern faculty member and now a scientific program director at Howard Hughes Medical Institute Janelia Farm Research Campus in Virginia, to understand the hippocampus, an area of the brain responsible for learning and memory. They are modeling how synapses work—the conditions under which they are activated, what resulting voltage changes are produced inside the neuron, and the level of voltage change that triggers a signal to its output targets.

“These neurons are, in essence, making decisions at the local level—processing inputs and deciding whether the inputs are significant enough to pass on the combined signal to all the neurons they connect to downstream,” Kath says. “One of today’s basic tasks of neuroscience is trying to figure out how this large, connected network of neurons processes information.”

These models help Kath make educated

guesses about what’s happening in selected parts of the brain. (Modeling the entire human brain in its full detail is far beyond the capabilities of today’s computers, given the brain’s vast number of synapses and multiple types of neurons and neurotransmitters.) The models—which integrate information gathered from a range of experimental tests—can also provide an alternative to physical experiments, particularly when the live options are too expensive or time consuming.

Because experimentalists are constantly improving their techniques, Kath frequently updates his models with new data. For instance, research partners at Stanford University have developed an imaging process called array tomography, which provides extremely precise pictures of cellular anatomy, and Kath is now refining his models with new details about the type and placement of synapses.

Researchers are still far from seeing the “big picture” of the brain. “Our experimental techniques are still so limited,” Kath says. “It’s like trying to put a huge rainbow jigsaw puzzle together. At first all you can see are the blue pieces. Then a new experimental technique comes along and you can see green pieces. Eventually we will be able to see the whole puzzle. But that is a long way off.” **M** Sarah Ostman

View from the Intersection

G. K. Chesterton wrote that “the whole object of travel is not to set foot on foreign land; it is at last to set foot on one’s own country as a foreign land.” Anyone who has traveled has had the peculiar experience of realizing that a whole host of things you had taken for granted—from the geometry of toilets to interpersonal distance during casual conversation—are far from universal. In that discovery comes the insight of just how strange our own customs can be.

But how do you appreciate the nature of something when you’ve never experienced life without it? That’s one of the puzzles of consciousness. The only times we lose consciousness are either with a one-way ticket to a place where we are forever unreachable, or with a round-trip ticket to a place where the Internet and phone lines are perpetually down. The hallmark of these two states, death and sleep, is a lack of consciousness. While we can never appreciate consciousness “from the outside,” we can gain some perspective by traveling back in time and thinking about why consciousness might have evolved in the first place.

Consciousness is a capacity our single-celled ancestors did not have 1.6 billion years ago, yet we do—so there must have been some advantage to it besides creating a make-work program for future academics. I’d like to suggest what that advantage might have been and propose that some of the big problems humanity is grappling with today might be traced to weaknesses in how this capacity evolved. Finally, I’ll claim that a certain kind of technology can help us with those weaknesses, one that is an excellent fit with many of our research programs at McCormick and the goals of Northwestern University’s Strategic Plan.

Single-celled eukaryotic animals emerged around 1.6 billion years ago. About half a billion years ago, multicellular aquatic life blossomed. Multicellular aquatic animals ruled the roost until 380 million years ago, when the fossil record tells us the first half-fish, half-land animals started to appear. With the emergence onto land, a singularly important change occurred: animals could see much farther. My lab’s work on the science of biological sensing has highlighted the importance of this change, which came about because

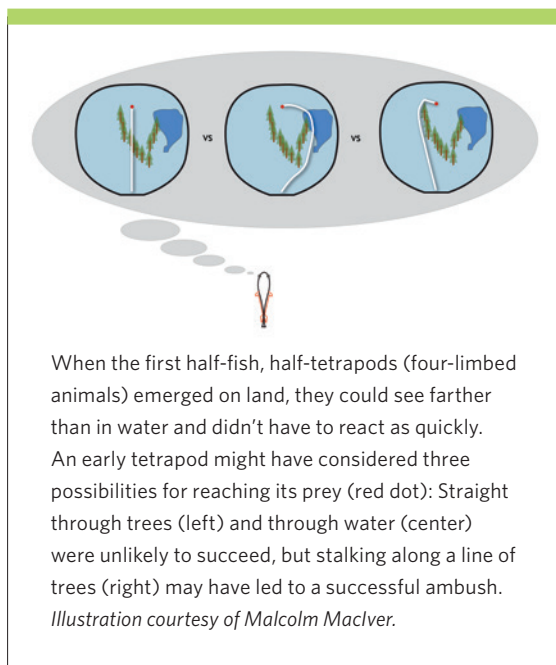
air is much friendlier to the transmission of light than water is. In fact, the photons that guide visual animals like us can travel 10,000 times farther in air than in water before a significant fraction of the photons get absorbed.

Why was this change so important? Because water absorbs light so quickly, the first animals that lived in water were essentially driven by their immediate sensations, just as we are when driving in a thick fog. They had to react rapidly on pain of either losing their dinner or becoming dinner. But once on land, they were better positioned for natural selection to work its magic: because land animals could see farther ahead in space, the ability to plan ahead could pay big dividends. Instead of bumping into a predator or prey and having to react immediately, they might spot one in the distance and contemplate various courses of action. When there’s a way to sense things without responding immediately, it’s possible to deliberate—to judge the relative merits of different approaches and pick the one most likely to succeed. Not easy, but most importantly, not worth the bother until you’ve emerged from the fog.

One can argue that the shift from being reactive to being deliberative—from being driven by immediate environmental contingencies

to being able to formulate plans and act accordingly—was momentous in the evolution of complex cognition. Deliberating is an ability that humans have in common with other mammals (and likely some birds, as well). Lab tests of rat brain activity have detected deliberation in action as the animal pauses at branch points before choosing a path, a phenomenon called vicarious trial and error.

Clearly, consciousness encompasses more than deliberation. But for the sake of argument, let’s equate the two. In mechanistic terms, this definition has enough concreteness and specificity to serve as a basis for asking if some of humanity’s current problems can be traced to problems of consciousness. After all, consciousness evolved under conditions vastly different from today’s.



As freed from immediate reflexive action as we've become, there are growing signs that our systems of awareness may be ill-adapted to 21st-century conditions. Despite the flood of media from places far away, we are still essentially parochial in our concerns: we care about our kith and kin and mostly about the here and now, and we have limited motivation to act on concerns for future problems that don't immediately affect our own lives. The looming climate crisis is a case study: caused by odorless, colorless gases whose effects take decades to be felt, the global-warming threat is like an 18-wheeler custom-engineered to stay in the blind spot of our awareness.

Climate change is just one species among an entire genus of problems consigned to the negative space of our consciousness. Any problem that is far away in time or space, or has many steps in a long chain of causation, will have limited impact on our consciousness. This explains how that tempting cheeseburger gets eaten while we're trying to lose weight, as well as why a nation burdens future generations with debt. The future that evolution enabled our earliest land-based ancestors to manipulate seems several sizes too small to fit the globally interconnected species with insatiable appetites that we are today.

What can be done? Perhaps we will reach a higher level of consciousness in another billion years of biological evolution. But why would we wait? Technology operates on much faster time scales. I have become cautiously optimistic about approaches that use new Internet-enabled tools that allow us to sense the distant consequences of our decisions. I first heard of these tools during a visit to the University of Washington, which is very active in the area. There is no single, commonly accepted name for the approach, although "persuasive technology" is sometimes used as an umbrella term. In the realm of energy use, it goes by "energy-feedback technology" or "eco-feedback technology"; in personal fitness and health, it can be called the "quantified self." The goal of these technologies is to provide people with instant, persuasive feedback from real-time networked measurements of their behavior. Anyone who has noticed how a hybrid-vehicle driver pays close attention to the dashboard's instantaneous miles-per-gallon display has seen this approach in use. In the quantified-self space, an example is FitBit, a wearable device that measures your daily physical activity, with weekly infographics showing progress and comparisons with peers.

A public housing program in Pittsburgh was a recent setting for the inspired application of energy-feedback technology. Participants in a

study—all public housing residents—were given tablet computers that displayed animated polar bears and other animals. When a participant's energy consumption went down, the animals would flourish and multiply; when it went up, they would do less well. As it turned out, although many did not have to pay for their energy, participants were motivated by the feedback to alter their energy use. A 2008 metastudy of feedback approaches to electricity conservation suggested that 5 percent to 12 percent decreases in use are typical (C. Fischer, "Feedback on Household Electricity Consumption: A Tool for Saving Energy?" *Energy Efficiency*, vol. 1, no. 1, 2008, pp. 79-104).

McCormick is proving innovative in this area. Michael Horn, assis-

tant professor of electrical engineering and computer science and of education and social policy, has a design initiative that uses similar principles to help families reduce consumption of water, electricity, and natural gas. Darren Gergle, associate professor of communication studies and of electrical engineering and computer science, has devised a mobile phone application that uses artificial intelligence for

processing 38 automatically collected parameters of user activity to generate an alert when someone shows signs of clinical depression. The system warns the user or caregivers to help arrest the depressive's downward spiral before hospitalization is needed.

Horn's and Gergle's initiatives are just two of several McCormick projects that are advancing consciousness-enhancing technologies, which I believe will be key as we better appreciate the limits of human awareness and design tools to fill the gap. The Segal 2.0 Design Cluster—a transdisciplinary initiative that Gergle, mechanical engineering professor Wei Chen, and I codirect—is an ideal home for some of this work. The Northwestern University Strategic Plan, with its emphasis on design, sustainability, health, and energy, resonates well with the vision of enhancing consciousness through feedback. Through the work of retooling our awareness, we can improve the chances that our species will have a good home for millennia to come.

"Perhaps we will reach a higher level of consciousness in another billion years of biological evolution. But why would we wait?"



Malcolm MacIver

is a group leader in the Neuroscience and Robotics Lab (NxR); associate professor in the Departments of Mechanical Engineering, Biomedical Engineering, and Neurobiology; and codirector of the Segal 2.0 Design Cluster. This article is based on "Can We Expand Our Consciousness with Neuroprosthetics?" a talk he gave in January as part of "The Brain," a TEDx Caltech event (tedxcaltech.caltech.edu).



QUANTUM LEAP

Prem Kumar's groundbreaking research in quantum communication gets a boost

CONSIDER LIGHT AS SAND falling through an hourglass: from a distance, the sand looks like a continuous flow. Up close, individual grains are apparent.

For more than 25 years Prem Kumar has harnessed those individual grains of light, called photons, to forge his career in quantum communication and computing. And while the AT&T Professor of Information Technology, professor of electrical engineering and computer science and of physics and astronomy, and director of the Center for Photonic Communication and Computing could now be considered a quantum photonics elder, he doesn't have time to slow down. As the lead investigator of a major new grant, Kumar hopes to discover new approaches that could help make his dream of quantum communication a reality.

Quantum communication is different from classical communication and computing, which works by processing "bits," fundamental units of information that can exist in only one of two states, 0 or 1. Quantum communication uses quantum bits ("qubits"), such as photons, ions, or atoms, which operate under the rules of quantum mechanics instead of classical mechanics; in addition to being in 0 or 1, qubits can be in a "superposition"—both 0 and 1 simultaneously. Because the superposition state is able to carry and process significantly more information in less time and with a higher level of security than do classical communication processes, researchers in the field dream of faster computers and a quantum Internet.

"We're trying to engineer nature in a different way than it naturally likes to be," Kumar says. "The jury is still out on quantum communication. We are working to achieve the goal of having quantum communication at the same level as classical communication, and we're nowhere near that yet."

As the lead investigator on a four-year, \$8 million grant from the Defense Advanced Research Project Agency's (DARPA) Quiness program to a group of university and industrial partners, Kumar plans to combine research from the last two decades to find new approaches to quantum communication. One might come from his groundbreaking work on quantum frequency conversion, by which the frequency of a light beam can be changed while its quantum state is preserved. Other possibilities include using atoms as quantum repeaters (similar to amplifiers) and creating pulses of light (arbitrary optical waveform generation) to better carry information.

"The goal is far-reaching," Kumar says. "We're going to use every trick of the trade that we've worked on over the years to make it happen."

Conducting quantum communication on the current telecommunications infrastructure is a challenge. Quantum information is fragile and cannot be amplified using traditional means. While the optical-fiber cables used today in classical communication can carry about 10 terabits of information

per second across vast distances, that infrastructure can barely support 1 megabit per second over 100 kilometers using quantum communication techniques.

Kumar couldn't have anticipated this future when he was growing up in India, but his intuition for the laws that govern the smallest part of the universe showed itself early. In seventh-grade math he argued that the intersection of two lines could not be a point; the lines themselves were a series of small atoms. Two years later, when he picked up a physics textbook and felt for the first time he was reading something "natural," his future was sealed. In graduate school at the University at Buffalo, he began working in optics, with lasers. "They were beautiful," he said. "Not only did I get my degree, but I got to play with these toys that looked pretty." But a postdoctoral stint at MIT led him to quantum optics, a field that was taking off due to research advances and a proliferation of fiber-optic communication.

He joined Northwestern in 1986 after spending five years at MIT as a research scientist, and in the early 1990s he developed the "quantum frequency conversion" technique that a recent *Physics Today* article highlighted as groundbreaking and fundamental to current research. It might make possible quantum communication across great distances.

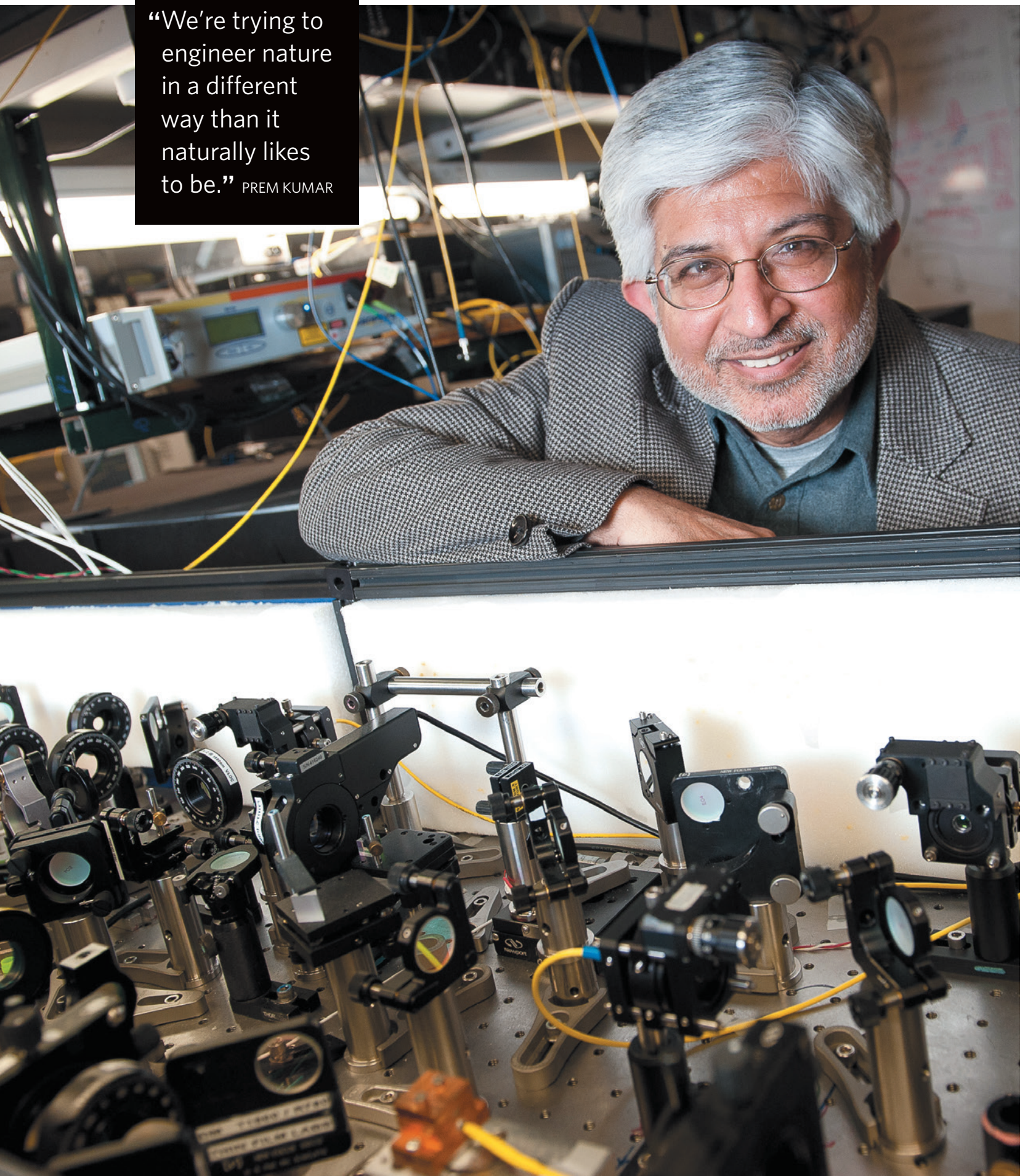
Most recently Kumar's group developed a switching device to enable the ubiquitous fiber-optic infrastructure to be shared among many users of quantum information. Such a system could route a qubit to its final destination, just as email is routed across the Internet today. The switch could also help encode information in photons for deep-space communication.

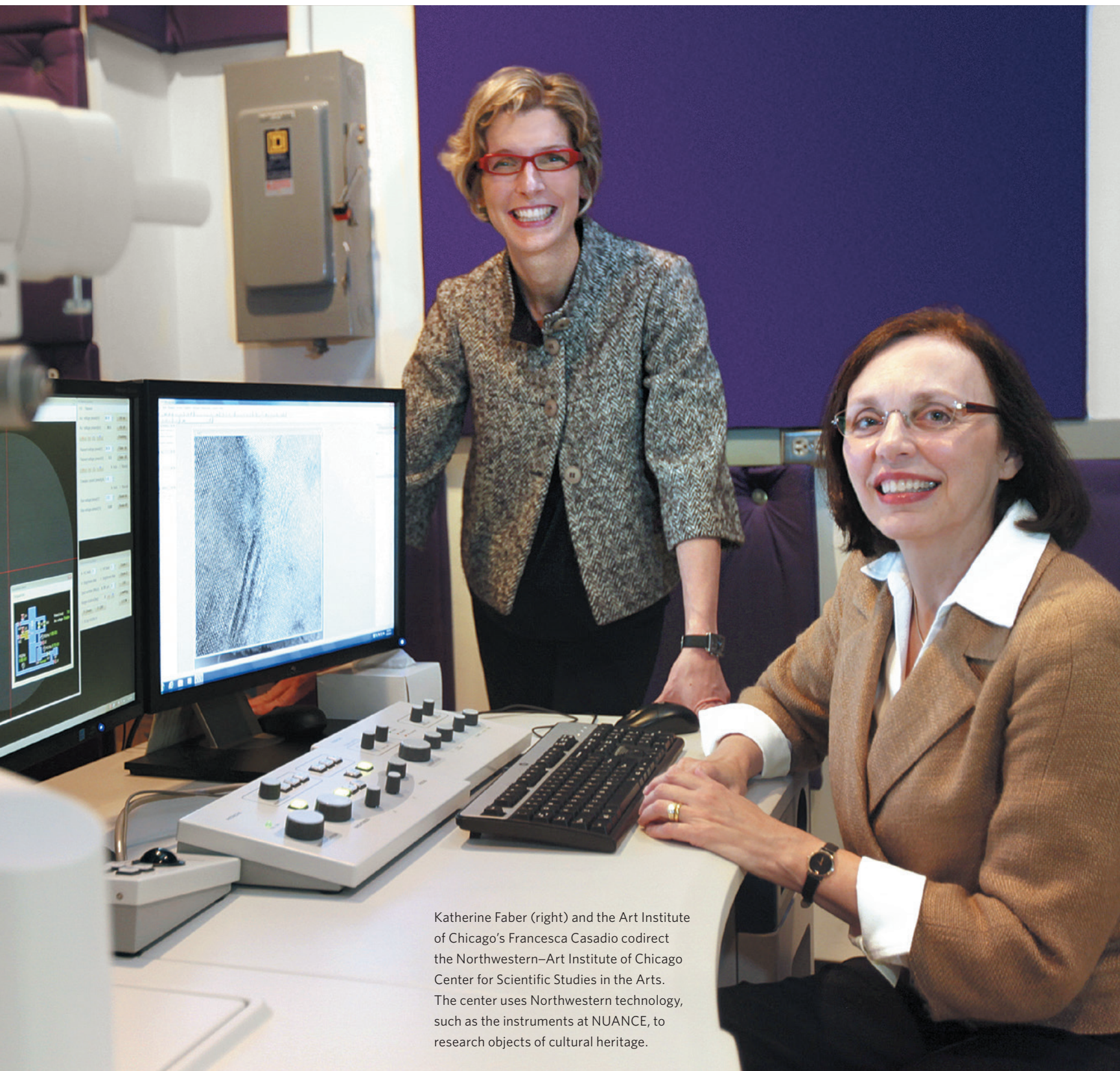
Much of this success belongs to Kumar's unique research group, a mix of engineering and physics students and postdocs. The physicists bring the fundamental knowledge of the universe; the engineers bring the ability to apply it. "The sum of the two is much greater than the parts," Kumar says. "They learn from each other, they teach each other, and it allows us to do better research."

Acknowledging Kumar's position among the top in his field, DARPA's Defense Sciences Office recently appointed him as a program manager; he took a leave and moved to Washington, DC, to help the office oversee and create programs. MIT also invited him to give the Hermann Anton Haus Lecture this spring. It was a return to the place where he began his research and an opportunity to reflect on his career. He thinks about advances still to come during the lifetime of his son, Rajan Kumar, a McCormick junior. The scholars Kumar has trained over a quarter of a century will continue his work, he hopes. "We all had hoped and still hope that there will be elements of quantum communication everywhere, but it's turning out to be rather hard," he says. "I want to see the future generations do better than I did."

M Emily Ayshford

“We’re trying to engineer nature in a different way than it naturally likes to be.” PREM KUMAR





Katherine Faber (right) and the Art Institute of Chicago's Francesca Casadio codirect the Northwestern–Art Institute of Chicago Center for Scientific Studies in the Arts. The center uses Northwestern technology, such as the instruments at NUANCE, to research objects of cultural heritage.

The science behind a masterpiece

Northwestern and the Art Institute of Chicago provide a national model of collaborative scientific research in the arts.

JOHANN FRIEDRICH BÖTTGER was a teenager in 1701, and like many teens he was a bit of a braggart. The budding German alchemist boasted about his ability to turn lead into gold—boasted so successfully, in fact, that his claims reached Augustus the Strong, elector of Saxony and king of Poland. Hungry for riches, Augustus summoned Böttger to prove his claims and then imprisoned him, forcing him to perform one fruitless experiment after another.

Böttger never made gold, of course. But during his servitude he managed to make other creations that would secure his place as the father of European ceramics. Among them was *perlmutterglasur*, a delicate, pale purple glaze that has captivated porcelain lovers and art historians ever since. For centuries, Böttger's recipe for this uniquely iridescent luster had remained a mystery.

That is, until 2010, when researchers from McCormick and the Art Institute of Chicago got involved. Using a transmission electron microscope at the Northwestern University Atomic and Nanoscale Characterization Experimental (NUANCE) Center, researchers analyzed a tiny fragment of Böttger luster from a private collection to determine its composition. Then an undergraduate researcher reverse-engineered the process to learn how Böttger made the luster.

"We believe he started with gold chloride, which would have been available in the early 1700s, placed it in suspension, layered it on top of the glaze, and heated it in a way so the gold diffused into the glaze," says Katherine T. Faber, Walter P. Murphy Professor of Materials Science and Engineering at McCormick. "And in the process he kept Augustus happy. It really is a wonderful story."

Over the past eight years the Northwestern–Art Institute collaboration has led to a nanoscale understanding of masterpieces like these—and a

greater understanding of how best to conserve them. Partnerships like this are rare; in the United States, scientific research on art collections is typically undertaken inside the walls of museums, at least those museums that can afford a laboratory. Only a few dozen American institutions have the necessary tools and expertise. Now a \$2.5 million grant from the Andrew W. Mellon Foundation has made it possible for Northwestern and the Art Institute to create the Northwestern University–Art Institute of Chicago Center for Scientific Studies in the Arts (NU-ACCESS), an interdisciplinary center that offers scientific research services to museums across the country that are unable to afford their own labs.

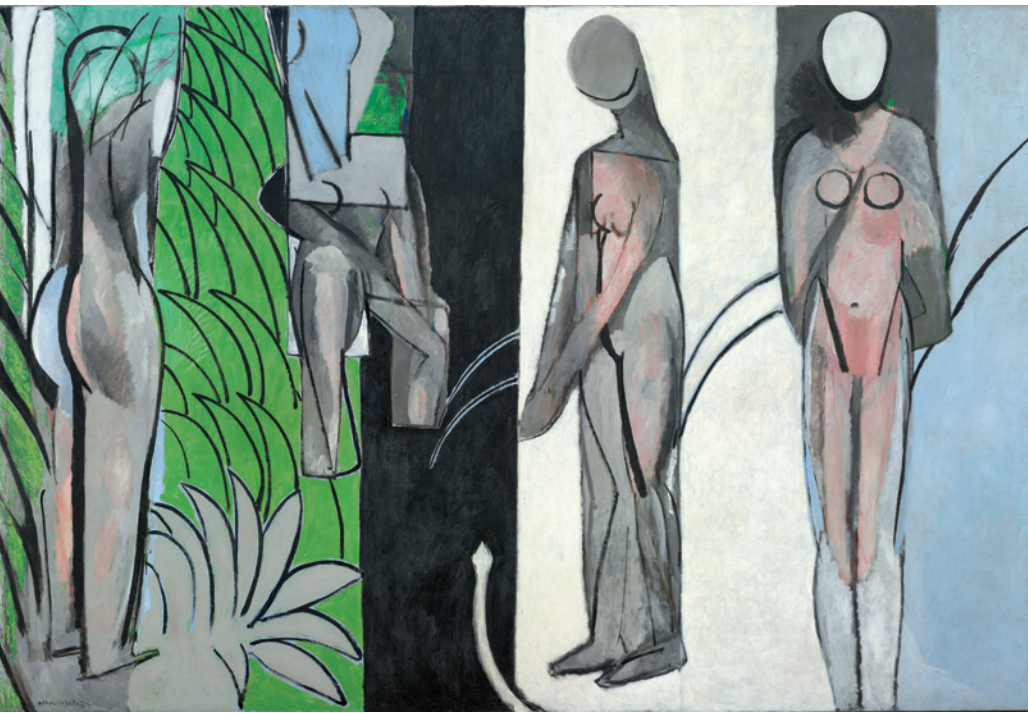
"It's good for students to see how they can use their technical backgrounds to work on atypical problems."

The Northwestern–Art Institute partnership began in 2004, around the time the museum hired Francesca Casadio, Andrew W. Mellon Senior Conservation Scientist, for a new position. Interested

in collaborating with materials science experts, leaders from the Art Institute contacted Faber, then chair of McCormick's Department of Materials Science and Engineering. "I had never conducted research on an object of cultural heritage before," Faber says, "but it was obvious to me that these were materials about which we could offer our expertise."

In 2004 Casadio brought the first project to McCormick: a study of *A Sunday on La Grande Jatte—1884*. Created by Georges Seurat in the 1880s, the world-famous pointillist painting consists of thousands of tiny dots of paint that form images of park goers alongside the Seine River in France, but over the years, the luminous yellow dots used to highlight the lawn in the painting had turned a dark ochre color.

A team of researchers led by Kimberly Gray, professor of civil and environmental engineering and of chemical and biological engineering, accelerated the aging process on reconstructions of the painting's yellow



Several other key pieces in the Art Institute of Chicago's collection have been studied through its ongoing partnership with Northwestern.

- 1 **Bathers by a River** by Henri Matisse. (Charles H. and Mary F. S. Worcester Collection, 1953.158.) Imaging technology developed by the Department of Electrical Engineering and Computer Science was used to colorize archival black-and-white photographs of the painting's early versions, providing insights into Matisse's working methods and the development of this masterpiece over time. The painting was part of the Art Institute's 2010 show *Matisse: Radical Invention, 1913–1917*.



- 2 **For to Be a Farmer's Boy** by Winslow Homer. (Gift of Mrs. George T. Langhorne in memory of Edward Carson Waller, 1963.760.) Conservators discovered that the painting's sky was originally painted in unstable red and orange colorants that have almost completely faded. Work by a team of Northwestern chemists to determine the original colors was included in the 2008 exhibition *Watercolors by Winslow Homer: The Color of Light*.
- 3 **Sketch of Margaret Sloane, Looking Right** by Mary Cassatt. (Gift of Laura May Ripley, 1992.158.) A research team removed tiny colored flecks from this pastel study and examined them using a highly sensitive technique called surface-enhanced Raman spectroscopy. Researchers were able to detect and identify organic pigments that could be matched to pastel sticks in Cassatt's paint box.
- 4 **A Sunday on La Grande Jatte—1884** by Georges Seurat. (Helen Birch Bartlett Memorial Collection, 1926.224.) The luminous yellow began to change within years of Seurat's completing the painting, but no one knew why. Scientists determined that exposure to a humid climate and burning coal caused the darkening of the zinc yellow pigment Seurat used.



- 5 **Head of a Woman (Fernande)** by Pablo Picasso. (Estate of Pablo Picasso/ Artists Rights Society [ARS], New York.) The Art Institute's current *Picasso and Chicago* show includes a study analyzing the metal alloys of modern sculptures. Having determined that many of the Picasso sculptures are made of high-zinc brass alloys, a research team was able to trace many of the unmarked works to the Valsuani foundry in Paris. *Fernande* is different; it has a low-zinc bronze composition more typical of sand-cast sculptures. The search for its unknown casting foundry is one of the open questions the new Center for Scientific Studies in the Arts hopes to address by broadening the alloy research to collections in other museums.



Researchers using transmission electron microscopy learned how the 18th-century German alchemist Johann Friedrich Böttger made his pale purple glaze (seen on the ceramics in front of Casadio and Faber).

paint and determined that exposure to a humid climate and burning coal had caused the color to change. Follow-up studies at the Advanced Photon Source of Argonne National Laboratory with Jean-François Gaillard, professor of civil and environmental engineering, as well as hands-on research by a summer intern, elucidated the precise reaction that caused the color change. The information provided guidelines for optimal storage and transportation conditions for other paintings containing the yellow pigment.

Since then scientists have analyzed faded watercolors by Winslow Homer to discover the pieces' original hues; determined the makeup of metal alloys in Picasso sculptures; and developed imaging technology to colorize archival black-and-white photographs of early versions of a Matisse painting. Projects are often driven by the Art Institute's shows, such as *Matisse: Radical Invention, 1913–1917* in 2010 and *Watercolors by Winslow Homer: The Color of Light* in 2008.

While staff at the Art Institute explore engineering methods that may enhance conservation and art history, researchers at Northwestern learn about critical problems in conservation science. "The entire University benefits by being engaged with one of the finest art museums in the country," Faber says, "and it's good for students to see how they can use their technical backgrounds to work on atypical problems."

Arts-related research has also sparked findings in other, unintended areas of study. In one ongoing project Faber; Kenneth Shull, professor of materials science and engineering; and Linda Broadbelt, Sarah Rebecca Roland Professor of Chemical and Biological Engineering, have been studying the composition of house paints Picasso used in some of his works. The three are developing tests to understand the physical and mechanical properties of a similar paint system: an indentation test, which involves pressing on the paint to test its response, and a "quartz resonator" test, in which researchers coat paint onto a vibrating piece of quartz to analyze its nanoscale structure. If paint samples that behave like Picasso's house paints can be developed, they can be used to test methods for cleaning the artwork.


The research has led to unexpected discoveries. "The focus is on paint, but there is an opportunity here to develop characterization methods for a variety of protective coatings and to learn how they degrade," says Shull. "These oil-based materials, which are important to the art community, are also sustainable materials that could have tremendous value elsewhere." Shull is currently investigating the application of the techniques in creating dental fillings.

For the Art Institute's current *Picasso and Chicago* show (through May 12), researchers traced some of Picasso's modern bronze

sculptures to a specific foundry in Paris by using emission spectroscopy and x-ray fluorescence to determine the chemical composition. The researchers included David Dunand, the James N. and Margie M. Krebs Professor of Materials Science and Engineering.

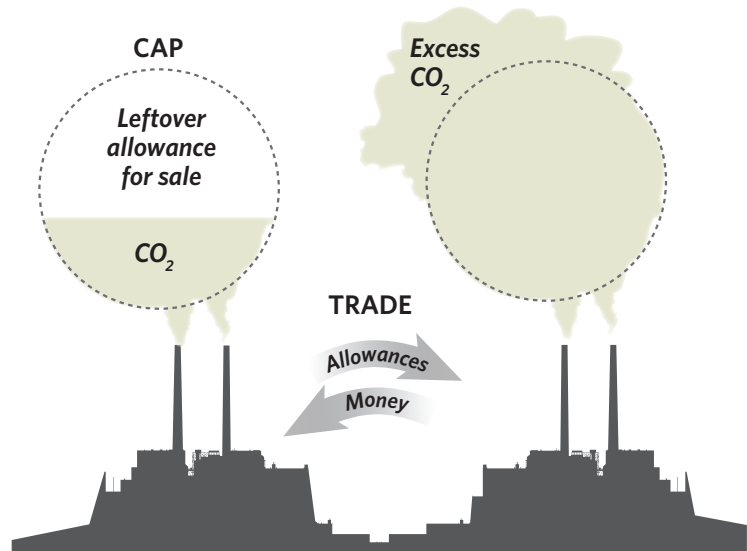
Since the Northwestern–Art Institute collaboration began, the partnership has been supported by the Mellon Foundation with additional grant support from the National Science Foundation. In January the Mellon Foundation announced the sizable grant to establish NU-ACCESS for six years. Casadio and Faber direct the center, which serves as a collaborative hub, facilitating interdisciplinary research partnerships in art studies and conservation on a national scale.

Museums and cultural institutions will be asked to submit proposals for the study of objects in their own collections or for object-inspired research. Faber and Casadio expect three to five major projects and up to 10 minor projects to be carried out each year.

Faber says she hopes the center will inspire other arts organizations and universities to bridge the gap between science and the arts. "We are thrilled to be offering this service, but I suspect the need is greater than we can handle," Faber says. "We're hoping this can be a model for other large museums."  Sarah Ostman

Carbon calculator

Eric Masanet uses mathematical models to understand carbon emissions and find solutions for reducing them.



As the ninth-largest economy in the world, California has the muscle to influence opinions beyond its borders. So it's no surprise that all eyes are on the Golden State as it implements a relatively new approach to combating greenhouse gas emissions: letting companies buy and sell the right to pollute.

Under California's "cap-and-trade" program—the most expansive of its kind in the country—state regulators place a cap on the amount of carbon that oil refineries, power plants, and large factories may emit per unit of production. The cap decreases over time to rein in emissions. Companies that exceed the legal limit face a choice: clean up or buy extra allowances from companies that have some to spare.

It sounds simple, but assigning carbon emissions to individual products is anything but. "Assigning emissions is an especially complex problem in the manufacturing sector, where one facility can produce a lot of different products," says Eric Masanet (MS '96), associate professor of mechanical engineering and of chemical and biological engineering at McCormick. "To distribute carbon allowances fairly across an industry, we need to account for these differences in product outputs within an industry, as well as differences in their production processes."

For the past year Masanet, Northwestern postdoctoral researcher Mike Walker, and partners from the University of California, Berkeley, and the Dutch consulting firm Ecofys have been working to design mathematical approaches to help the California Air Resources Board, the regulatory

agency overseeing cap-and-trade, make credible, mathematically sound decisions about carbon allowances across California's many industrial plants.

Masanet is focusing on California's food processing industries, which include large companies like Morningstar, Frito-Lay, and Gallo, that can have massive operations that are complicated to analyze. In the tomato processing industry, for instance, numerous products, from ketchup to diced tomatoes to sauce, are made from one raw commodity. Any formula regulators use to assign carbon allowances must take all the products into account.

"Regulators can't just say to a tomato processing plant, 'You can emit X grams of carbon dioxide for each tomato you process,' because the emission levels are different for each product," Masanet says. "Our goal is to accurately assign emissions to a broad range of products—providing a calculation method to regulators so they can fairly distribute allowances and drive change across an industry."

Driving change is the goal of all of Masanet's work. He often employs life-cycle analysis to study the environmental impacts of the entire life cycle of a product, from manufacturing to consumption to disposal. By quantifying the energy usage, emissions, and environmental effects of current and potential technologies and behaviors, life-cycle analysis informs smarter manufacturing processes and policies.

"From a sustainability perspective, my research seeks to determine where we are today, where we could be, and the steps we can take to get



“The idea is to leave something behind so that other researchers can help move the field forward.”

there,” Masanet says. “Putting numbers on potential reduction opportunities is an important first step in designing policy, as these numbers illuminate where design can make a difference, where manufacturing can make a difference, and so on.”

Whether comparing the carbon footprints of tomato products or researching the life cycle of computer equipment, Masanet is supplying the cold, hard facts that have been lacking in his field. “You frequently hear that a product or process is ‘green,’ but it takes good data to determine whether that’s true,” Masanet says. “People want to know if they should use paper or plastic, cloth diapers or disposable. While the answer might seem obvious, it actually depends on a lot of factors, and we don’t know the answer until we do these detailed analyses.”

Researchers like Masanet are beginning to close that knowledge gap by making sustainability research available not just through publications but also through open-source models that others can adapt and reuse. Masanet currently has been funded to develop two open-source models: one, funded by Google and in collaboration with Lawrence Berkeley National Laboratory, to quantify the energy efficiency benefits of cloud computing, and another, funded by the National Science Foundation, to minimize the environmental footprints of complex manufacturing supply chains. “The idea is to leave something behind so that other researchers can help move the field forward,” he says.

Masanet’s big-picture analyses are also helping to guide economic decisions. In a project for the US Department of Energy, Masanet and his collaborators are assessing the societal and economic benefits of next-generation manufacturing process technologies in the United States.

“We think industries like nanotechnology, clean energy technologies, and additive manufacturing might create jobs, reduce carbon emissions, and be a boon for our economy, but putting numbers to these claims is incredibly important,” Masanet says. “There are thousands of technologies the government could invest in. Having hard numbers on the potential benefits of each technology helps in decision making.”

After only a year at McCormick, Masanet has already added three sustainability courses to the curriculum, including Life-Cycle Analysis and Sustainable Manufacturing Systems. In addition, he is working on a new project, funded by McCormick’s Walter P. Murphy Society, that would enable Northwestern students to provide no-cost life-cycle sustainability audits to local manufacturers.

“Sustainability improvements are vital for a clean planet and a healthy economy, but they’re not going to happen on their own,” Masanet says. “We need to change behavior, change mindsets, realign incentives. It’s going to take bright students getting trained in these areas and going out and making it happen, and Northwestern is making a big commitment to doing that.”

M Sarah Ostman

Michael Reddick
SYNTHETIC BIOLOGY

A SEAT AT THE LAB TABLE

Undergrads play a vital role in McCormick research

When Michael Reddick (chemical engineering '13) arrived at Northwestern, he had a hunch that he wanted to study chemical engineering—he'd aced high school chemistry, after all. Then he found himself gravitating toward medicine as well, but he wasn't sure how to meld the two. "I liked the idea of being a doctor, but I didn't just want to be the person administering the drugs," he says. "I wanted to be the person discovering the drugs. The idea of discovery, application, and technology all in one was very exciting to me."

Reddick didn't have to wait until graduate school to learn that he was interested in research—and to learn what research would be like. By landing a spot in a McCormick research lab that seeks to reprogram yeast cells to serve as inexpensive diagnostic tests for diseases, Reddick has gained invaluable insight into what conducting research means: hard work, trial and error, and hours upon hours of learning about other researchers' work.

Real research doesn't much resemble the research described in high school textbooks—but that doesn't deter undergraduates like Reddick. Whether they take on the work for course credit, as a paid position, or just for the experience, undergrads play an increasingly vital role in McCormick research laboratories; since 2005 the percentage of undergraduates engaged in research at the school has more than tripled to 40 percent.

"Having undergraduate students in our labs is a critical part of the research experience at McCormick, not just for the undergraduates who do it but for the graduate students, postdoctoral researchers, and professors who work with them," says Julio M. Ottino, dean of the McCormick School, Distinguished Robert R. McCormick Institute Professor, and Walter P. Murphy Professor of Chemical and Biological Engineering. "Our undergraduate research program fosters learning for the students, while our labs benefit from our students' curiosity, work ethic, and perspective."



From yeast, a career path rises

When Reddick sought a spot in a lab during his sophomore year, his timing couldn't have been better for his interests: McCormick had just hired several faculty members whose research in synthetic biology blurred the lines between medicine, biology, and engineering. Among them was Keith Tyo (above, left), assistant professor of chemical and biological engineering, who studies cells' metabolic networks to synthesize new materials and engineer new kinds of sensors. "I emailed Professor Tyo before he even arrived on campus," Reddick says. "I was that eager for a spot in his lab."

Reddick landed a spot and has spent the past two years in the Tyo lab studying the intracellular communication of yeast cells to determine how they respond to stimuli. Reengineering the cells so that researchers could control their growth was just the beginning. By rewiring the cells' sensing mechanisms, Tyo's team seeks to reprogram them to do useful things for humankind, such as providing an inexpensive and transportable diagnostic tool for the developing world.

The lone undergraduate in a newly established lab, Reddick was part of an all-hands-on-deck mentality. "It's been such a cool process to see someone start a lab," he says. "Most times when you join a lab it's already established, but I was there for everything—from ordering equipment to setting up the space to getting projects under way. In the process I was fortunate to interact with Professor Tyo a lot."



Maya Stuhlbarg
STRUCTURAL HEALTH
MONITORING

Five more undergraduates have since followed Reddick to the Tyo lab. "Undergraduate researchers, especially the fantastic students we have at Northwestern, are a great asset," Tyo says. "Their enthusiasm and willingness to try new things can be an example to graduate students and even to me. In my lab they get the opportunity to start making a real impact and to see how their work fits into a larger plan to solve some really important problems. And the older researchers get to develop their mentoring skills."

Reddick's work in the Tyo lab has shaped his career plans as much as he'd hoped. The experience led to a lab stint last summer at the University of Wisconsin. Reddick plans to enroll in a doctoral program after graduating this spring and to join a lab there working on similar synthetic biology research. "Professor Tyo's lab was how I learned what's out there," he says. "It has showed me what I want to do with my career."

Connecting to coursework

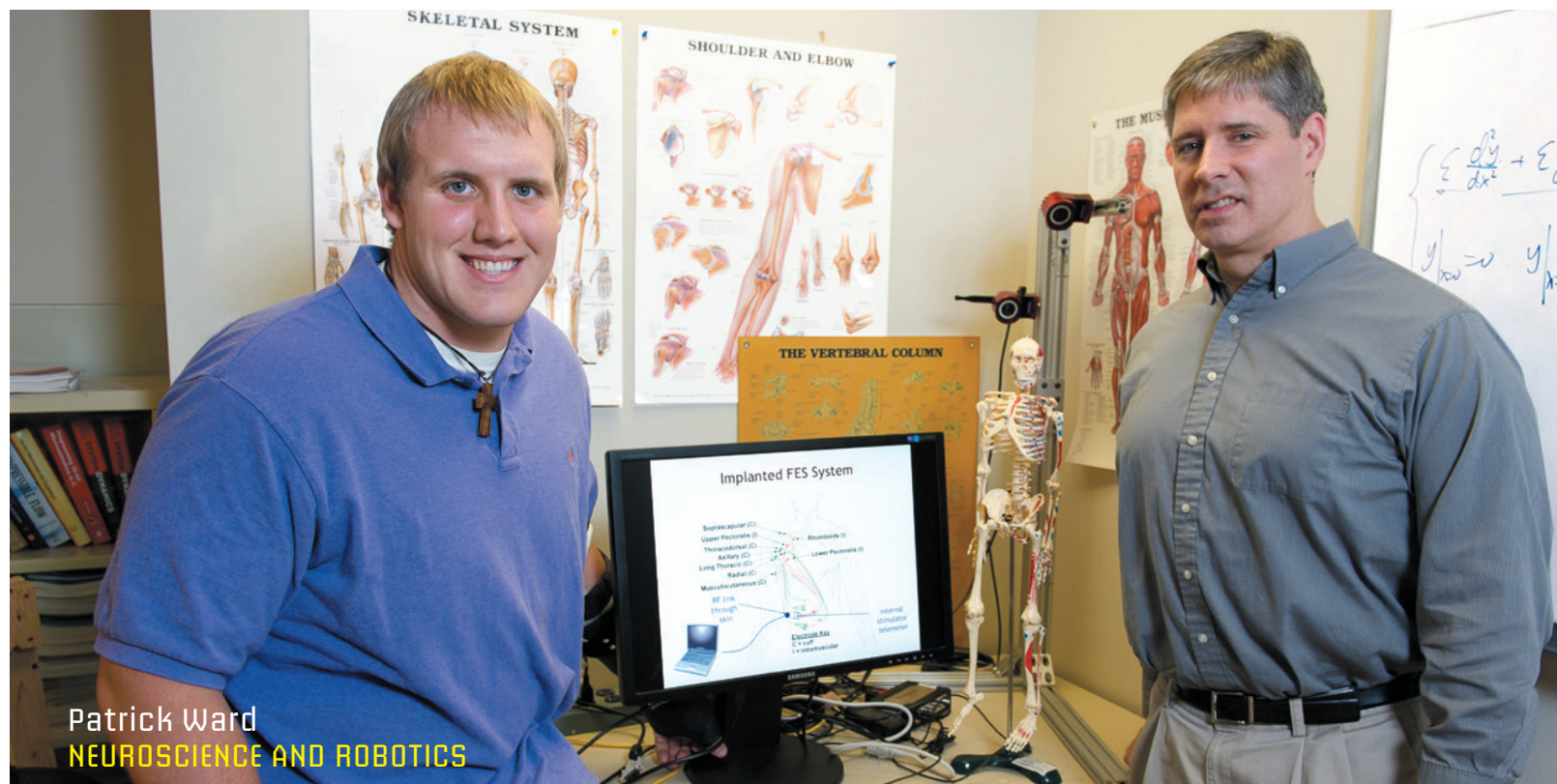
Not all research opportunities involve wearing a lab coat—and that's perfectly fine with Maya Stuhlbarg (civil engineering '13). For the past two years Stuhlbarg has worked on structural

health monitoring research at Northwestern's Infrastructure Technology Institute, and her "lab" sites have ranged from a Wisconsin freeway overpass to the base of a deteriorating California bridge.

"I don't think I would have liked research as much if I had been confined to a lab. I think I would have gotten bored with it," Stuhlbarg says. "At ITI I get an understanding of the bigger picture."

Stuhlbarg helps ITI develop and maintain electronic sensor systems that monitor the structural performance of bridges and other structures throughout the United States. The systems—metal boxes that affix to the structures and collect data about deflections, temperature changes, and shrinkage—transmit information wirelessly to computers at ITI, where researchers crunch the numbers and turn them over to transportation officials to aid in infrastructure-related decision making.

Students at ITI travel across the country to install and maintain equipment. The summer before her junior year Stuhlbarg flew to Malibu, California, where she spent a week installing sensor systems on a scour-critical bridge. The condition occurs when a bridge, usually with its



Patrick Ward
NEUROSCIENCE AND ROBOTICS

foundations in a body of water, experiences a loss of support as rocks and soil are washed away.

Stuhlbarg was able to contribute meaningfully on the job site after just a year at ITI, applying many of the topics she'd learned about in her coursework, such as stress and strain and behavior of beams and columns. "It was a really great experience," she says. "It allowed me to see the decisions that are necessary with structural health monitoring, such as where to place the sensors or where to find a power source, and it gave me first-hand experience working in real conditions."

"ITI has worked with many undergrads over the past several years, and we have a good system in place to bring them in, get them up to speed, and get them contributing quickly," says David Corr (pictured with Stuhlbarg on page 29), clinical associate professor of civil and environmental engineering and Stuhlbarg's research adviser. "The type of research we do connects directly to the topics they are learning in their courses."

Stuhlbarg's recent focus has been a highway overpass in Hurley, Wisconsin, near the Michigan border. Logging is an important industry there, so large trucks frequently travel the area's freeways. The two states have vastly different weight regulations for trucks, however, making for an interesting case. Stuhlbarg is working on a paper about the

Wisconsin project that she hopes to see published before graduation.

Stuhlbarg is planning a career in infrastructure design, for which her ITI experience will be invaluable. "If you want to design new things," she says, "you have to understand maintenance—and now I do."

Tangible results

Some undergraduates have so much on their plates that carving out time for research is a challenge in itself. Dedicated student-athlete Patrick Ward (mechanical engineering '13), a Wildcats left tackle and two-time NCAA Academic All-America honoree, couldn't squeeze in lab time during the school year, when he was busy attending football practice, working out, maintaining a 3.94 GPA, and preparing to graduate early. So, Ward did research over the summer.

He was offered a spot in Northwestern's Neuroscience and Robotics Lab with Kevin Lynch (above, right), professor of mechanical engineering. "I had Patrick in my Introduction to Mechatronics class, and when I saw his discipline, work ethic, and native ability, I started recruiting him immediately," says Lynch. "We are fortunate to have had many outstanding undergraduates work in our lab, and Patrick was one of the best."

In the lab Ward participated in National Science Foundation-sponsored research aimed at helping a woman who had suffered a spinal cord injury regain voluntary control of her right arm. The Northwestern lab, in collaboration with the Rehabilitation Institute of Chicago and Case Western Reserve University, is developing a system based on surgically implanted electrodes to stimulate the woman's arm, shoulder, chest, and back muscles to animate her arm. Coupled with a system that senses what task she would like to perform, the goal is to restore her ability to perform basic functions such as eating and drinking.

A missing step in creating a working system was to develop an optical tracking system that could track the arm's precise location in space. That's where Ward came in. Ward spent his afternoons researching, evaluating, and implementing high-speed, vision-based methods to provide feedback for the electrical stimulation controller. "Even in the best-designed controller, there's going to be some error between where the subject wants to move her arm and where the computer moves it," Ward says. "Using a feedback controller, we can detect the error in the position and make a correction, then adjust the electrical stimulations as needed."



Marissa Krotter
MIXING AND CHAOS

After spending weeks learning about methods for tracking rigid bodies, Ward got to work writing code in MATLAB—a technical computing language and interactive environment for algorithm development—that would interpret vision data from a three-camera system. In one of his favorite activities of the summer, he went to work in McCormick’s prototyping shop to create a stand-in for the human arm to test his work. “I built a really crude, three-degrees-of-freedom model of a human arm out of two-by-fours, door hinges, and screws, and I attached some reflectors to it,” he says. “As I moved the test arm around, the computer reconstructed the three-dimensional motion of the arm from the vision data. It was really gratifying to see my efforts pay off.”

All new terrain

Coauthoring a journal paper is an exciting opportunity for an undergraduate. Being the lead author of a paper that lands on a journal cover—with coauthors who include Dean Ottino and Richard Lueptow (above, right), senior associate dean—is knocking the ball out of the park.

But Marissa Krotter (mechanical engineering ’13) is no ordinary student. As a scholar in the Murphy Institute, a program that invites

select McCormick undergraduates to engage in self-directed activities, Krotter had funding for a long-term research project. When it came time to choose a sophomore-year project, she followed her interest: fluid dynamics.

Krotter had become acquainted with Lueptow the previous year, when a course required her to design an umbrella that could withstand Chicago’s high winds. “There are a lot of forces at work, such as how the velocity of the winds and shape of the umbrella can impact forces,” she says. “Dean Lueptow is an expert in fluid dynamics, so I emailed him and asked if we could talk.”

Lueptow welcomed her into his lab. Early on in her research there, Krotter performed easy tasks, like organizing supplies and keeping chemical lists up to date. “It was a good way to become familiar with the lab,” she recalls. As her comfort level grew, so did her responsibilities. By her senior year Krotter was entrenched in the cut-and-shuffle method, a new way of mixing solid materials that resembles a deck of cards being cut and shuffled. Explored over the last few years by Ottino, Lueptow, and their research team, the method might find applications in geophysics and materials processing.

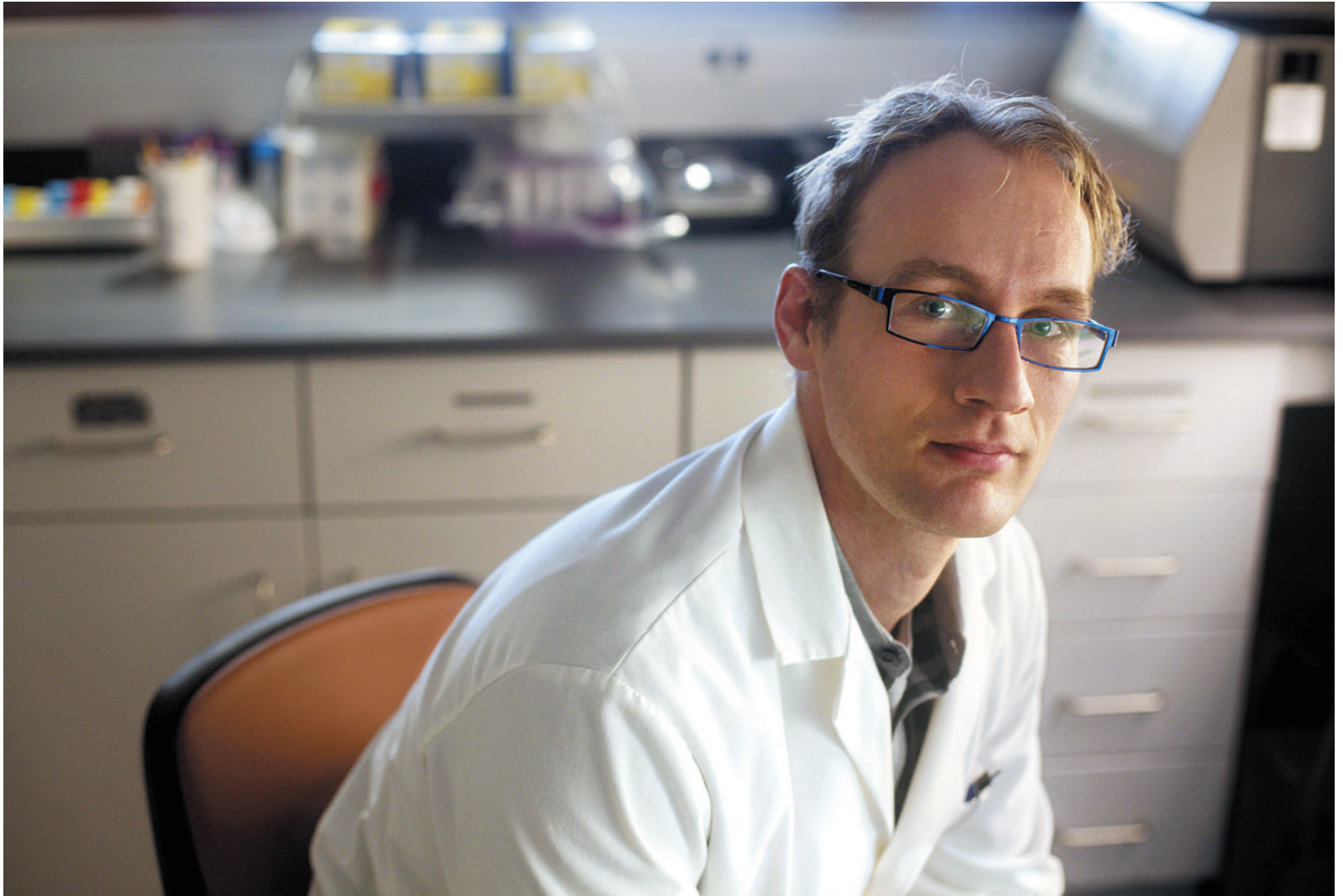
These days Krotter spends most of her time writing code in MATLAB. In her research, she has

also collaborated with a doctoral student in the Department of Engineering Sciences and Applied Mathematics who is applying theorems related to a relatively new area of mathematics called “piecewise isometries” to the cut-and-shuffle approach. She interacts frequently with Lueptow and participates in meetings every few weeks with Ottino and the rest of their team. “Working with Deans Ottino and Lueptow has been great, especially hearing their insights into research,” Krotter says. “I’m always amazed at how willing and happy they are to meet with me and make sure I’m getting what I need out of this process.”

The experience reached its pinnacle in December, when Krotter’s paper about the cut-and-shuffle method appeared on the cover of the *International Journal of Bifurcation and Chaos*. “The whole process of writing a paper, putting all the figures together, and getting it published has been so eye-opening,” she says.

Working in a lab has given Krotter a keen insight into how the research process works. “Shifting from the classroom to research is like night and day,” she says. “In class, if you’re working on a project or doing homework, you have an answer set so you know if you’re on the right track. Research is completely open-ended. It’s all new terrain.” **M** Sarah Ostman

Reaching across disciplines and cultures

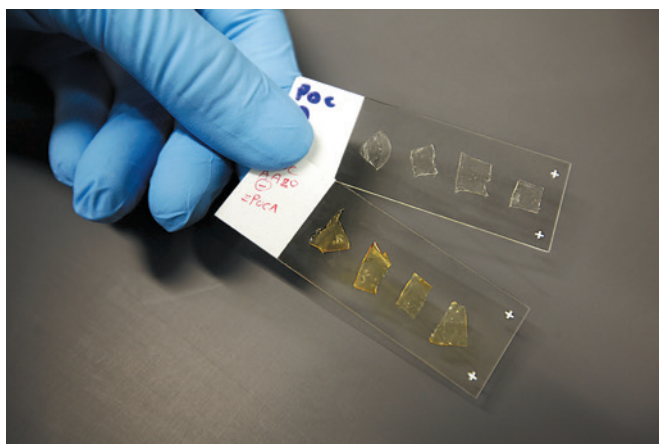


*Biomedical engineering graduate student **Robert van Lith** has spent the last five years honing new approaches to vascular therapies that could ultimately improve the quality of life for millions of patients.*

It's a notable accomplishment:

his work has garnered two patent applications and several academic papers. But his most valuable talent may lie in his ability to reach across cultures and disciplines to innovate. His early career has already spanned three continents and includes training from some of the top business and technology transfer professors at the University.

"One of the great things about Northwestern is that it's very collaborative, very interdisciplinary," he says. "It has been great to interact with people from so many different backgrounds and disciplines."



Van Lith's interest in medicine began during childhood, in his native Netherlands, when his older brother became a physical therapist. But he soon noticed that his best work was in the hard sciences: physics and math. "I didn't really want to squander what I was good at," he said, "so I started looking into engineering."

He majored in biomedical engineering—a new discipline at Eindhoven University of Technology—and stayed on for a master's degree. During that time he enrolled in a research internship at Osaka University in Japan and fell in love with the Japanese culture.

"It was so different, yet I felt completely at home," he says. "I got along really well with people in Japan." It also appealed to his engineering nature, he said: the cities were big and chaotic but well organized.

So after graduation he was selected for a special program run by the Dutch government that sent young professionals to Japan

for a year. There he worked for Olympus's Life Sciences division on a new microscope prototype for cell and tissue research. The experience in industry was great, he said. But he wasn't ready to give up on academia; he felt that if he wanted to do research and development in industry he'd need a PhD. He applied to several graduate schools in the United States and Canada but ultimately chose Northwestern, not just for its top-quality research, but also because of the vibe he got when visiting.

"The students here seemed much happier," he says. "And I loved Chicago, loved Lake Michigan. The people here are laid-back, and I enjoy living in a place with four seasons."

As a student in the lab of Guillermo Ameer, professor of biomedical engineering and surgery, van Lith has conducted research on the interplay between polymers, drug delivery, and tissue engineering. He is currently developing a polymer to coat synthetic grafts for bypass

surgeries. In patients with diseases such as atherosclerosis, synthetic grafts, which are used to replace blood vessels, often fail in vessels with small diameters. Surgeons and scientists believe that injury to the inner cell lining causes oxidative stress, resulting in the vessel's becoming occluded. Van Lith and his lab colleagues are developing a graft with antioxidant properties to alleviate the stress. Because it is believed that the injury is due to the lack of nitric oxide, van Lith is also working to modify a peptide to deploy nitric oxide at the site of the surgery.

Along the way, he's also trying to understand the relationship between oxidative stress and nitric oxide. "They are related, but we still do not know how," he says. "Everybody is trying to discover the exact nature of their connection."

That ability to conduct both basic science research and direct application research has contributed to his success, says his adviser.

"Robert is very smart, hard working, and always willing to take on new projects," Ameer says. "He is very dedicated to research."

Van Lith also attributes his achievements in part to his collaboration with Melina Kibbe, Edward G. Elcock Professor of Surgical Research at Northwestern's Feinberg School of Medicine. That sort of cross-disciplinary collaboration offers immediate feedback: surgeons can immediately tell if an innovation would actually be feasible or useful.

But van Lith isn't content to be in the lab for the rest of his career: he wants to bring his innovations to the marketplace. "Research developed in academia can be very slow moving into the real world," he says.

To get a better handle on the process, van Lith served as an Innovation to Commercialization (I2C) fellow this past summer. The program, offered by Northwestern's Innovation and New Ventures Office, gives selected students experience in researching intellectual property for innovations developed at Northwestern.

Van Lith and his colleagues learned how to develop patent applications, protect IP rights, and understand product licensing. He developed a business plan—including a competitive analysis and possible funding opportunities—for a Northwestern professor's anticancer drug.

At the same time, he also participated in Business for Scientists and Engineers, an eight-week leadership program for science and engineering graduate students that draws on the Kellogg School of Management's core MBA curriculum.

"These two programs were perfect complements to each other," van Lith says. "They were great opportunities to learn how to move products into the real world."

Though van Lith is undecided about what he'll do after he finishes his degree this year—maybe start his own company, maybe work for a startup—he is certain that Northwestern has helped prepare him for an interdisciplinary career.

"At Northwestern, you have the resources and opportunity to develop yourself and your skills however you want," he says.

M Emily Ayshford

ON THE JOB

From startups to high finance, young McCormick alumni take their skills far and wide.

Times have changed.

The career paths of McCormick graduates are not as clear cut as they were 10 years ago, when traditional engineering industries like chemicals and materials, electronics hardware, and manufacturing were the most popular destinations. Today's graduates take the critical thinking and problem-solving skills learned at McCormick in unconventional directions. And if what they want to do isn't out there, they create it themselves. "A normal job" doesn't apply to the career choices of the six recent graduates profiled here.

Dan Cornew

Lead mechanical engineer, Titan Aerospace
Mechanical engineering '11

Located in the desert an hour east of Albuquerque, the town of Moriarty, New Mexico, may not have the nightlife that some early-20-somethings are searching for. But it has everything Cornew needs for his work: plenty of sunshine, an airport, and a sparse population—making it easy to get flight clearance.

McCormick: What does Titan Aerospace do?

Cornew: Titan Aerospace is a startup that designs and builds solar-powered unmanned aerial vehicles, or drones. Our long-term goal is to build solar-powered UAVs that could stay in the air for several years, flying at 65,000 feet. We believe they could do much of the work currently being done by satellites—like telecommunications, weather surveillance, and military spying—at a fraction of the cost.

The company started just over a year ago and we're still small. We have 14 people working for us right now. We have a hangar at the Moriarty airport, and that's where we build these things. As the lead mechanical engineer, I'm in charge of all the design and construction of the aircraft. Right now we're building a 10-meter-wingspan aircraft in order to validate the design. In the

next few weeks we hope to do an overnight flight with it, and after that we'll start on a 50-meter-wingspan aircraft that will do several weeks in the air. Then we'll start looking for customers.

McCormick: What is a typical workday for you?

Cornew: Well, I live in the hangar. It has a separate apartment, though; it's quite civilized! I roll out of bed around the time everyone else gets in, we sit down, discuss what we're doing, and then we build. Since our aircraft need to be incredibly lightweight—our 10-meter bird only weighs 36 pounds—I spend a lot of time trying to figure out how to accomplish things without adding weight or bulk. It's very much a prototyping shop; we try to figure out how to do something, build it, test it, then build the next one. Every so often we take a bird out to the field and go flying. Or rather, we sit on the ground. It goes flying.

Our aircraft are not very complicated. We've deliberately removed everything that's not vital because we want them to stay up, and the more complicated the design, the more likely it is to fail. Electrically, it's quite simple. We run on off-the-shelf laptop batteries and off-the-shelf solar cells. We're trying to break a British company's record for flight time for a solar-powered UAV, which is two weeks.

McCormick: What were your qualifications for this job?

Cornew: My current boss, who is Titan's founder, was looking for someone with experience in aerospace and solar power. I had interned at SpaceX for six months and had been chief engineer for Northwestern's Solar Car Team. He also wanted someone who was passionate about gliders—aircraft that run without engines. I have been flying them since I was a kid. That helped, because our aircraft are essentially gliders, but with an electric motor and solar panels. Anyway, I learned about the job through a solar car listserv. I contacted him and became the company's first employee.

McCormick: What advice would you give to current McCormick students who want to be competitive in your line of work?

Cornew: Get on a project team like Northwestern's Solar Car or Formula SAE Team. Be as involved as you can be. The skills you use there are really what you'll use on the job. Plus, when you're going for a job interview and you say, "I went to class," it's not all that impressive. It's all the stuff you did beyond class that matters.



Brittany Martin Graunke

Founder and CEO, Zealous Good
Industrial engineering '07

When Graunke graduated, she started consulting for Bain & Company, working with corporate and nonprofit clients. Knowing she wanted to work with nonprofits, she became United Way's strategic engagement manager. Her experience in that job prompted her to found a social enterprise website that connects people who have items to give away with nonprofits that need the items.

McCormick: How did you get inspired to start Zealous Good?

Graunke: At United Way part of my job was working with donors to help them feel more connected to the organization. This was during the recession, and more than once I had corporate donors come to me and say, "We're downsizing, and we're getting rid of all our big-screen TVs, and we'd like to donate them to an organization that needs them." On the other hand, I'd talk to nonprofits that desperately needed TVs for job-training programs or tutoring but didn't have access to any. It seemed like there was no vehicle to help the two sides connect.

Well, the engineer and the consultant in me flared up, and I thought, there is a piece missing in the in-kind donation space. I realized that with some efficient processes and technology, we could leverage a solution. What developed was Zealous Good.

McCormick: How did you go about starting the company?

Graunke: I started talking with people who knew what I needed to learn: people who worked in tech, people who had started websites, people in the social enterprise space. And I started connecting with more businesses and nonprofits to see what their needs were. After nine months of research and coffee meetings in the evenings and on weekends, I decided to take on the project full-time.

I decided that I was going to start it in a bootstrapped way with a four-month pilot. I developed a basic website and assembled a small group of nonprofits. That process helped us to develop the model we use today.



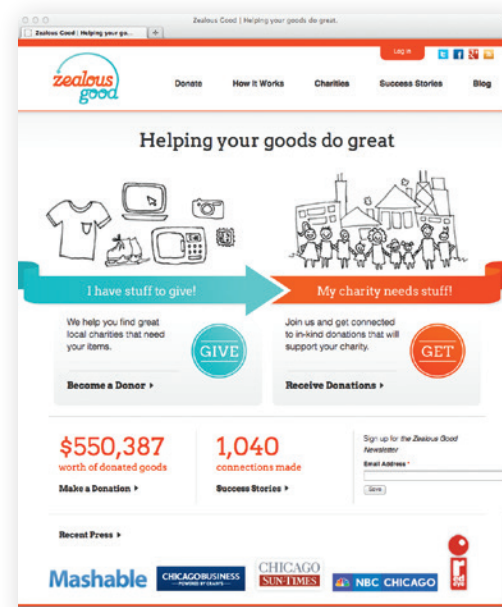
McCormick: Tell us about that model. How does your business make money?

Graunke: Nonprofits are able to create profiles on the Zealous Good website, and they can request in-kind donations for free. When a donor responds with an offer, the nonprofit either can sign up as a Zealous Good member for a few dollars a month or can pay as it goes, remitting a small fee for each donation received.

It's a low-cost model, and it's dependent on the company reaching a certain scale. We currently have 220 nonprofit members, all in the Chicago area. I look at Chicago as our pilot city. We're perfecting our model here, and then we hope to scale out to at least 20 other cities.

McCormick: Do you find yourself drawing on your McCormick education in your work?

Graunke: Definitely, especially when it comes to problem solving. I often draw on the skills I learned in the Engineering Design and Communication course [now Design Thinking and Communication]. Whenever I'm faced with a problem, no matter how big or small, I don't just jump in and say, "Here's what I think the best answer is." It's been ingrained in me that the first step is research. You want to be able to develop an inexpensive prototype. You want to be able to test, iterate, and fix it and enlist users to see how it works. That whole process has been integral in building Zealous Good.





David Evitt

**Cofounder and CEO, Estufa Doña Dora
Mechanical engineering and Segal Design
Certificate '09**

Shortly after graduating from Northwestern, Evitt packed up and headed to Guatemala to volunteer with a nongovernmental organization. He planned to stay one year before returning to the United States and getting a “normal” job. Three years later, he still calls Guatemala home and has started a business that builds and commercializes safe, fuel-efficient wood-burning cookstoves.

McCormick: Did you always plan on working abroad after graduation?

Evitt: No, initially I wanted to study abroad during my undergraduate years, but that didn't work out. So it was important to me to live outside the United States for at least a year before getting a traditional engineering job. After graduation I was looking for an internship or volunteer opportunity to use my engineering skills in another country, and that's how I got started with an NGO in Guatemala working in appropriate technology development [a technological development model that focuses on sustainability and a culture's unique needs]. One of my first projects was interviewing families about their cooking traditions to provide the context for developing a more efficient wood-burning cookstove.

Originally I thought I'd do something related to automobiles after graduation. I'd always been interested in energy efficiency and the idea of fuel-efficient diesel engines. I did co-op at Caterpillar and spent my last two rotations in the engine

development group, and I was active with Northwestern's Formula SAE team.

It's been a bit of an evolution, transitioning from fuel-efficient engines to efficient wood stoves, but I think at their core they are the same. They're both rooted in a sense of possibility about how engineering solutions can help us use resources more wisely.

McCormick: Why are efficient wood stoves so important in Guatemala?

Evitt: Guatemala is a country of about 14 million people, and 62 percent regularly buy firewood for cooking. There is a strong cultural attachment to cooking with wood, and the general impression here is that food cooked on wood tastes better.

But the current stove practices are problematic for many reasons. Most families cook on smoky, open fires—essentially campfires on the floors of their homes. The fire puts the whole family, especially children, at risk for disfiguring and disabling burns, and indoor air pollution from smoky fires is a leading cause of death of children under five. Also, wood is expensive. It's typical for a family to spend up to 20 percent of its income on wood. It also leads to forest degradation, which is a big problem in this country.

McCormick: What is a typical workday for you?

Evitt: A typical workday has changed over time. In the beginning—after I finished the initial round of interviewing families about cooking—I worked on the stove design. I followed the process through prototype development, user tests, initial pilot, and

manufacturing process development. We literally built the factory from the ground up.

During that time the NGO closed its Guatemala office, and I helped found a Guatemalan entrepreneurship center called Alterna, and we built a business called Estufa Doña Dora around the cookstove model I had been developing. Alterna is now incubating the cookstove business. We received a round of angel funding in March 2012 to launch the commercialization effort of our stove that helps families save money, improve health, and preserve the standing forest.

Now there's an incredible variety from day to day. Some days I'm in the office working on the 2013 budget, refining our sales process, scaling production, looking for mentors, reaching out to partners. Other days I might be out delivering stoves, which includes positioning the stoves in customers' homes, installing the chimneys, and showing the families how to use the stoves. Another day I might be purchasing raw materials to make the next batch of stoves.

My favorite part of the job is definitely visiting people in their homes. I go all sorts of places far off the tourist track that I wouldn't otherwise have the opportunity to see. For example, a few months ago we sold 25 stoves to a group in a really rural community in the mountains. It was an hour away from the nearest town by dirt road. I spent 24 hours with a tomato farmer and his family to see how they lived and cooked. It was an incredible experience—a situation where I was able to interact with the family and have a window into a completely different style of life, all through the stove.

Lourdes Solis

Vice president, corporate coverage and solutions, Deutsche Bank Securities
Civil engineering '06

Although she studied civil engineering at McCormick, Solis found herself drawn to a very different field upon graduating: finance. Seven years later, she has worked her way up to become a vice president at one of the world's largest financial institutions. While the connection between her education and her career may not seem obvious, Solis says the analytical skills she learned as an engineer help her on the trading floor every day.

McCormick: Tell us about your work.

Solis: I work in capital markets at Deutsche Bank in New York City. My job is a combination of traditional banking, serving as an adviser to corporate clients, and working on trading products. I work with the real estate industry, so my clients include about 70 major real estate companies, property managers, casinos, and hotels. My role is to deliver the banks' markets products, such as interest rate hedges and foreign exchange hedges, to these clients, help them raise capital by issuing bonds to institutional investors, and help them grow by buying other companies.

McCormick: How did you get into the financial industry?

Solis: When I was at McCormick, I got a scholarship to work for General Motors. I spent two summers working with their facilities management group, the only civil engineering position they had in the company, which entailed managing reconstruction and new construction of manufacturing plants. I realized it wasn't the right job for me. I'm an outgoing person, and I was more interested in managing projects and dealing with clients. The following summer I was recruited by SEO, a nonprofit that recruits minority students for summer jobs on Wall Street, and was placed at Deutsche Bank. That was my first experience on the trading floor.

When I accepted a job at the bank after graduation, I was surprised at how many of my new colleagues were engineers—probably

25 percent of the group. It's not such a stretch, though. Traders have to build financial models, they have to understand how to solve problems, and they deal with math in every shape and form. Engineering fits well into that.

McCormick: When you began at Deutsche Bank, did you have any experience in finance?

Solis: I didn't know anything about finance. No accounting, nothing. In fact, I told them, "I have never considered finance as an option; this just sort of happened. I'm a quick learner, though, so we'll see where we get." Seven years later, I'd say it's gone pretty well. I'm 29 years old and CFOs and treasurers of multibillion-dollar companies are calling me for my advice. I'm the only Latino vice president in my division, which has more than 100 people. Sometimes it's kind of surreal.

McCormick: What advice would you give to current McCormick students interested in following a similar path?

Solis: I heard a saying once: "An engineer can be an economist, but an economist can never be an engineer." If you think you want to go a finance-related route, why not study engineering? It provides a really solid background, your ability to manage and solve problems is very strong, and because of how intense the curriculum is, if you can make it in engineering, you can pretty much do anything.





Derek Morris

**Cofounder and chief technology officer,
Walk.by
Computer science '12**

For people who don't enjoy bricks-and-mortar shopping, online shopping has been a blessing. But while the Internet is great for cookie-cutter items, it can be difficult to find unique pieces like those in local boutiques. Just months after graduating from McCormick, Morris and his partners developed a solution to this problem: Walk.by.

McCormick: What is Walk.by?

Morris: Walk.by is a website and mobile app that allows local boutiques to put their inventory online to reach a larger customer base. With the snap of a photo, the item is sent out across all the merchant's social networks with a link so customers can purchase the item on our website. Or a customer can come straight to our website and browse. Walk.by is free for the customer, and it's a very low-risk arrangement for the merchant, because they don't pay unless we sell an item. At that point we take a commission.

The company currently consists of 11 people, including six McCormick alumni and current students, and we work with about 150 merchants in Chicago. We got started last August with funding from Lightbank, the venture capital fund that supported Groupon and [the customer loyalty program] Belly. Lightbank has been with us from the beginning, so it's been great to have that support.

McCormick: How did the idea for Walk.by originate?

Morris: The idea sort of evolved over time; there was no thunderbolt moment. We originally started with three people, and we threw around the idea of making it easier to buy things online that are only available locally. We eventually narrowed our focus to fashion.



Personally, I knew my junior and senior year that I wanted to do something related to tech and entrepreneurship. I was a teaching assistant for NUvention:

Web, and that was an eye-opening experience for me, helping other companies get started, meeting entrepreneurs who came to speak to the class. It was the push I needed to decide that I wasn't going to go work at a tech company after graduation. It was a risky decision, because I had already done an internship at Microsoft and had a job offer there.

McCormick: How does your experience at Walk.by compare with your experience at Microsoft?

Morris: Walk.by isn't a typical 9 to 5, but for me, it's fantastic. I worked long hours at Microsoft, but now I start my day earlier and work even longer hours, because I have this sense of determination that comes with working at a startup. One of the things I love most about my job is it's actually fun to come to work. We have three

interns from McCormick right now. They come into the office [in Lightbank's incubator space in Chicago's West Loop] during the week, then go home on the weekends and work some more, of their own accord. Every day is interesting, which makes it hard to step away. If you miss three days or a week, the company has moved on.

McCormick: What advice would you give to current McCormick students interested in following a similar path?

Morris: Chicago has a burgeoning tech scene and there are lots of people and educational events—go to them. 1871 [a co-working space for startups in Chicago's Merchandise Mart] is a great focal point. Go in and talk and hang out with people, get diverse opinions on startups and technology. And take NUvention—it will teach you skills and methods that you need as an entrepreneur, and it will introduce you to people that can help you out later on.



Elif Koru

**Structural design engineer,
TAV Construction
Civil engineering '12**

Career experts often tout internships as the best route to a career, and so it was for Koru. After a summer internship with airport builder TAV Construction, she was offered an engineering position working on a TAV airport in her home country of Turkey. Less than a year later, she has had an uncommon experience: designing an airport waste facility.

McCormick: What does your job at TAV entail?

Koru: TAV Construction is one of the biggest airport contractors in the world. I primarily work on İzmir Adnan Menderes International Airport, which is on Turkey's Aegean coast, helping with structural design for construction projects. This is great for me because I love airports; my family traveled a lot when I was young, so we spent a lot of time in airports. Although I work on the İzmir Airport, I'm actually based in TAV's headquarters in Istanbul, so I'm exposed to a variety of other airport-related projects as well.

McCormick: What has been the most interesting project you have worked on?

Koru: I designed a waste facility at İzmir Airport, which was unexpected and exciting. My company was reviewing the architectural drawings for the waste facility, and my supervisor asked me to design the structural system. As I was looking at the plans, I started to question why the facility had been designed this way—how the trucks would get to the trash receptacles, how the cars would maneuver. I started questioning and trying to come up with a better design.

I asked my supervisor, and I was really surprised that he was open to my ideas. They sent me to the airport site, which is about an hour away by plane. I started talking to the workers at the waste facility, asking them what they were doing and how they were doing it. I ended up incorporating the workers' input into my design.

It was really nice to get that experience on something small, like a waste facility, because on a large airport project, the waste facility is a small detail. Because it was small, I was able to experiment with it, and I could concentrate on the design without worrying too much about the aesthetics. I mean, it's not the entrance of the airport or anything. It was a great way for me to learn.

McCormick: What McCormick experience did you draw on for the waste facility project?

Koru: The process that I followed—researching, going to talk to the workers—was very similar to what we learned in Engineering Design and Communication [now Design Thinking and Communication]. I also used my experience from Architectural Engineering and Design, one of my civil engineering courses. On the airport project we had a client, of course, but just like we had done in Architectural Engineering, I came up with three different concepts and presented my ideas. Then they gave me feedback and settled on a final design. After that we did the structural calculations. Of course, a certified architect did the final drawings. But it was still the result of the design process I had followed, which is nice.

McCormick: What advice would you give to current McCormick students interested in following a similar path?

Koru: I think I was very lucky to be at a company like TAV and to be given an opportunity like this. But I think experiences like these can be created in most places. Start questioning things that you're doing. Try to see ways in which you can improve the things that are being done. If I hadn't questioned the facility, I wouldn't have gotten the opportunity to do an architectural design. It's really not a technical skill that led me to an experience like this—just an ability to question, be curious, and try to do things in better ways.

Alumni Profile: Matthew Levatich

Reflecting on his 18-year career with Harley-Davidson Motor Company—a career that has ranged from project engineer to president, from Milwaukee to England and Italy and back—Matthew Levatich (MMM '94) finds that his ability to lead positively, even in tough times, was cultivated during his time at Northwestern.

“My integrity is core to who I am and how I want to be, and it was reinforced, refined, and anchored in my 18 months in the MMM program,” he says.

Levatich's journey from engineer to business leader began in childhood. His father, an architect, was always creating and improving everything around the house. “My childhood was full of mechanical activities,” he remembers. Levatich was especially interested in how things were made; a *Sesame Street* episode depicting how milk was bottled stands out in his memory. Once Levatich discovered his talent in math and science, an engineering degree was the practical choice; he graduated in mechanical engineering from Rensselaer Polytechnic Institute.

Between his undergraduate and graduate studies, he worked as a process engineer for Albany International and in product and process development at another division of the corporation. But after five years he decided he needed to enhance his

management and marketing capabilities; “I felt like I didn't have the skills necessary to do things as well as I wanted,” he says. The MMM program, a combined MBA from the Kellogg School of Management and a master's of engineering management from

McCormick, impressed him. He liked its integrated nature and team orientation, which weren't typical of business and engineering curricula in the early '90s. The program was only in its third year at the time, and the curriculum was still developing—and that appealed to Levatich's entrepreneurial nature. Students had influence over courses and were engaged in improving the program. “There's a certain investment that comes with helping to figure out improvements as you go,” he says.

Levatich fondly remembers his time in the program, including great friends, terrific classmates, and insightful instructors. “It changed how I feel and look at the world and think about myself,” he says. “It was fantastic.”

After graduation Levatich was hired into Harley-Davidson's leadership development program. After a difficult economic period in the 1980s, the company was growing and looking for young management talent. It was the sort of challenge Levatich was looking for.

Harley-Davidson's management rotation exposed him to manufacturing, strategic planning, project management, and, finally, international marketing at Harley's European headquarters in England. While there, he helped launch the Buell brand, a racing-inspired motorcycle line, and became director of sales for the company's distributor markets in Europe, the Middle East, and Africa. In 1999 he moved back to Milwaukee to begin the development of the Harley-Davidson Museum before moving into roles ranging from overseeing supply chain to vice president of parts and accessories.





"I was continuing the intensive development education that I started in the MMM program," he

says, getting "the confidence and skills necessary to have the right impact on people and on different parts of the company."

In early 2008 Harley acquired MV Agusta, an Italian sport bike company, and sent Levatich to Europe to run it. The fit was perfect: He wanted to put it all together and run a company, and he, his wife, and two sons loved to learn about new cultures. He was back in Milwaukee in less than a year, however, as he was named president and chief operating officer of the Harley-Davidson Motor Company.

"The opportunity to run this motorcycle company was a dream come true," Levatich says. And the recession proved the perfect time to use his leadership skills. Over the past several years, part of Levatich's job has been to lead the development of a strategy that the company could rally around; now he looks forward to using that foundation to grow. "I'm a forward-looking guy," he says. "I'm going to

continue to learn and grow and develop, and what I want for me I also want for this company and the people who are a part of it."

As a member of McCormick's MMM Advisory Board, he enjoys watching the program evolve. "I think my experience is useful in helping guide the program," he says.

In his work and free time he travels the world, often to motorcycle rallies where he meets riders who connect so strongly to the Harley-Davidson brand. "I love beautiful products that are carefully, beautifully made, that have a big emotional impact on customers," says Levatich, who himself rides an "absolutely gorgeous" 2013 anniversary edition Road Glide and a sportier 2012 XR1200X. "The connection our customers have with our products and our brand is unparalleled. I wish I had every product we make."

"What a perfect choice, right?" he says of working at Harley-Davidson. "The product matters to people, and that really matters to us. Every day I think, wow!"

M Emily Ayshford



MURPHY SOCIETY DONORS

The Walter P. Murphy Society honors individuals for their annual gifts of \$1,000 or more to the McCormick School. Members have a unique opportunity to assist the dean in making decisions to fund faculty and student initiatives through Murphy Society grants. The society honors the legacy of Walter P. Murphy, the benefactor whose gifts supported the construction of the Technological Institute. Listed below are donors who contributed to McCormick between September 1, 2011, and December 31, 2012.

Life Fellows

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

Peter J. Barris '74 and
Adrienne Chagares Barris
William R. Blackham '52
Harold E. Bond '46, MBA '64
and Pauline June Bond
Johnnie Cordell Breed H '97
Stanton R. Cook '49, H '85
Family of Lester Crown '46
John A. Dever '51
James N. Farley '50*
Nancy Hollabaugh Farley
Robert J. Fierle '45
Wilbur H. Gantz and Linda
Theis Gantz
Lavern Norris Gaynor '45
Madeline Halpern '77, MSJ '86
Estate of Richard C. Halpern*
Melville H. Hodge '52 and
Jane K. Hodge '52
James N. Krebs '45
Estate of George H. Martin
PhD '55*
Richard S. Pepper '53 and
Roxelyn Miller Pepper '53
Patrick G. Ryan '59, H '09 and
Shirley Welsh Ryan '61
David Sachs '81 and Karen
Richards Sachs
Gordon I. Segal '60 and Carole
Browe Segal '60
Robert E. Shaw '70, MMgt
'81 and Charlene Heuboski
Shaw '70
Benjamin W. Slivka '82, '82,
MS '85 and Lisa Wissner-
Slivka '85
William M. Smedley '38,
MS '40

Denise Smith*
Harold B. Smith MBA '57
Chu Tull
Jane Schulte White*
William J. White '61
Ronald Willens and JoAnne
Willens

Dean's Circle

\$10,000 or more

Haitham Mohammed
Al-Angari MS '01, PhD '06
Thomas P. Anderson '69 and
Doris Anderson
Curt J. Andersson '84 and
Susan C. Andersson
Donn R. Armstrong '62
Jeffrey Beir '80 and Sarah Beir
Delfo Bianchini '79 and
Francine Bianchini
John W. Blieszner '74 and
Constance Knope Blieszner
'74
Larry D. Brady and Deborah
Hartsough Brady '65
Mary Clark Christensen '57*
Robert W. Christensen '55,
MS '56
Neil Collins
David W. Cugell and Christina
Enroth-Cugell
David Alan Eckert '77
Alvin W. Filstrup III '62,
PhD '68
Scott H. Filstrup '65, MBA '67
and Margee Filstrup
Morris Eugene Fine
James F. Gibbons '53 and
Mary Krywick Gibbons '54
Estate of John S. Grabowski
'54, MBA '62
John Allen Haase '53, MS '64*
Jiaxing Huang
Mark Hueschen and
Sandra S. Lee

Diego Klabjan
John E. Kranjc '77
James R. Lancaster '55
Jan E. Leestma MBA '85 and
Louise M. Leestma
Wing Kam Liu
Stella Mah
John A. McQuown '57
Gregory John Merchant
PhD '90
Daniel D. Mickelson '63 and
Sandra Riney Mickelson
Donald P. Monaco '74, MS '74
and Patricia Kiefer Monaco
Emil C. Muly Jr. MS '58,
PhD '62 and Faye Ochsenhirt
Muly '61
Donald A. Norman and Julie J.
Norman
D. Eugene Nugent '51 and
Bonnie Weidman Nugent '49
Richard Padula '84 and
Susan Mullen Padula '86
David L. Porges '79 and
Gabriela Andrich Porges
Kenneth J. Porrello '78, MMgt
'82 and Sherry L. McFall '78
Stephen R. Pratt '84 and
Edie E. Zusman '85, MD '87
Vivek Ragavan '74 and Nilima
Ragavan
Warren W. Rasmussen '53,
MBA '56 and Nancy Petersen
Rasmussen '53
Damoder P. Reddy MS '67 and
Soumitri Reddy
Thomas J. Riordan '78 and
Margaret Davis Riordan '78
Virginia Nicosia Rometty '79
William Sample and Karen
Sample
Leif Selkregg
Michael Stark '78 and Shauna
Stark
William A. Streff Jr. '71,
JD '74 and Kathleen
Myslinski Streff
Tengmeng Tan
Charles Thomas and Cary
Meer
Estate of Alice L. Trinker*
Thomas C. Tyrrell '67 and
Melanie Tyrrell
Hugo L. Vandersypen MS '69,
PhD '73
Boris V. Vuchic PhD '95

Todd M. Warren '87 and Ruth
Warren
Johannes Weertman and
Julia Randall Weertman
James N. White '85 and
Patricia White
Howard B. Witt '63 and
Marilyn A. Witt

Innovators

\$5,000 to \$9,999

James S. Aagaard '53, MS '55,
PhD '57 and Mary-Louise
Aagaard
Phil Bakes
Clay T. Barnes '88, MBA '92,
MEM '92 and Karen Griffin
Barnes '88
Peter Andrei Belytschko '98,
MBA '05
James P. Benson MMgt '81 and
Kimberly Benson
Leo Price Blackford
Daniel Roy Boggs MS '91,
PhD '94 and Virginia Boggs
David E. Boyce '61
Laverne S. Brown '45
Lee C. Carr '68
Dennis H. Chookaszian '65
and Karen M. Chookaszian
James Andersen Clark '77 and
Colleen Behan Clark '77
Vando D'Angiolo
Lee A. Dayton Sr. '65 and
Mrs. Lee A. Dayton
Robert C. Feldmann '76
William Scott Galliani '84,
'88 and Carolyn McPadden
Galliani '84, MS '88
Michael N. Goodkind PhD '73
and Mary E. Goodkind
MS '70, MMgt '81
Michael J. Gordon '92 and
Amy Gatewood Gordon '91
Gene M. Handel '68
Garrett Hanken and Elaine
Hanken
Kary Hisrich '98
Jonathan Hoff and Judy Hoff
Mele Howland
Paul D. Janicki '83
Dale A. Keister '62 and
Beryl Ann Keister
Kenneth Kirsch '75, MS '78,
PhD '80
Timothy K. Krauskopf '84,
MBA '99
William J. Kroll Jr. '67, MS '71
John Z. Kukral '82 and
Karin Bain Kukral
P. Noel Kullavanijaya '82,
MS '85, MMgt '86 and
Wendalyn M. Williams '84,
MD '86
Sek-Hon A. Leung '80 and
Jenny Leung
Matthew Levatich MBA
'94, MEM '94 and Brenda
Levatich
Michael P. Lidrich '72, MS '79
Mark S. Lillie '81
Priscilla Marilyn Lu PhD '80
Ralph F. Medcalf Jr. '62
Mark J. Modzelewski '84 and
Jacqueline Modzelewski
Michael M. Morison '85,
MBA '95 and Gloria Gottfried
Morison '87
Leon N. Moses and Rae A.
Moses*
David L. Nichols '91,
MBA '00 and Charmaine
Jackson Nichols MMgt '99
Gregory M. Odland '86,
MMgt '91 and Tracy Reid
Schaffzin
Scott David Roberts '01,
'01 and Jill Lewandowski
Roberts '03, MBA '11
Thomas F. Rosenbaum and
Katherine T. Faber
John Ruan III '67
Michael J. Rusinko '84 and
Mary L. Rusinko
Stephen L. Schwartz '74,
MMgt '76 and Terry Schwartz
Mariel Spalter '89 and
Andrew L. Katz
Patricia Timpano Sparrell
MS '82 and Duncan Sparrell
Tim J. Stojka '89 and
Effie Zounis Stojka '89
Steven J. Stryker '77, MD '78
Alan R. Swanson '71 and
Janet E. Rassenfoss
John Taysom
James M. Utterback '63,
MS '65 and Margaret Nichols
Utterback '65

James E. Van Ness MS '51,
PhD '54 and Mary Ellen
Van Ness
Edward F. Voboril '65 and
Melanie Fraccaro Voboril '64
Ying-Hon Wong '79, '79
William A. Woodburn MS '75
and Marie C. Woodburn
James L. Zydiak PhD '89 and
Katrina L. Helmkamp '87,
MMgt '92

Designers

\$2,500 to \$4,999

Theodore D. Ahlgren '57, MS
'65, PhD '67 and Marjorie
Bennett Ahlgren
A. Craig Asher MMgt '93,
MS '94
William E. Bachrach MS '82,
PhD '85
Keith G. Barrett '56, MS '57
Kevin F. Barrett '81
Margaret M. Bertelsen
Hampton '80, MMgt '84 and
Steven J. Hampton
Bradley C. Canel '97
Peter S. Castro '51, MS
'56, PhD '59 and Patricia
Ludeman Castro '59
Jiun Shyan Chen MS '87,
PhD '89
Estate of Edward M. Cikanek
'64*
Lee A. Clair
Dana M. Comolli '81 and
Cori S. Staley '80
Donna M. Dominguez
Tamarah Duperval-Brownlee
'91 and Clarence Brownlee
Martin M. Eisman MS '67 and
Carol Baeder Eisman '67
Robert B. Fairley '69 and Paula
Housh Fairley '68
Charbel Farhat
Jacob Fish PhD '89
Kathleen R. Flaherty '73, MS
'75, PhD '79
Mark A. Fleming MS '94, PhD
'97 and Arantzazu Alarcon-
Fleming
Michelle M. Gerhard '82
Bill Gibbons '73, MS '74 and
Eileen Goode Gibbons '74
Siobhan Refice Greene '78
Doris A. Hightower '79

Duane D. Hong '97 and Lisa
Matta
Don J. Howard '63
Adam Inselbuch
Josetta I. Jones '92
Troy R. Karlsson '84 and
Kimberly Karlsson
Mark E. Kelly '50 and Doris
Keane Kelly
Jenifer Serafin Kennedy
MS '89, PhD '91
Donald R. Lee '63, MS '65 and
Charlene M. Lee
Itai Leviathan PhD '93
Larry Lu and Ann Lu
Michael S. Lurey '67
Harry Major '70, MBA '72 and
Lauren Major
Joseph S. Martinich '72, PhD
'80 and Vicki L. Sauter '75,
MS '77, PhD '80
Joel D. Meyer
Brian Moran and Patricia
Brophy
Robert Bradford Morehead
MBA '05 and Jennifer Moore
Morehead '00, MBA '08
Linda J. Morgan
Mark J. Morton '66
Dennis P. Neumann MBA '88
Leslie Mongin Olds MS '91
Devan V. Padmanabhan
'90, JD '93 and Suchita
Padmanabhan
Mary Anne T. Powers
Timon Rabczuk
Mark A. Ratner PhD '69 and
Nancy Ratner
Philip D. Robers PhD '68 and
Sandra Robers
Peter M. Rub '72, MMgt '75
and Monique Troglia Rub '76
Paul H. Schipper MS '75, PhD
'77
Dieter A. Schmitz JD '84 and
Megan Boyle MSJ '87
Aaron M. Schuelke '97 and
Monika Santana Schuelke '98
Mark Scudder
Scott A. Shay '79, MMgt '80
and Susan Shay
Andy Hok-Fan Sze MS '74 and
Lola Sze
Robert B. Taggart '67, MS '68
and Donna F. Taggart
Robert W. Waldele '72

Alan J. Wasserstrom '62 and
Daina Wasserstrom
Richard V. Westerman '63 and
Carla Westerman
Leslie A. Wiley '79 and
Clarence L. Irving Jr. '76
Charles S. Williams MS '80
Jessica Lutkenhaus Winter '97
and Adam E. Winter '97
Estate of Donald M. Yamashita
MBA '76*
Teck Soon Yap and Yen Yue
Yap
Thomas Zimmermann

Members

\$1,000 to \$2,499

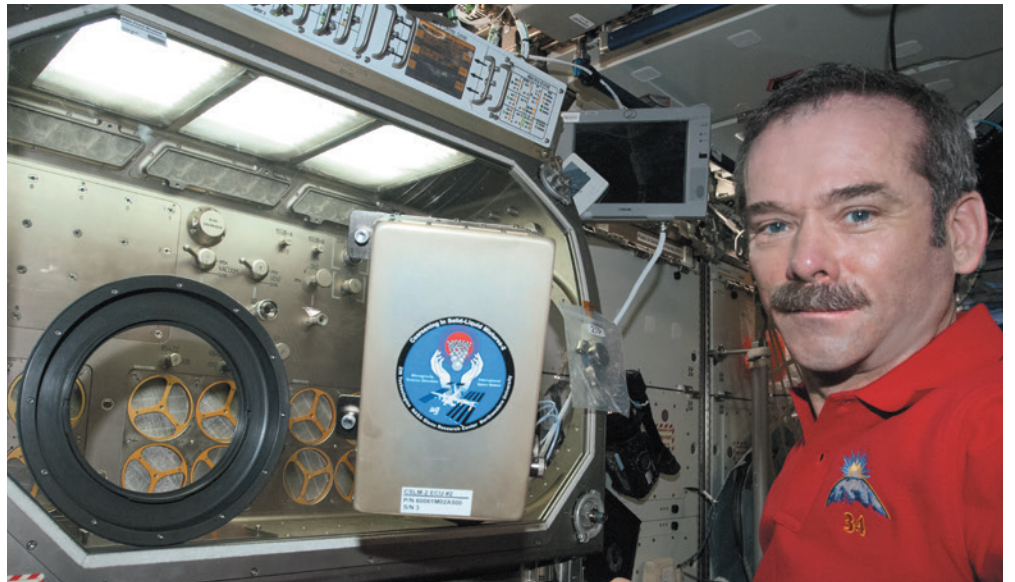
John F. Aberson '52*
Patricia F. Aberson
Todd Abraham and Anne Opila
Dongchan Ahn MS '94, PhD
'97 and Debra J. Ahn
Elizabeth Toof Anderson
MSED '59
Grant C. Anderson '98
Thomas E. Anderson MS '91
and Lynn T. Anderson
Teruaki Aoki PhD '70
Nitu Arora '88
Nicholas N. Bailey '97 and
Miranda Lin Bailey
Michael F. Barnes '74
Kay Howard Barney '47,
MS '49
Ralph W. Behrens '62
Michael W. Belin
Paul D. Berndt '84
Viresh Bhatia '88
Ricardo Braga and Sonia Braga
Neil L. Bretthauer and Vicki
Whamond Bretthauer MMgt
'82
Roger O. Brown and Barbara
Brown
Karen Dombro Cagle '79 and
Robert C. Cagle
Norman Carlson
Norman W. Carlson '81, MA/
MS '83, PhD '86 and Susan
Slagell Carlson '87
Stephen H. Carr and Virginia
McMillan Carr MS '71, PhD
'76
Huachen Chen MS '81 and
Felicidad Chen
Zhen Chen

Polly G. Cherner
Paulus F. Chew '84
Tsu-Wei Chou MS '66
Kooyoung Peter Chung
PhD '93
C. Clair Claiborne PhD '84 and
Patricia A. Claiborne
Anne C. Clark MS '85 and
Alexandros Hasson
Scott F. Clugston MS '82
Alan S. Cohen MS '69, PhD '71
and Natalie Krewitsky Cohen
'68, MA '71
Morris A. Cohen MS '71,
PhD '74
Sanford Cohen '58
Gregory S. Collins '88 and
Elain F. Collins
Randall E. Collins '74 and
Karen Lilianstrom Collins
'75
Sean Lawrence Corcoran
MS '97
Eugene M. Cummings '63
Richard G. Cunningham '43,
MS '47, PhD '50 and Suzanne
Barrett Cunningham '45
Kurt P. Dammermann '90
Charles F. Davis Jr. '48, MS '49
and Patricia L. Davis
Richard F. Davis '64, MS '66
Elizabeth K. Dean
Guy H. Deboo '76 and Susan
Mary Franzetti '76
Wolfram Karl Deutsch PhD
'98
Daryl Ditz and Nimmi
Damodaran
David A. Dixon '63, MS '64,
PhD '66
Donald A. Dobson '50, PhD '55
Justine Dube Donnelly
MBA '00, MEM '00 and
Matthew W. Donnelly
Adam R. Draizin
William R. Drake '77
Charles B. Dunne III '69
Allan B. Edwards '56, MS '57
and Nancy Huebner Edwards
'54
Lee A. Eggherman '62
Edward A. Euler '65, PhD '68
and Amy Drnec Euler
Larry G. Evans PhD '71

Willard S. Evans Jr. '77, MMgt
'81 and Debra Halbert Evans
'79
Farhad Aspy Fatakia '08
Christian M. Fernholz '93
William L. Firestone PhD '52
Alan R. Fisher '55
John E. Flinn MS '67
Steven D. Fox '92
Marvin E. Garrett '63, MBA
'65 and Judith Wasilko
Garrett '64
Edwin P. Garst '70 and Karen
Patton Garst '72, MS '74
Leonard L. Garver '56, MS '58,
PhD '61
Thomas H. Getz '62, JD '65
Steven Gilbert MS '86 and
Jennifer Gilbert
M. Fred V. Glock Jr. '67 and
Holly Kuruze Glock '70
Stephen T. Gonczy PhD '78
William J. Gorge '87, MBA
'92, MEM '92 and Stacia W.
Gorge
Rahul Goyal '99 and Jenny
Wang Goyal '99
Philip H. Graham '60 and
Linda Robinson Graham '60
Eric P. Granberg '82
Brittany Martin Graunke '07
Darren D. Grayson '92
Daniel R. Greenberg '80, MS
'80
Mark Greenberg and Carol
Greenberg
Donald Greenhalgh and
Martha Greenhalgh
James E. Greenlee '66, MD
'70, GMER '76 and Raylene
Benson Greenlee '69
Steven Abraham Gross '76 and
Julia L. Winston
Nicole R. Grove Ellis '93
Matthew P. Gubiotti '99
Paul R. Gudonis '76
Donald G. Gwinn MSED '65,
PhD '72 and Joanna Hall
Gwinn '66, MSED '67, MMgt
'83
James Reid Hahn III MS '88
Jeffrey Halpern and Elissa
Cohen Halpern
John R. Hammer '81
Peter S. Hanson '90
Edward T. Harley '49

- Carolyn Larson Harman '48*
Bruce S. Harrison '82 and Sharon Harrison
Warren R. Haug MS '63, PhD '65 and Karen N. Haug
George T. Hawley '60 and Charlotte J. Hawley
Kenneth J. Hemmelgarn Jr. and Terri L. Hemmelgarn
Clyde E. Henderson '73 and Janis Henderson
Mark Hennessy and Tracey Hennessy
Howard N. Henry '71, MMgt '78
Richard N. Herman '55, MS '59
Nancy J. Hermanson '83
David Curtis Hinton '95
Craig V. Hodson '69
Carl J. Holdampf '51 and Margaret Miller Holdampf '51
Roy Y. Hori MS '73, PhD '81
Paul A. Humiston Jr. '60 and Gretchen Bower Humiston
Arthur P. Hurter '56, MS '58, PhD '62 and Florence E. Hurter
Michael Jacobson and Trine Sorensen-Jacobson
Paul A. James '70 and Pamela Butler James '71
Dennis C. Jans '72, MMgt '76 and Georgia Yeager Jans '72
Jeffrey P. Kao '97
Donald Kaplan and Evelyn Karson
Ali Kassamali and Teresa Kassamali
Philip A. Katen '99
Michael D. Keer '85, MME '86
James M. Kennedy
Robert D. Kersten MS '61
Robert J. Kiep '88
Janet E. Klein '81
William C. Knodel '61 and Elizabeth Torrey Knodel '58
Jack A. Koefoot '46
Tom C. Krejcie '74 and Valerie Krejcie
Robert J. Kudder MS '72, PhD '78
David B. Larimore '68
Sang-Ho Lee PhD '93
Ven-Gen Lee PhD '93
- Jeffrey Richard Lefebvre MS '86, PhD '92 and Julie Kompare Lefebvre '87
Robert E. Leigh '54, MS '59 and Elaine Leigh
Gary Francis Leung '88, '88 and Ma Bethzaida Ladisla
Steve Liao '92
Richard J. Long '65
Robert A. Long '81 and Sheryl Loyd Long '81
Michael C. Madsen '68
Herbert Malin MS '51
Terence H. Marshall '77, MBA '94, MEM '94
Patrick R. McCarter '98
Michael K. McEvoy and Karen McEvoy
Myron J. McKee Jr. '48
Gregory W. McKinney MS '81 and Nancy Lubich McKinney
Arthur S. Mehner MS '68 and Kay Mehner
Gaylord M. Messick '61
Bill Millar '70 and Barbara J. Millar
Warren P. Miner '59 and Sandra Schultz Miner '58
David Mintzer and Justine Klein Mintzer
Lyle F. Mockros '56, MS '57 and Glenda H. Mockros
James Morreale '84 and Patricia Anderson Morreale '83
Milton M. Morris '92, MBA '04 and Renee Rhoten Morris
Clifford A. Moses '65, PhD '74
Robert L. Mullen PhD '81
G. Thomas Munsterman '62 and Janice T. Thompson
Michael J. Murphy '95, '95
Philip David Murray '78, MS '78 and Leslie Murray
George L. Nemhauser MS '59, PhD '61 and Ellen Krusaw Nemhauser '61
Nels Peter Nordquist and D. Berinstein Nordquist MSJ '90
Scott G. Norquist '95 and Penny Norton Norquist '96
William I. Nowicki '79 and Elizabeth R. Nowicki
Peter J. Nowobilski '81 and Dorota Nowobilski
- William B. Olson '51 and Jeanne Caldwell Olson '50
Fred J. Osborne '83, '83
J. M. Ottino and Alicia I. Loffler
Robert M. Packer '81
Garol A. Partoyan '59
Marci Zapolsky Peller '86 and Paul A. Peller '86
Jason Michael Perlewitz '01
Robert L. Peskin MS '75, PhD '77
Gerald T. Petersen '57, CERT '74 and Carol Krametbauer Petersen '56
Richard A. Phelan '43 and Edith Van Tuyle Phelan '46
Robert A. Phillips '63, MS '65, PhD '72
Robert J. Plaschke '85 and Elizabeth Tweedie Plaschke '85
Kimon Proussaloglou MS '88, PhD '92 and Popi Proussaloglou-Siziopikou
Mark S. Pucci PhD '82
Dong Qian PhD '03
Donald E. Rathbone MS '57
John S. Reilly '95 and Cynthia L. Mount '95
Anthony J. Risica MS '81
Donald E. Rome '77
Melvyn L. Rumerman MS '65, PhD '68 and Millie Rumerman
Kanji Sahara MS '59, PhD '61
Gilbert T. Satterly Jr. MS '65
William E. Saul PhD '64
Timothy J. Scale MS '75, PhD '80 and Loral L. Briggs '73, PhD '78
Leslie Schaffer and Gloria Schaffer
Alan L. Scharff '46 and Sandra Evelyn Scharff
Sandra Schiller
Logan H. Schlipf '51
John H. Schmertmann MS '54, PhD '62 and Pauline G. Schmertmann
Walter G. Schmid MBA '71 and Leslie Adickes Schmid MBA '98
Brian Lloyd Schmidt '85, MMUS '88 and Emily Muly Schmidt '91
- Joseph L. Schofer MS '65, PhD '68 and Nancy L. Schofer
John K. Scholvin '89
Deborah Lee Schuh '82
William E. Schultz MS '67 and Virginia G. Schultz
James A. Schuyler '68, MS '71, PhD '73
Arnold M. Schwartz '76
Bruce H. Schwartz '82 and Sheila Jurzyna Schwartz '82
Lyle H. Schwartz '59, PhD '64
Stephen B. Schwartz '57 and Nancy Astrof Schwartz
Robert W. Semmler '50
Gwynne Rowley Shotwell '86, MS '88 and Robert F. Shotwell
Gregory D. Showalter '83 and Gloria J. Showalter
Verneta Simon MS '93
James C. Skelton '64
Russell M. Smith Jr. '76
Hee Kwon Song '91 and Christina S. Chu '90
J. Howard Speer Jr. '53 and Catherine Kerins Speer '52, MA/MS '53
Jeffrey Staab '83 and Sara Hippe Staab '84
Gregory M. Stanley MS '74, PhD '77 and Linda Wang Stanley MMgt '76
Ronald Star and Faye Star
William R. Steffey MS '97
Stuart Stock '77, MS '78 and M. Christine Janicke Stock '79, MD '81, GMER '84, GMEF '85
Burton L. Streicher '72
Theodore A. Struve '57, MS '64, PhD '65 and Gail Reinholtzen Struve '57
Chin-Teh Sun MS '65, MS '67
Jen-Chun Sung PhD '87
Shelly Sung
Mary L. Szymkowski '85
Ronald J. Tabar '73 and Margaret Tabar
Gazel Manette Tan '74, MS '77
Gary F. Teletzke '78
Charles R. Thomas and Marilyn McCoy
Audrey Seelig Timkovich '85
Jeffrey J. Toman '78, MS '78 and Mary Toman
- John M. Torkelson
Andrew Joseph Towarnicky '07, MS '08
John J. Tracy and Katherine K. Tracy
Koichi Tsuchiya PhD '91
Dogan Turhan MS '70
Paul D. Ulland '66 and Judy Ulland
Vijay K. Varadan MS '74
Jeffrey M. Veis '84, MMgt '91 and Anne Pierson Veis '87
Prashant R. Velagaleti '02, MPD '07
Giulio Ventura
Jerome E. Vielehr '57
Mary M. Vondrak '82 and Patrick Kirk '81
Harvey E. Wahls '54, MS '55, PhD '61
Samuel A. Walker III MS '71 and Joanne Walker
Chung-Yi Wang MS '92
Samuel Chih-Hung Wang MS '75, PhD '79 and Sujane Chang Wang MS '78, PhD '81
Sheldon Wang
Glenn C. Wantha '85
Nina Joag Waranica '85 and Gregory P. Waranica
Raymond Noble Wareham '70
Michael J. Warga '80 and Susan Hague Warga '81
Paula Chambers Waterman '97 and Jeffrey S. Waterman '95, MSED '06
Darryl J. Weiman '74
Howard J. Weiss MS '73, PhD '75 and Lucia Beck Weiss
Bruce W. Wessels
James T. West '48
Mark Wharton '82 and Nancy Wharton
Molly Wells Williams '63 and Roger G. Williams
Donald R. Wilson '46
Alan Wolff MSC '96, PhD '08 and Vivian Wolff
Walter Wundrow '80 and Diane Wundrow
Shaoping Xiao PhD '03
Barry L. Yang PhD '84
Thomas J. Zlatoper MA '74, PhD '80

* deceased



MCCORMICK EXPERIMENT BLASTS OFF INTO SPACE

The Dragon, the SpaceX vessel that delivered 1,200 pounds of supplies to the International Space Station in March, also carried precious scientific cargo—including a set of experiments that studied crystal formation in space for **Peter Voorhees**, Frank C. Engelhart Professor of Materials Science and Engineering, and graduate student Thomas Cool.

Six one-foot-long furnaces, each holding tin crystal formations known as dendrites, underwent a series of carefully regimented tests at the space station that can't be conducted on Earth. In the absence of gravity, researchers can more fully understand the growth of dendrites, snowflake-like shapes that form when a metal or other material solidifies. Back on Earth, that knowledge could translate into better high-performance materials for aerospace and other applications.

With space station astronauts on a strict schedule, the experiments were designed to run autonomously. Following a book of instructions, the astronauts—including Chris Hadfield of the Canadian Space Agency (pictured above)—only had to place the furnaces into a laboratory module called the Microgravity Science Glovebox, connect the proper ventilation, and flip a switch. However, they had to return periodically to change the furnaces and troubleshoot problems.

The Dragon marked the second nontest launch by the private space company SpaceX. McCormick alumna **Gwynne Shotwell** (BS mechanical engineering '86, MS '88) is the company's president.



CLASS NOTES

1950s

Lee R. Olson ('51, MS '52) is a former vice president and director at Stauffer Chemicals in Westport, Connecticut. After retirement he helped coach volleyball at John Jay High School in Cross River, New York, for 15 years.

Edward F. Harris (MS '52) worked for Motorola after graduate school and then launched his own business, Mark Products Co., in 1954. Now retired, he enjoys his favorite hobby, amateur radio. His wife, Vera Zaretsky Harris (Weinberg '43), died in 2008.

Milton Staackmann ('55) is an assistant specialist at the Hawaii Natural Energy Institute, a research arm of the School of Ocean and Earth Science and Technology. His next birthday will be his 80th.

Len Garver ('56, MS '58, PhD '61) received the Charles Concordia Power Systems Engineering Award from the Power & Energy Society of the Institute for Electrical and Electronics Engineering in 2012. The award recognized his 33-year career in the electric utility systems engineering department of General Electric, where he developed methods for planning and evaluating electric power systems. He retired in 1994.

1960s

Robert D. Kersten (MS '61) has retired as dean and professor emeritus at the University of Central Florida in Orlando. He received the 2012 Golden Vector Award from the Pan-American Federation of Engineering Associations.

Joseph E. Doninger (MS '62, PhD '65) has been appointed director of manufacturing and technology for Focus Graphite.

Charles A. Wentz Jr. (PhD '62) has been named to the board of directors of the Lessie Bates Davis Neighborhood House in East St. Louis, Illinois. He also led his church's efforts to create a mission vegetable garden to benefit several food pantries. In 2012 the half-acre site produced more than 16,000 pounds of vegetables.

Phillip L. Gould (MS '66), a senior professor at Washington University, has been named a distinguished member of the American Society of Civil Engineers, the society's highest accolade. The honor was given for developing innovative technology to design and construct large cooling tower shells; applying finite-element technology to develop prosthetic heart valves; and promoting earthquake hazard mitigation through research, teaching, and leadership. Gould has also received the Earthquake Engineering Research Institute's Alfred E. Alquist Special Recognition Award.

Donald J. Massaro (MS '67) has been appointed president, CEO, and board member of the e-commerce software company Rainmaker Systems.

William "Bill" Huxhold ('68), professor and chair of the Department of Urban Planning at the University of Wisconsin-Milwaukee, received the 2012 Education Award from the University Consortium for Geographic Information Science.

Ronald D. Neufeld (MS '69, PhD '73), professor of civil and environmental engineering at the University of Pittsburgh's Swanson School of Engineering, was named a 2012 Water Environment Federation Fellow.

1970s

Raymond Noble Wareham ('70), former senior managing director for Bernstein Global Wealth Management, has joined the investment management firm Rockefeller & Co. as managing director and senior client adviser.

Robert J. Kudder (MS '72, PhD '78), a structural engineer, is a senior consultant at Raths, Raths & Johnson in Willowbrook, Illinois. He received the Award of Merit and the title of fellow from the ASTM International Committee E06 on Performance of Buildings.

Grayson Marshall (PhD '72, D86) is a distinguished professor emeritus at the University of California, San Francisco. He received an honorary doctorate from Malmö University in Sweden in 2012.

Peter J. Barris ('74), managing general partner of New Enterprise Associates, has announced plans for the venture capital firm to open an office in Chicago.

Promod Haque (MS '74, PhD '76, Kellogg '83) has been promoted to senior managing partner at Norwest Venture Partners.

Michael McCracken ('76) has written his first novel, *Kiss and Smell* (CreateSpace, 2012), a mystery about an eccentric detective and his ever-present canine partners. McCracken is a management consultant and amateur photojournalist when he is not writing or working with dogs.

David Goldberg ('78) has retired from ExxonMobil after 33 years and is living in an oceanfront community in Orange County, California, with his wife of 31 years, Blanca.

Virginia M. Rometty ('79), CEO of IBM, has become chairman of its board. Rometty was profiled by CNN Money after being ranked No. 1 on the *Fortune* 2012 "50 Most Powerful Women in Business" list.

Brian A. Strzalka ('79) has been named CEO of ET Technology (Wuxi). A privately held company with locations in Wuxi, China, and Bremen, Germany, ET Technology specializes in the design and production of sectional and rolling garage doors, operators, and door components.

1980s

Alexander James Darragh (MS '80), a chemical engineer and innovator in the graphite industry, has been appointed by CBRE Group, a commercial real estate services firm, to oversee global corporate services in Canada, Latin America, and the Caribbean.

Yogi Bhardwaj (MEM '83) has joined Resources GCS as chairman.

Bradley S. Schneider ('83, Kellogg '88), managing principal for Cadence Consulting Group, has been elected to the US House of Representatives from Illinois's 10th District.

Catherine S. Greenberg ('84), a founding partner of Cleargreen Advisors, has been named vice president of sustainability for Xanterra Parks and Resorts.

Jay Behrens ('85) leads the product development, management, and marketing efforts at HyperCube after retiring from Verizon. HyperCube evolved from a traditional tandem carrier into a fast-growing provider of IP-enabled services.

Steven McLaughlin ('85) is the Steve W. Chaddick School Chair in the School of Electrical and Computer Engineering at Georgia Institute of Technology. He had been vice provost for international initiatives at Georgia Tech.

Jay Goldberg (MEM '86, PhD '98) was recognized at the 2012 National Society of Professional Engineers annual meeting as a recipient of its prestigious Engineering Education Excellence Award.

Martha Jahn Martin ('86) has been elected secretary of the Union League Club of Chicago. She is a third-generation member of the family that owns Chicago Metallic Corp., a 119-year-old business in the acoustical ceiling industry. She is vice president of human resources, secretary, and member of the senior management team.

Mark A. Moore ('86), a veteran in the field of product development and engineering, has been appointed senior vice president of products for Recommind, a provider of predictive information management and analysis software.

Carla S. Vaughan ('86), an engineering supervisor with Huntington Ingalls Industries' Newport News shipbuilding division, received a Technology All-Star Award at the 17th annual Women of Color STEM Conference recognizing achievements in science, technology, engineering, and math.

Brad Charles ('87) is senior director of operations planning and logistics at Pepperidge Farm in Norwalk, Connecticut. He previously worked at PepsiCo Americas Beverages for 14 years.

Steven Kramer (MS '87), has joined HNTB Corp. as vice president and southeast division sales officer in its Arlington, Virginia, office. He is responsible for sales, marketing, and project development of transportation infrastructure in the southeastern United States.

Christopher Clower ('88) is executive chairman of Western Manganese, an Australian mining company.

Steven Roland Schmid (MS '89, PhD '93), associate professor of aerospace and mechanical engineering at the University of Notre Dame, has been named an ASME Foundation Swanson Fellow and assistant director for research partnerships in the Advanced Manufacturing National Program Office at the National Institute of Standards and Technology.

1990s

Christopher Austin ('91), a partner at Michael Best & Friedrich in Milwaukee, has been listed as a leader in the intellectual property field by *Chambers USA: America's Leading Lawyers for Business*.

Dennis K. Bonn (MEM '92), vice president of marketing at Menasha Packaging in Wisconsin, has been appointed to the Michigan State University Packaging Alumni Association board of directors.

Rajpaul S. Attariwala (MS '93, PhD '97) has been appointed medical director of Premier Diagnostic Health Services.

David C. Thomsen ('94), a product designer previously with consulting firm IDEO, has become executive vice president of product and design for Wanderful Media, a digital local-discovery shopping company.

Jeffrey Waters (MEM, Kellogg '94), senior vice president and general manager of Altera Corporation, has been named to a semiconductor member position on the board of directors of the Global Semiconductor Alliance.

Charles Blumberg ('95), information technology manager at Kemper Corp., spent a week in Haiti in April 2012 with Fish Ministries, a program that creates a sustainable food source for the local population. He built chicken coops and a greenhouse at a school and orphanage.

Matthew Darling ('96) has a new position as lead materials engineer in ABB's high-voltage cables division.

Don Dennis ('97) has been sworn in as an attorney in California.

Craig Witsoe (MEM, Kellogg '97), previously president and CEO of Lineage Power, has been appointed CEO of Elo Touch Solutions, a supplier of touch-enabled technology.

Brian Brinkmann (MEM '98) recently joined Logi Analytics, a business intelligence and analytics software company headquartered in McLean, Virginia, as vice president of products.

2000s

Louis Pinkham (MEM, Kellogg '00), previously senior vice president and general manager with Eaton Corporation, has been appointed group president, fluid handling, with Crane Company, a manufacturer of highly engineered industrial products.

Matthew Harsh ('01) is an assistant professor of global engineering studies at the Centre for Engineering in Society at Concordia University. He had been a postdoctoral associate with the Center for Nanotechnology in Society at Arizona State University in Tempe.

Jennie Lassey Iverson ('01) has written and published *Ski Town Soups* (Ski Town Group, 2012). The hardcover, coffee table-caliber cookbook features recipes from well-known chefs and restaurants at 60 of the top ski resorts in North America.

Francis Mills ('01) is a senior engineer at Accio Energy, developing wind energy devices and high-voltage test apparatus. He has been licensed as a professional engineer in Michigan.

Mark A. Campo (MS '02), technical manager of the American Concrete Institute's certification programs, has been appointed executive director of the American Shotcrete Association.

Scott David Amsbaugh (MEM, Kellogg '04), previously vice president of sales and marketing at Brooks Instruments, has been promoted to general manager.

Beth Lopour ('04) is investigating epilepsy as a postdoctoral scholar with the Department of Neurobiology at the University of California, Los Angeles. Her husband, Dan Shrey ('04), is in the final year of his pediatric neurology fellowship at UCLA.

Jonathan Adams ('06) has joined Prudential Capital Group as an investment associate. Adams earned an MBA with honors from the University of Chicago Booth School of Business, with concentrations in finance and accounting, in 2012.

Michael Hoaglin ('06) is on sabbatical from his final year of medical school at the Perelman School of Medicine to work in New York City as clinical director in the medical unit of *The Dr. Oz Show*.

Jon Horek (PhD '06), a Chicago-based professional engineer, was chosen as a delegate to the 2012 Young Atlanticist Summit organized by the Atlantic Council and the Chicago Council on Global Affairs.

Ying Zhu "YZ" Chin ('07) has published *deter* (Dancing Girl Press, 2013), her first chapbook of poems.

Lei Cui (PhD '07) was promoted to project manager at Mars & Co., a global management consulting firm specializing in business strategy and operational improvement for major corporations.

Keith Knipling (PhD '07), a staff scientist at the US Naval Research Laboratory, received a 2012 Presidential Early Career Award for Scientists and Engineers. Knipling became a National Research Council fellow at the NRL in 2006.

Alice Zhao ('08) is a systems integration and technology analyst for Accenture. She was one of three recipients of a 2012 graduate fellowship from the Alumnae of Northwestern University. She is in the inaugural class of Northwestern's Master of Science in Analytics program.

Pelayo Cortina Koplowitz ('09), an analyst with the global energy fund Ecofin, has been appointed to the board of directors of Northern Gold Mining.

Michael J. Parrott ('09) has joined Mars & Co., a global management consulting firm specializing in business strategy. He is an associate consultant in the firm's Greenwich, Connecticut, office.

2010s

Eric DeFeo ('11) has been promoted to senior associate consultant at Mars & Co., a global management consulting firm specializing in business strategy and operational improvement for major corporations.

Send us your news!

Please email your news to
magazine@mccormick.northwestern.edu

CLASS NOTES

In Memoriam

Donald C. McGrane '33, MS '34
 Leonard E. Meyer '33
 Granville M. Green '37
 Norman E. Myers '38
 Frederick A. Groenke '39
 Eric Yondorf '43
 Leroy M. Anderson '44
 John F. O'Halloran '44
 William R. Buechler '46
 Michael Sivetz '46
 Paul B. Jacob Jr. '48
 G. R. Kruger '48
 Edward J. Leibrock '48
 Milbourne "Ed" Lord Jr. '48
 George M. Brown '49
 Robert E. Gustafson '49
 Charles H. Harker Jr. '49
 George W. Jandacek '49
 Joseph J. Moder '49
 Glenn F. Park '49
 Jack L. Spangler '49
 Thomas E. Prendergast '50
 Don B. Schiewetz '50
 Karl H. Siegmund '50
 Paul N. Stevens '50, MS '51, PhD '55
 Frederick A. Fluegge '51
 Craig F. Metheny '51
 Charles E. Swanson '51
 Albert J. Wilson '51
 William S. Ruxton '52
 John Allen Haase '53
 Glen P. Winton '53
 William D. Baasel '54
 Tingye Li '55
 Arnold D. Kerr MS '56, MS '58
 George J. Kidd Jr. '56
 Donald K. Hendershott '57
 Philip E. Novak '57
 Glenn M. Reiter '58
 Alfred A. Hendrickson, PhD '60
 Roger I. Oslund '61
 Heinz Schwarz '61
 Andy V. Ananthakrishnan '62
 John L. Cooper Jr. '62
 Frederick G. Heineken '62
 Alan S. Borg '63, Kellogg '65
 Pierre C. Gehlen PhD '66
 Karl K. Nesbeitt '66
 Homer R. Schwartz '66
 Michael G. Kovac MS '67, PhD '70
 Richard W. Srch '68
 Robert B. Herring '69

Klaus M. Langeneckert MS '69, PhD '71
 Harold C. Seamans '69
 John W. Caldwell '71
 Kathryn Plummer Daugherty '73
 Raymond J. Glatthorn '73
 Edmund K. Lai '78
 Raymond D. Niehaus '80
 Laura A. Olvey '84
 Mark Raymond Rizzo '85
 Brett A. Myers '93
 Justin Michael Carter '95
 Karen Kay Greig MEM '06, Kellogg '06

McCormick Alumni and Friends Honored

Alumni, friends, and a former staff member of McCormick were honored at the annual Northwestern Alumni Association awards banquet in March.



Robert Shaw ('70) and **Charlene Shaw** (Weinberg '70) each received an Alumni Service Award in recognition of loyal service rendered voluntarily to the University. Charlene Shaw has served as a member of the Northwestern Alumnae Board and the Weinberg College of Arts and Sciences Board of Visitors. Robert Shaw has mentored students through

McCormick's NUvention course and has served on the boards of five student startup companies. He has been involved in the development of new programming through the Farley Center for Entrepreneurship and Innovation and the Segal Design Institute. He has served on several advisory boards at McCormick, including the McCormick Advisory Council and the Mechanical Engineering Advisory Board.



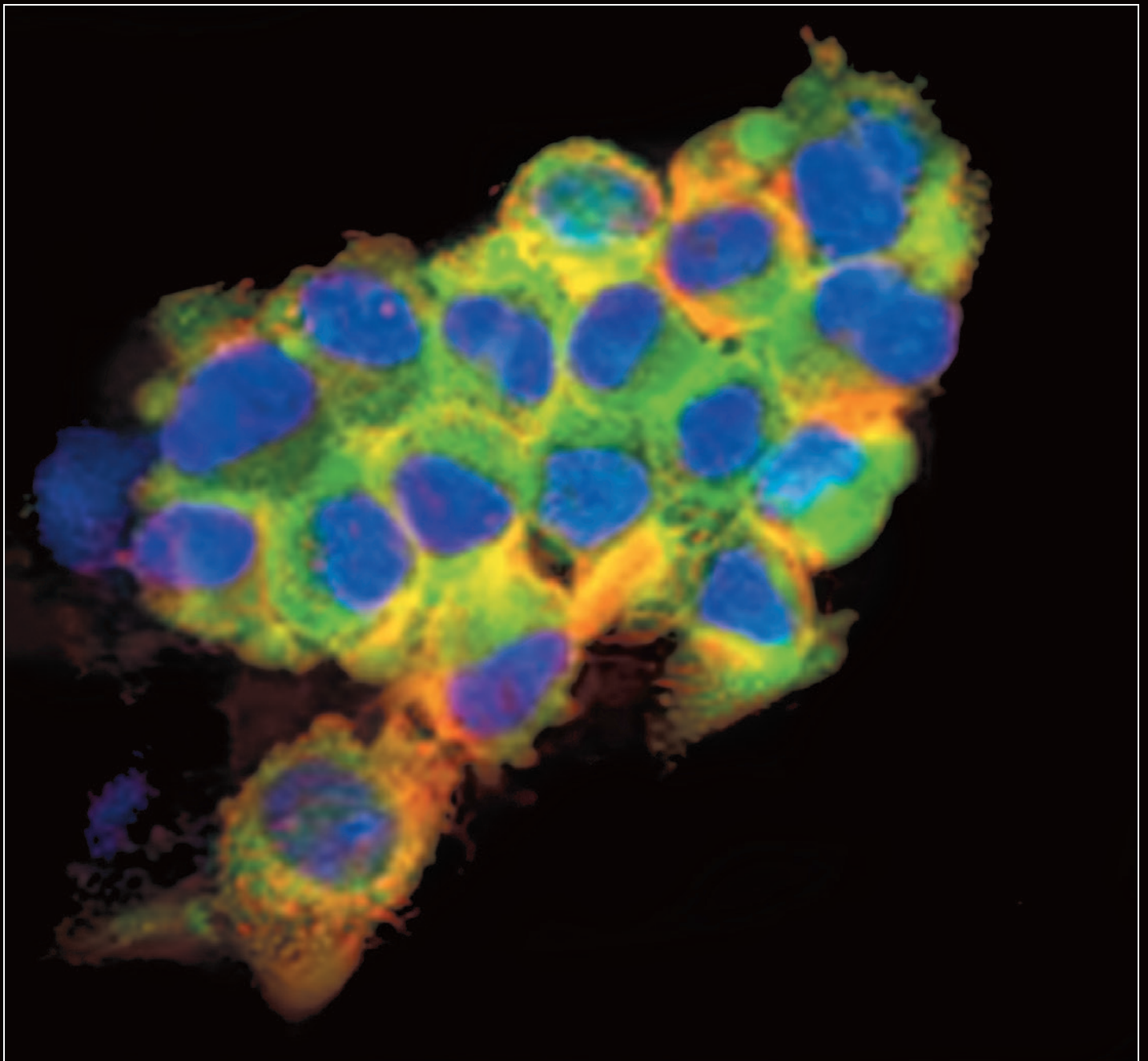
Lonnie E. Haefner (PhD '70) received the Alumni Merit Award for high achievement in a profession or field. He is a professor emeritus at Washington University in St. Louis and president of L. E. Haefner Enterprises, a corporation involved in the study, financing, and marketing of transportation engineering and capital-intensive real estate development projects. He has contributed to the transportation engineering field through

teaching, research, and practice and has held national committee chairmanships with the Transportation Research Board and the American Road and Transportation Builders Association.



Carolyn Krulee (MSED, School of Education and Social Policy, '69), who was also honored with an Alumni Service Award, worked for many years at McCormick, first as a secretary and then as assistant dean. During that time she formed a task force to increase the enrollment of women in engineering studies. She also developed a course that introduced junior high and high school students to computers, and she helped design an

engineering program, now known as EXCEL, for entering students who are committed to diversity issues.



the art of engineering

Vinayak David, professor of materials science and engineering, has been advancing “theranostics”—a combined approach that uses nanostructures to both diagnose and treat disease—for cancer and Alzheimer’s disease. His group uses magnetic nanostructures as localized high-contrast agents for magnetic resonance imaging and for activation of therapeutic heat generated by external radio frequency fields. The figure above shows use of these nanostructures in brain tumor cells. Blue represents the cells’ nuclei, while green and red identify cancer markers targeted simultaneously by distinct antibody-functionalized magnetic nanostructure systems. David’s group believes that the combination of targeted imaging and thermal activation has the potential to replace conventional cancer diagnosis and therapy.

**Robert R. McCormick School
of Engineering and Applied Science
Northwestern University**
Technological Institute
2145 Sheridan Road
Evanston, Illinois 60208-3100

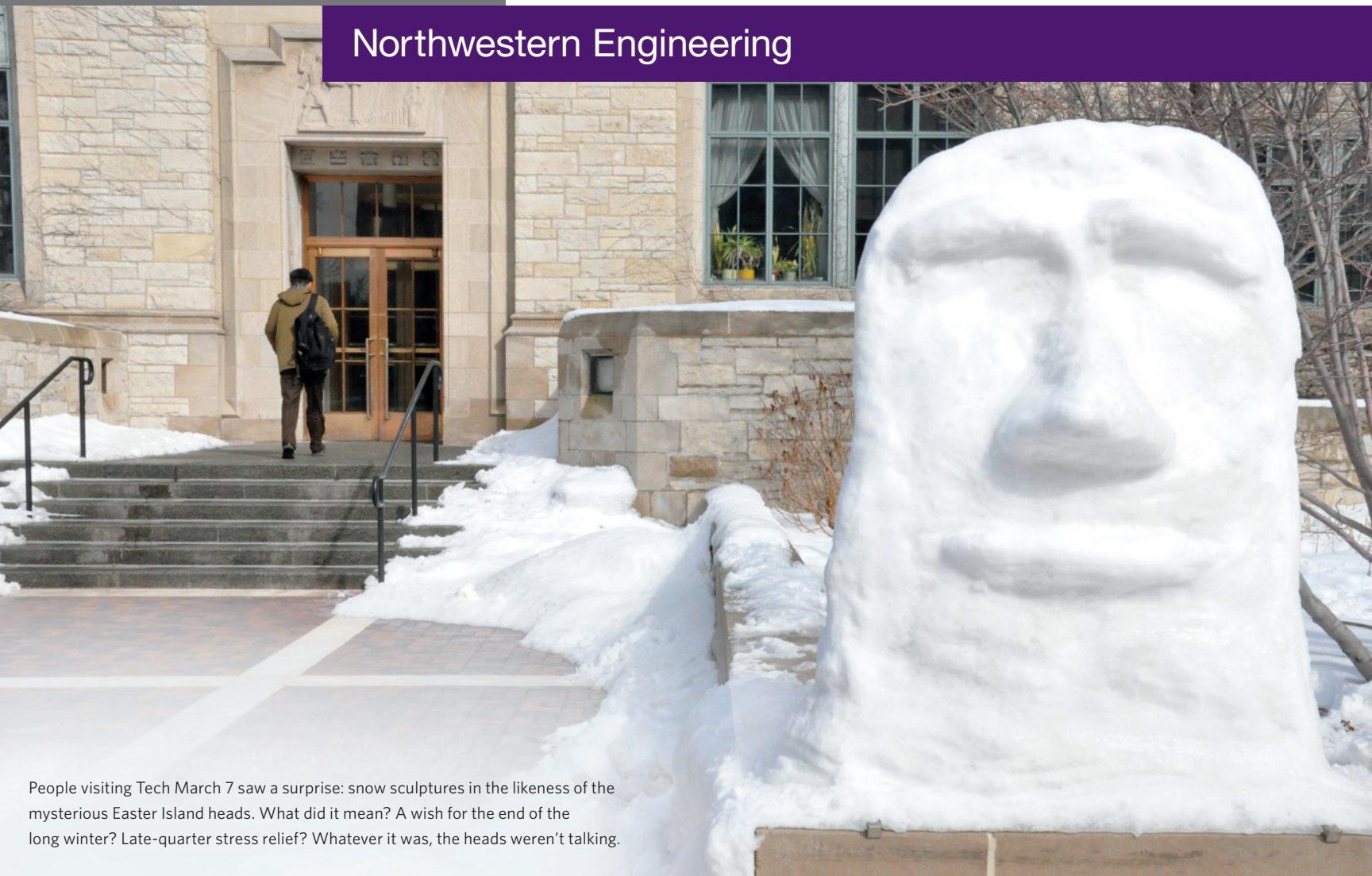


NORTHWESTERN
UNIVERSITY

Nonprofit Organization
U.S. Postage
PAID
Northwestern University

McCormick

Northwestern Engineering



People visiting Tech March 7 saw a surprise: snow sculptures in the likeness of the mysterious Easter Island heads. What did it mean? A wish for the end of the long winter? Late-quarter stress relief? Whatever it was, the heads weren't talking.