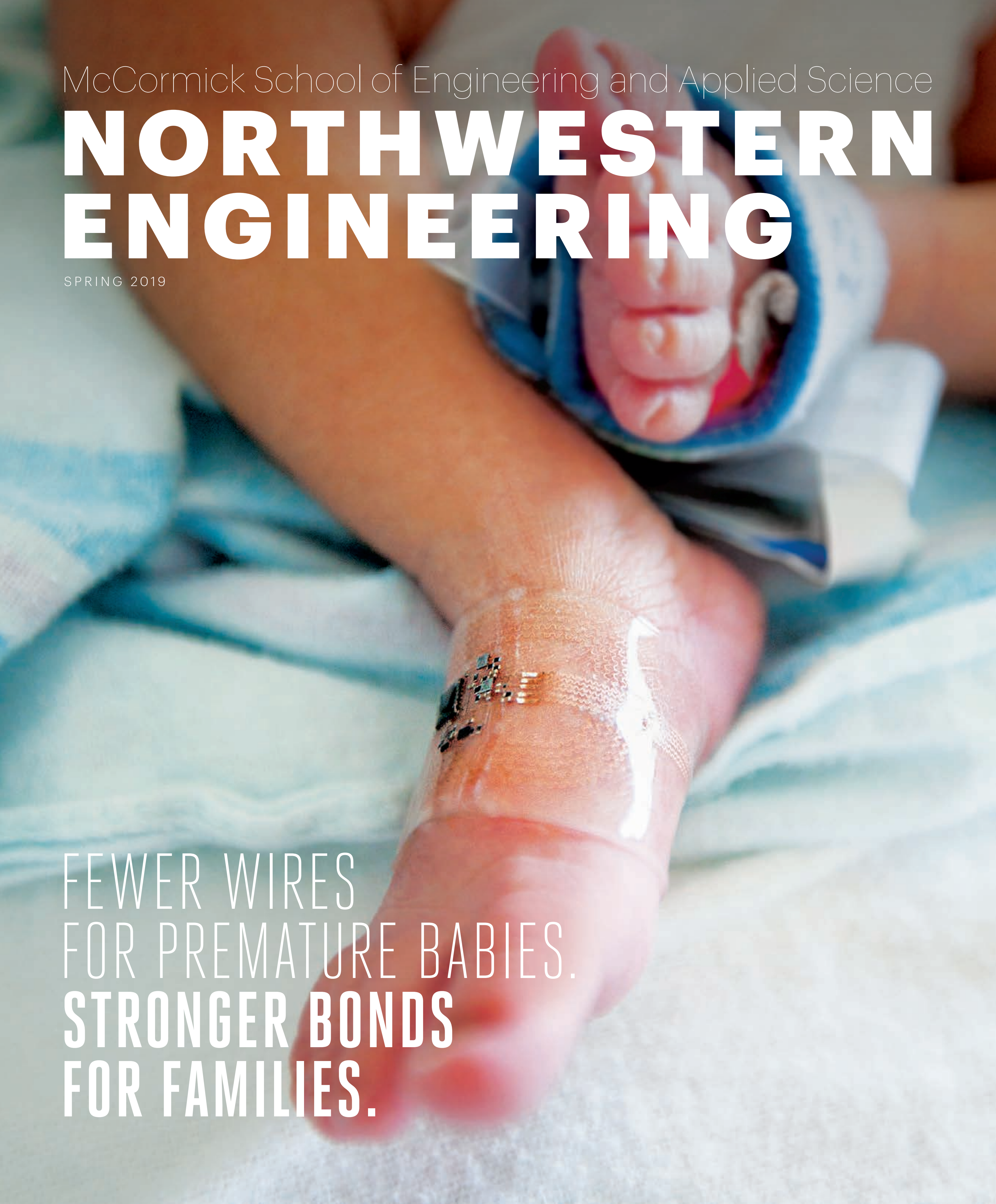
McCormick School of Engineering and Applied Science

NORTHWESTERN ENGINEERING

SPRING 2019



FEWER WIRES FOR PREMATURE BABIES.
STRONGER BONDS FOR FAMILIES.

ART ACNE

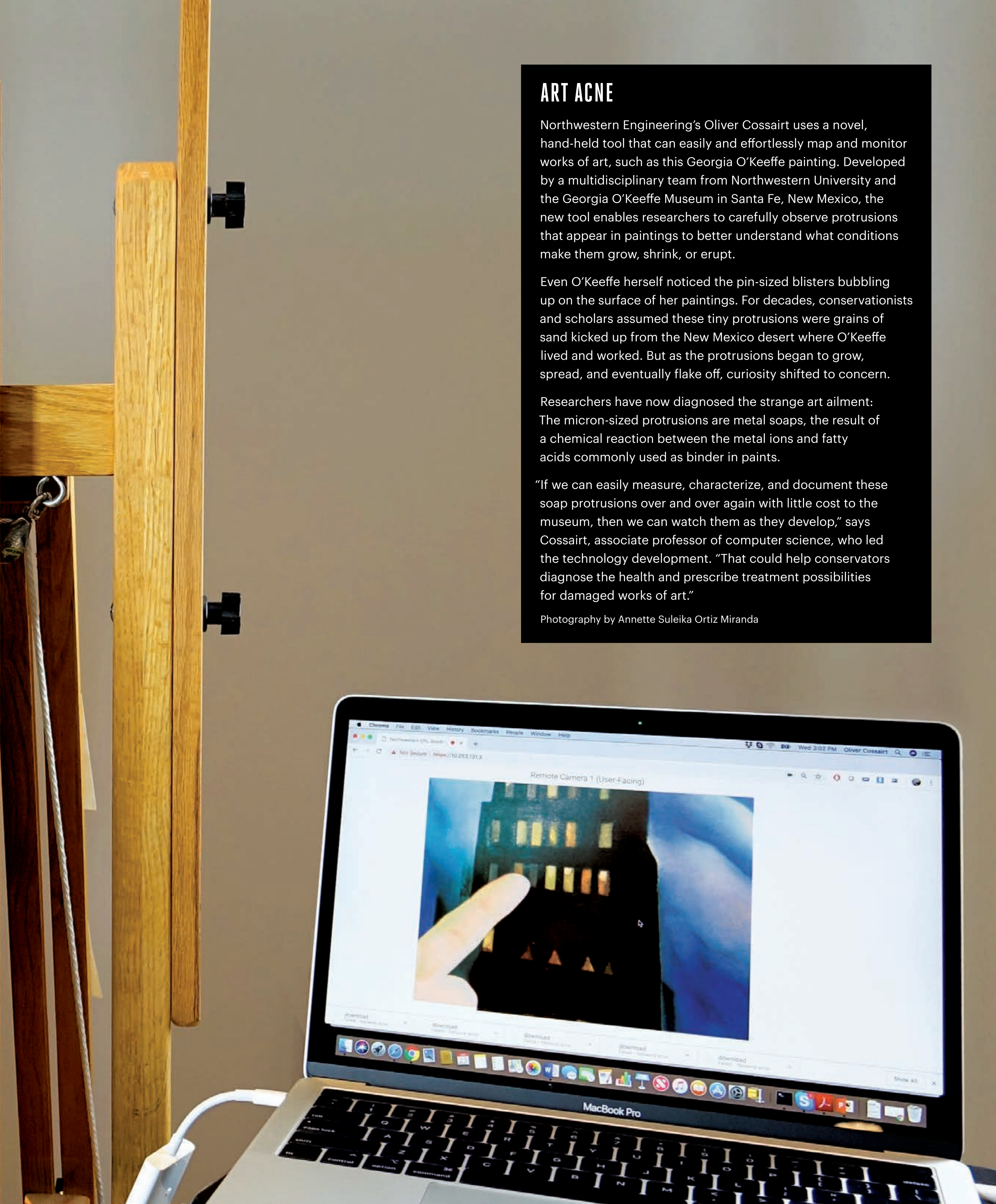
Northwestern Engineering's Oliver Cossairt uses a novel, hand-held tool that can easily and effortlessly map and monitor works of art, such as this Georgia O'Keeffe painting. Developed by a multidisciplinary team from Northwestern University and the Georgia O'Keeffe Museum in Santa Fe, New Mexico, the new tool enables researchers to carefully observe protrusions that appear in paintings to better understand what conditions make them grow, shrink, or erupt.

Even O'Keeffe herself noticed the pin-sized blisters bubbling up on the surface of her paintings. For decades, conservationists and scholars assumed these tiny protrusions were grains of sand kicked up from the New Mexico desert where O'Keeffe lived and worked. But as the protrusions began to grow, spread, and eventually flake off, curiosity shifted to concern.

Researchers have now diagnosed the strange art ailment: The micron-sized protrusions are metal soaps, the result of a chemical reaction between the metal ions and fatty acids commonly used as binder in paints.

"If we can easily measure, characterize, and document these soap protrusions over and over again with little cost to the museum, then we can watch them as they develop," says Cossairt, associate professor of computer science, who led the technology development. "That could help conservators diagnose the health and prescribe treatment possibilities for damaged works of art."

Photography by Annette Suleika Ortiz Miranda



"In these stories and throughout Northwestern Engineering, the importance of teamwork is key to success. With our track record, you can expect to read about more life-changing wins in future issues."

GREETINGS FROM NORTHWESTERN ENGINEERING

One of the key strengths of engineering is the capability to partner with other fields to unlock new opportunities.

This viewpoint comes shining through in John Rogers's collaboration with colleagues in both the McCormick School of Engineering and the Feinberg School of Medicine to develop a pair of soft, flexible wireless sensors that replace the standard wire-based sensors used on premature babies. These new sensors monitor vital signs—heart rate, respiration rate, and body temperature—and eliminate the rat's nest of wires. This innovation is not just important for its considerable technical achievements; it makes possible the crucial bonding that occurs between parents and their tiny babies through cuddling—an impact that lasts a lifetime.

In this issue, you'll also learn about our new Center for Physical Genomics and Engineering, which examines the regulation of global gene expression. When our researchers targeted the chromatin structure to limit a cancer cell's ability to evolve resistance to chemotherapy drugs, the technique eliminated virtually 100 percent of cancer cells in cell cultures and animal models. While the work is still in its early stages, it underscores Northwestern's spot at the forefront of this emerging field that has the potential to change the course of lives by changing the course of diseases.

You'll also read how Northwestern Engineering is at the center of collaborations with eight institutions to revolutionize the creation of new materials, how our TIDAL Lab combines music with computer science to draw younger, more diverse students, and how undergraduate students in the Segal Design Institute work with scientists from Shedd Aquarium to develop tools to conduct critical research to help aquatic life, much of which faces challenges as our seas change. This type of partnership is unique to Northwestern Engineering, and our students find meaning in the work.

Also, we hear from alumni who turned their student work into successful startups—which were then bought by prominent companies.

In these stories and throughout Northwestern Engineering, the importance of teamwork is key to success. With our track record, you can expect to read about more life-changing wins in future issues.

As always, I welcome your feedback.

JULIO M. OTTINO
Dean, McCormick School of Engineering and Applied Science

On the Cover Tiny, flexible wireless sensors developed by Northwestern researchers eliminate the rat's nest of wires previously necessary to monitor premature babies' vital signs.

Photography by Sally Ryan

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

Northwestern | McCORMICK SCHOOL OF ENGINEERING

Executive Director of Strategic Initiatives and Marketing: Kyle Delaney

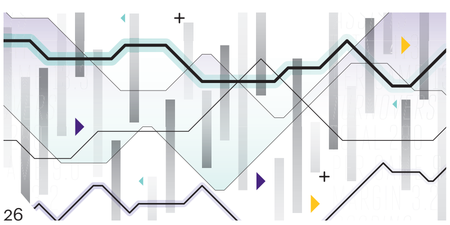
Managing Editor: Julianne Hill

Produced by The Grillo Group, Inc.

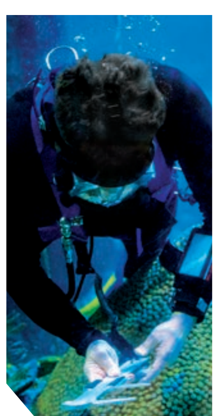

14

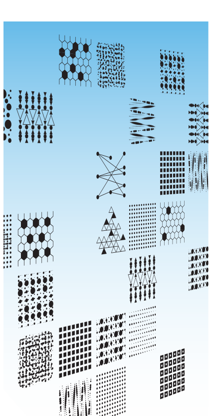

16


22


26


28


32


38


40

NORTHWESTERN ENGINEERING
SPRING 2019

NEWS

Linda Broadbelt, Wei Chen Elected to National Academy of Engineering

Northwestern Engineering Professors Linda Broadbelt and Wei Chen have been elected to the National Academy of Engineering (NAE), one of the highest professional distinctions awarded to an engineer.

Broadbelt and Chen stand among the 86 new members and 18 new foreign members announced by the NAE. They will be formally inducted during a ceremony at the NAE's annual meeting in Washington, DC.

"LINDA AND WEI ARE OUTSTANDING RESEARCHERS, COLLABORATORS, AND EDUCATORS. WE ARE EXTREMELY PROUD TO HAVE THEM RECOGNIZED AT THE HIGHEST LEVEL IN OUR FIELD."

JULIO M. OTTINO Dean, McCormick School of Engineering

MMM Students Win Kellogg Design Challenge

With nearly 160 students representing seven universities in three countries competing in the Kellogg Design Challenge, three Northwestern teams placed among the top five finalists. A Northwestern team named JDMMMBA took home the $12,000 cash prize.

The event required the 36 teams to design solutions to a challenge of overcoming behavioral and psychological barriers to adopting insulin pump therapy for type 1 diabetes patients. Medical equipment company Medtronic, which recently developed new insulin pump technology, served as the event's corporate sponsor.

The solutions, informed deeply by empathy for users, ranged from developing an app to help children manage their type 1 diabetes to using Bluetooth technology to monitor pumps. The winning solution, the Medtronic NextStep Trial Project, would encourage patients to participate in a free, three-month trial of the pump without having to give up insulin shots.

48
Number of years Northwestern Engineering has held Career Day for Girls

3
Number of Northwestern Engineering researchers elected to the American Institute for Medical and Biological Engineering's College of Fellows

16
Number of annual Edison Awards, one of which alumna Ginni Rometty received

NEW CENTER TO JUMPSTART POINT-OF-CARE TECHNOLOGIES FOR HIV TREATMENT IN AFRICA

Northwestern Engineering will lead the new Center for Innovation in Point-of-Care Technologies for HIV/AIDS at Northwestern University (C-THAN). Focused on developing and commercializing technologies critical for improved management of HIV-infected individuals in Africa, the multi-institutional center has received a five-year, $7.5 million grant from the National Institute of Biomedical Imaging and Bioengineering, Fogarty International Center, and Office of AIDS Research within the National Institutes of Health.

C-THAN will work with partners in Africa to foster an ecosystem of point-of-care technology development to better detect and monitor HIV and common comorbidities and complications, including tuberculosis, hepatitis B and C, diabetes, heart disease, and cancers.

NORTHWESTERN ENGINEERING LAUNCHES NEW CENTER FOR DEEP LEARNING

As artificial intelligence grows in prominence, Northwestern Engineering is launching the Center for Deep Learning, which will build a community of data scientists focused on deep learning to service the Midwest's research and industry needs.

Led by faculty in computer science and industrial engineering and management sciences, the interdisciplinary center will produce academic research and technological solutions in collaboration with corporate partners, ranging from Fortune 500 corporations to startups in industries like financial technology and pharmaceuticals.

NVIDIA, the company that created the graphics processing unit, or GPU, is the center's inaugural partner. The company donated the high-performance hardware that the center uses for deep learning research. "The center is an opportunity for folks in the industry to apply deep learning technology and have it actually provide business impact," Professor Doug Downey says.

"We see a lot of interest from companies in this space, a lot of interest in students coming out in this field, and it's a hot job market right now. There's recognition that Northwestern has strength in this area."

TIM ANGELL
Senior Associate Director, Northwestern Corporate Engagement

8

Number of interdisciplinary student teams that participated in the Analytics for Social Good Hackathon to benefit the American Red Cross

700

Number of patrons attending annual ETOPiA science-based theater productions, a program created by Matthew Grayson

New PhD Seminar Series Broadens Horizons

To encourage Northwestern Engineering PhD students to expand their horizons, Dean Julio M. Ottino created a new seminar series, "Whole-Brain Leadership for PhD Students," which welcomed faculty from outside Northwestern Engineering for lunchtime talks.

"Reflecting on my own study, some of the most memorable and formative ideas were gained from talks and conversations with those outside of my field," Ottino says.

Eight speakers representing disciplines ranging from theater to law to philosophy participated during the 2018–19 academic year. Along with Ottino, they included Judd A. and Marjorie Weinberg College of Arts and Sciences Dean Adrian Randolph; transdisciplinary artist Dario Robleto; Iñigo Manglano-Ovalle, professor of art theory and practice; economic historian Joel Mokyr; philosopher Sandy Goldberg; historian Ken Alder; law professor Shari Diamond; and Todd Rosenthal, professor of theatre.

ENGINEERS AND CHEMISTS AWARDED $3.6 MILLION TO STUDY QUANTUM COMPUTING

A group of Northwestern engineers and chemists have been awarded $3.6 million from the US Department of Energy to support their work of creating better qubits, the smallest unit of a quantum computer.

The grant is one of 85 research awards totaling $218 million. All focus on the emerging field of Quantum Information Science (QIS) and are expected to lay the foundation for the next generation of computing and information processing. Northwestern Engineering Professors Mark Hersam and James Rondinelli are coinvestigators on the University's portion of the Basic Energy Sciences grant project.

Possible long-term applications include quantum computers capable of solving complex problems beyond the capacity of today's most powerful supercomputers. Quantum systems also could be used to create extremely sensitive sensors with uses in medicine, science, national security, and encryption.

Engineering Solutions for Children: Workshop Promotes Innovation in Pediatric Research

Four Northwestern Engineering professors were among the researchers, engineers, and medical professionals who presented at "Sensors and Sensing: Engineering Devices for Pediatric Research and Clinical Care," a workshop on advances in technology related to data capture and clinical treatment of children.

John Rogers spoke about his wearable and bio-integrated electronic devices, while Josiah Hester discussed efforts to create tiny, energy-harvesting computer systems that he believes hold broad-scale applications in medicine.

Matthew Grayson shared research on novel sensors that are flexible and pressure sensitive, and Michael Peshkin, pictured, discussed how haptics technology could change how people interact with electronic devices. Professors from the Northwestern University Feinberg School of Medicine also presented.

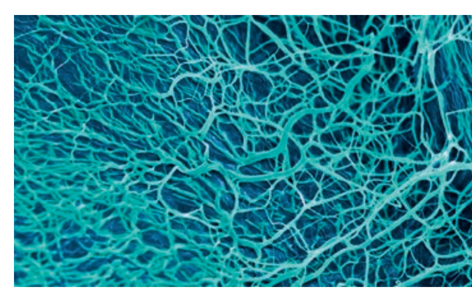
The event, which drew nearly 50 mentors and trainees in engineering and pediatrics, was sponsored by the McCormick School of Engineering, the Northwestern University Clinical and Translational Sciences Institute, and Ann & Robert H. Lurie Children's Hospital of Chicago. It was held in the James L. Allen Center on Northwestern's Evanston campus.

SPINAL FUSION CHALLENGE: SIMPSON QUERREY INSTITUTE RESEARCHERS AIM FOR MEDICAL—AND MATERIALS—BREAKTHROUGH

A research team led by Professor Samuel Stupp, director of Northwestern's Simpson Querrey Institute, has received a $3.1 million National Institutes of Health grant to explore a novel solution to bone regeneration and spine fusion.

Bone is the second-most transplanted tissue in the United States, with around 2 million surgeries performed annually. More than 500,000 of these procedures involve spine fusions, which often use autograft bone taken from the patient. Researchers have not yet discovered a universally safe and effective substitute when autograft bone is not available.

"It's very exciting for us to embark on molecular and supramolecular design of new, sophisticated biomaterials that could eliminate the need for autograft or biologics in spinal fusion surgeries and other procedures where bone regeneration is critical," Stupp says. "This will be extremely important for patients as it would decrease the morbidity associated with autograft harvesting or enable bone regeneration that otherwise would not happen."



NEW LEADERSHIP ANNOUNCED AS COMPUTER SCIENCE EXPANDS

Samir Khuller, former professor of computer science and a distinguished scholar and teacher at the University of Maryland, joined Northwestern as the inaugural Peter and Adrienne Barris Chair of Computer Science. In his new role, Khuller will lead the ongoing expansion of computer science at the University.

Also, Professor Randy Berry was named John A. Dever Chair of the Department of Electrical and Computer Engineering.

The moves come as the Department of Electrical Engineering and Computer Science separates into two.

18

Number of students presenting designs for service discovery tools to City of Chicago officials

NORTHWESTERN, SAIC STUDENTS PARTNER THROUGH DATA AS ART CLASS

Sixteen students from Northwestern and the School of the Art Institute of Chicago (SAIC) collaborated to produce information visualization projects spanning multiple disciplines and data sets as part of Design 375: Data as Art in fall 2018.

"Some projects took on visualization in a unique way that was much more visceral and had artistic properties," says Professor Larry Birnbaum. "Other projects really took environmental data and made you aware of their presence in a way that you would not normally."

"THIS CLASS SEEMED LIKE A GOOD WAY FOR ME TO TAKE SOME OF MY TECHNICAL EXPERIENCE AND MARRY THAT TO MY ART PRACTICE."

JOE BURKE ('17, EDI '18)

1972

Year the Ralph Coats Roe Medal was established, which alumna Gwynne Shotwell received

9

Types of devices from John Rogers in Museum of Science and Industry's "Wired to Wear" exhibit

163

Number of middle school and high school students at Career Day for Girls

CRAIN'S NAMES TWO NORTHWESTERN COMPANIES AS CHICAGO'S MOST INNOVATIVE

A pair of Northwestern University spin-off companies—Narrative Science and Aptinyx—claimed the top two spots on the *Crain's Chicago Business* 2018 list of Most Innovative Companies.

Ranked number one, Narrative Science uses artificial intelligence to turn big data into stories. Professors Kristian Hammond and Larry Birnbaum founded the company in 2010.

Aptinyx, number two on the list, develops drugs to treat nerve pain, post-traumatic stress disorder, and Parkinson's disease. Professor Joseph Moskal launched the company.

SYNTHETIC BIOLOGY EXPERTS GATHER FOR INAUGURAL WORKSHOP

Northwestern welcomed regional synthetic biology leaders from academia and industry to share research and promote collaboration within the burgeoning field.

Sponsored by Northwestern's Center for Synthetic Biology, the two-day Central US Synthetic Biology Workshop drew nearly 200 faculty, researchers, and students from numerous universities.

Northwestern Engineering's Joshua Leonard and Michael Jewett cochaired the workshop along with two researchers from the University of Wisconsin-Madison.

Industry professionals from AbbVie, DowDuPont, LanzaTech, and Procter & Gamble also attended.

With an emphasis on allotting presentation time to graduate students and postdoctoral students, the workshop featured short lectures showcasing new research and experiences in synthetic biology that could inform future growth in the field.

The event also included networking sessions and trainee poster presentations.

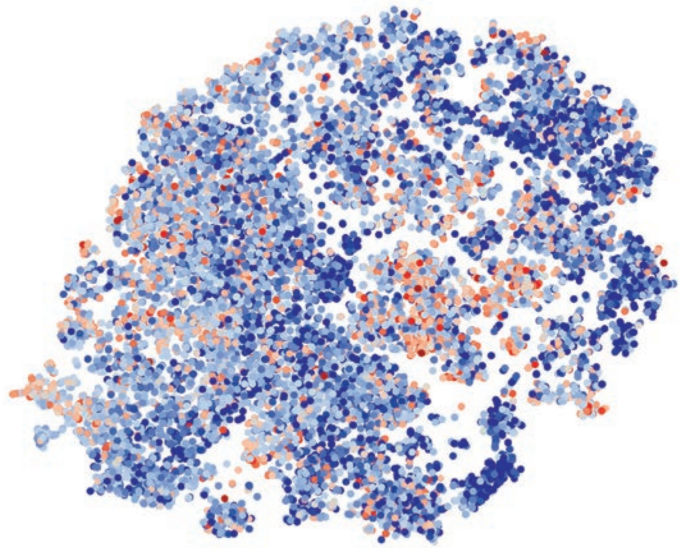
GRADUATE STUDENTS CELEBRATE COMMENCEMENT

Northwestern Engineering celebrated the graduation of its accomplished 361 master's and 109 PhD students on December 15 in the Pick-Staiger Concert Hall.

"You all have brought a diversity of thought and experience to your education, and you will leave not only with a degree, but with a community of some of the best minds in your fields," Dean Julio M. Ottino said.

The ceremony featured remarks by Matthew Tirrell ('73), a pioneering researcher in the fields of biomolecular engineering and nanotechnology. He is the founding Pritzker Director and dean of the Institute for Molecular Engineering at the University of Chicago.

LAB NOTES



Study Explains Why Some Human Genes are More Popular with Researchers than Others

A Northwestern team including Professor Luís Amaral has found that historical bias is a key reason biomedical researchers continue to study the same 10 percent of all human genes, the sequences of which are known, while ignoring many genes known to play roles in disease.

The team found that well-meaning policy interventions intended to promote exploratory or innovative research have actually resulted mostly in creating additional work on the most established research topics: the genes first characterized in the 1980s and 1990s, before completion of the Human Genome Project.

The researchers applied a systems approach to the data to uncover underlying patterns. In addition to explaining why some genes are not studied, the researchers can explain the level to which an individual gene is studied. And, they can do that for about 15,000 uncharacterized genes. Looking forward, the Northwestern team is developing a public resource that could help identify understudied genes that have the potential to be of critical importance to specific diseases.

"EVERYTHING WAS SUPPOSED TO CHANGE WITH THE HUMAN GENOME PROJECT, BUT EVERYTHING STAYED THE SAME. SCIENTISTS KEEP GOING TO THE SAME PLACE, STUDYING THE EXACT SAME GENES. SHOULD WE BE FOCUSING ALL OF OUR ATTENTION ON THIS SMALL GROUP OF GENES?"

LUÍS AMARAL
Erastus Otis Haven Professor of Chemical and Biological Engineering

NEW TECHNOLOGY GIVES UNPRECEDENTED LOOK INSIDE CAPILLARIES

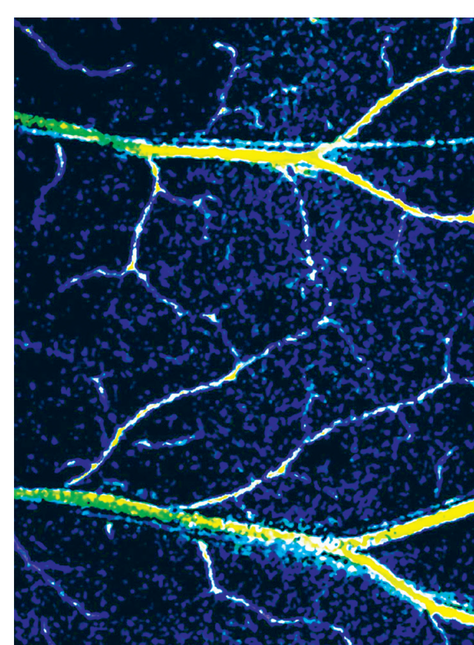
Professor Vadim Backman and a Northwestern University team have developed a new tool that images blood flow through tiny capillary blood vessels, giving insight into the central portion of the human circulatory system. Called spectral contrast optical coherence tomography angiography (SC-OCTA), the 3D-imaging technique can detect subtle changes in capillary organization for early diagnosis of disease.

SC-OCTA works by combining spectroscopy, which looks at the various visible light wavelengths, with conventional optical coherence tomography (OCT), which is similar to ultrasound except it uses light waves instead of sound waves. Like radar, OCT pinpoints the tissue of interest; spectroscopy then characterizes it.

While many types of imaging only work if the area of interest is moving or completely still, SC-OCTA can take a clear picture in both states. This enables it to image stagnant blood or moving organs, such as a beating heart.

"Now we can see even the smallest capillaries and measure blood flow, oxygenation, and metabolic rate."

VADIM BACKMAN
Walter Dill Scott Professor of Biomedical Engineering



SPACE MICROBES AREN'T SO ALIEN AFTER ALL

A study led by Northwestern Engineering's Erica Hartmann has found that—despite its seemingly harsh conditions—the International Space Station (ISS) is not causing bacteria to mutate into dangerous, antibiotic-resistant superbugs.

The ISS houses thousands of different microbes, which have traveled into space either on astronauts or in cargo. Hartmann's team used data from the National Center for Biotechnology Information to compare the strains of Staphylococcus aureus and Bacillus cereus on the ISS to those on Earth. Found on human skin, S. aureus contains the tough-to-treat MRSA strain. B. cereus lives in soil and has fewer implications for human health.

While the researchers found that the bacteria isolated from the ISS did contain different genes than their Earthling counterparts, those genes did not make the bacteria more detrimental to human health. Instead, the bacteria are simply responding, and perhaps evolving, to survive in a stressful environment.

SHINING NEW LIGHT ON BLADDER ISSUES

A team of neuroscientists and engineers from Northwestern University, Washington University in St. Louis, and the University of Illinois at Urbana-Champaign developed a soft, implantable device that can detect overactivity in the bladder and then use light from tiny, biointegrated LEDs to tamp down the urge to urinate.

The device works in laboratory rats, and one day may help people who suffer from incontinence or frequently feel the need to urinate. "We're excited about these results," says Northwestern Engineering Professor John Rogers, who co-led the research. Similar technology could be used in other applications, like treating chronic pain or stimulating pancreatic cells to secrete insulin.

"People will be in little capsules where they cannot open windows, go outside, or circulate the air for long periods of time. We're genuinely concerned about how this could affect microbes."

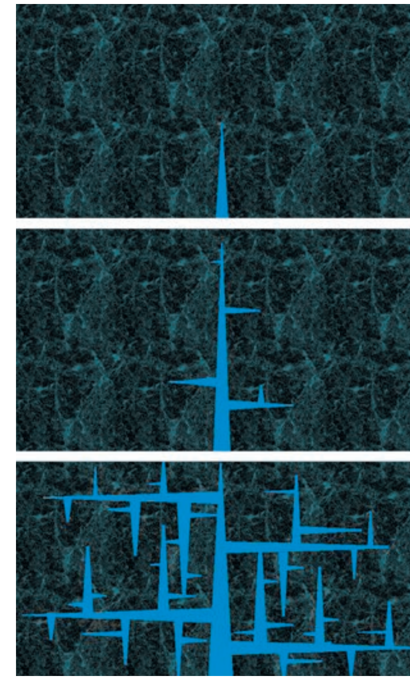
ERICA HARTMANN
Assistant Professor, Civil and Environmental Engineering

$100,000

Amount of Gates Foundation Grand Challenges Explorations grant given to the Julius Lucks Lab

3

Number of Faculty Early Career Development Program (CAREER) awards granted by the National Science Foundation in 2019

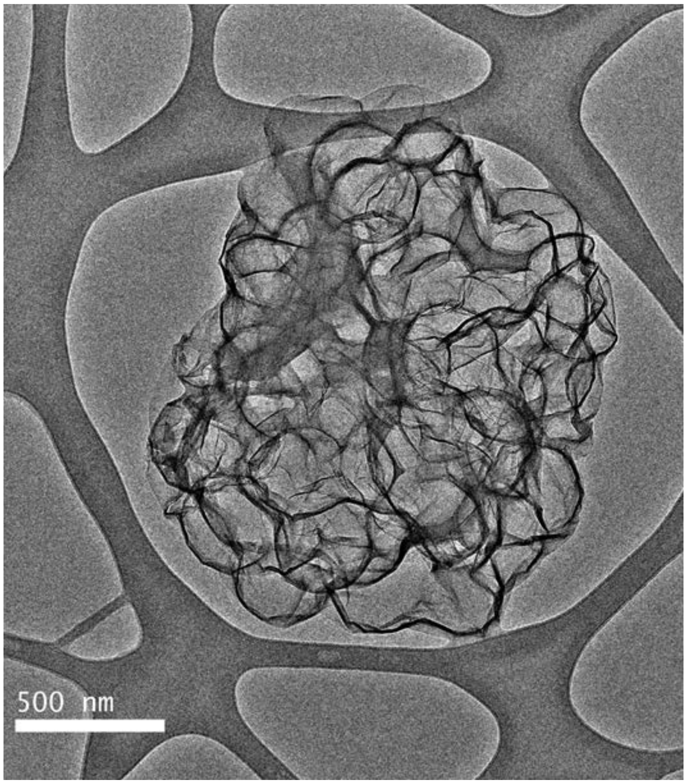


A MODEL FOR MORE EFFICIENT, PROFITABLE FRACKING

A new computational model from Northwestern Engineering's Zdeněk Bažant and Los Alamos National Laboratory researchers could boost efficiencies and profits in natural gas production. It not only predicts previously hidden fracture mechanics more efficiently, it also accounts more accurately for the known amounts of gas released during the process.

Despite the fracking industry's growth, much of the process remains mysterious. Because fracking happens deep underground, researchers cannot observe the fracture mechanism of how the gas is released from the shale.

By considering the closure of preexisting fractures caused by long ago tectonic events and water seepage forces not previously considered, the model shows how branches form off vertical cracks during the fracking process, allowing more natural gas to be released. The model is the first to predict this branching while remaining consistent with the known amount of gas released from the shale during this process.



Fluid-inspired Material Self-heals Before Your Eyes

Northwestern Engineering's Jiaxing Huang has developed a new coating for metal that self-heals within seconds when scratched, scraped, or cracked. The novel material could prevent tiny defects from turning into localized corrosion, which can cause major metal structures to fail.

Huang and his team created a system comprised of oil and a network of graphene capsules fluidic enough to flow automatically, but not so fluidic as to drip off metal surfaces. When the network is damaged by a crack or scratch, it releases the oil to flow readily and reconnect.

The coating not only sticks, it sticks well—even under water and in harsh chemical environments. Huang imagines that it could be applied to surfaces that are normally submerged in water, like bridges and boats, as well as metal structures near leaked or spilled highly corrosive fluids.

"WHEN A BOAT CUTS THROUGH WATER, THE WATER GOES RIGHT BACK TOGETHER. THE 'CUT' QUICKLY HEALS BECAUSE WATER FLOWS READILY. WE WERE INSPIRED TO REALIZE THAT FLUIDS, SUCH AS OILS, ARE THE ULTIMATE SELF-HEALING SYSTEM."

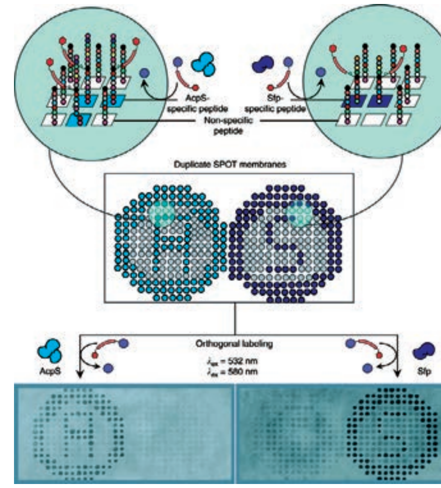
JIAXING HUANG
Professor, Materials Science and Engineering

3

Number of Northwestern Engineering faculty who received Google Faculty Research Awards

2

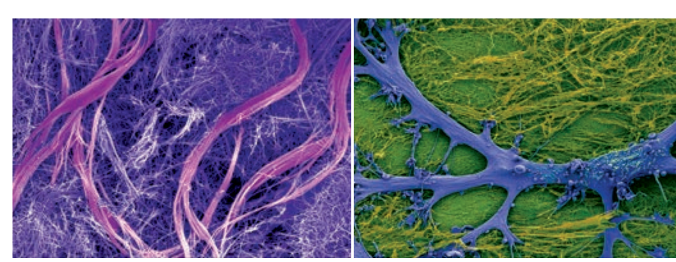
Number of amino acid substitutions in an MS2 bacteriophage made by Danielle Tullman-Ercek, which could impact future drug delivery strategies



USING MACHINE LEARNING TO FIND PEPTIDES

Northwestern Engineering researchers teamed up with colleagues at Cornell University and the University of California San Diego to develop a new way of finding optimal peptide sequences: They used a machine-learning algorithm as a collaborator.

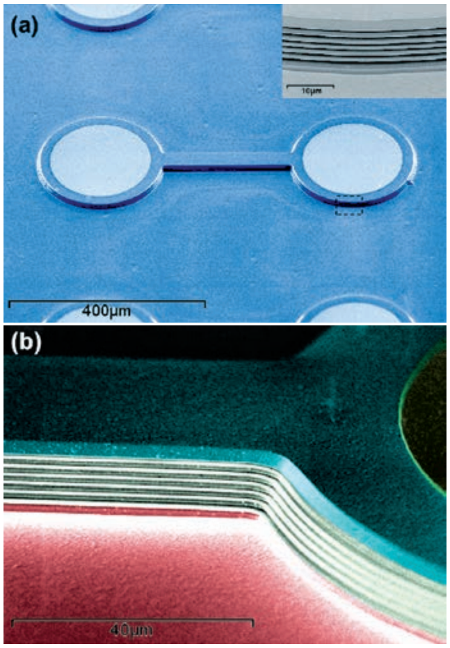
The algorithm analyzes experimental data and suggests the next best sequence, creating a back-and-forth selection process that drastically reduces the time needed to identify the optimal peptide. The results could provide a new framework for experiments across materials science and chemistry.



NEW BIO-INSPIRED DYNAMIC MATERIALS TRANSFORM THEMSELVES

Northwestern Engineering's Samuel Stupp and Erik Luijten have developed soft materials that autonomously self-assemble into molecular superstructures and disassemble on demand, opening the door for applications ranging from sensors and robotics to new drug delivery systems and tools for tissue regeneration.

The highly dynamic new materials also provided unexpected biological clues about the brain microenvironment after injury or disease when their superstructures revealed reversible phenotypes in brain cells characteristic of injured or healthy brain tissue.



NEW METHOD IMPROVES INFRARED IMAGING PERFORMANCE

A new method developed by Northwestern Engineering's Manijeh Razeghi has greatly reduced a type of image distortion caused by the presence of spectral cross-talk between dual-band long-wavelength photodetectors. The work sets the stage for a new generation of high spectral-contrast infrared imaging devices with applications in medicine, defense and security, planetary sciences, and art preservation.

Dual-band imaging allows objects to be seen in multiple wavelength channels through a single infrared camera. In night-vision cameras, for example, dual-band detection can help the viewer better distinguish between moving targets and objects in the background.

Spectral cross-talk is a type of distortion that occurs when a portion of the light from one wavelength channel is absorbed by the second channel. To suppress that, Razeghi and her team developed a novel version of a distributed Bragg reflector (DBR), a highly refractive, layered material placed between channels to separate the two wavelengths.

While DBRs have been widely used as optical filters to reflect target wavelengths, Razeghi's team is the first to adapt the structure to divide two channels in an antimonide type-II superlattice photodetector, an important element of night-vision cameras that the researchers previously studied.

34 MILLION

Number of people relying on the Great Lakes, studied in a climate change report by researchers including Aaron Packman

Stop Sterilizing Your Dust

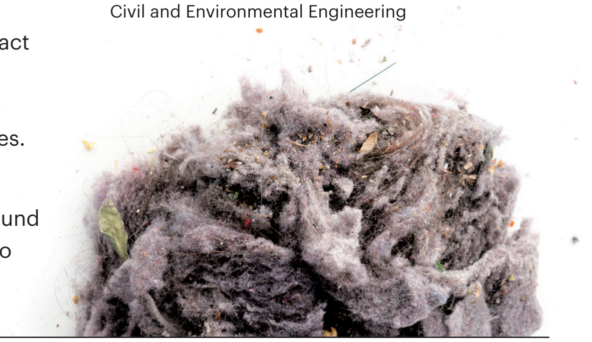
Most people have heard about antibiotic-resistant germs. But how about antibiotic-resistant dust? Professor Erica Hartmann found that an antimicrobial chemical called triclosan is abundant in dust—and linked to changes in the dust's genetic makeup. The result is dust with organisms that could cause an antibiotic-resistant infection.

Hartmann compared dust samples collected from 42 athletic facilities, places where people commonly make intimate contact with equipment and use antimicrobial wipes to cleanse these areas before and after exercising. She looked at the bacteria present in that dust, specifically examining the bacteria's genes.

In dust with higher concentrations of triclosan—commonly added to antibacterial hand soaps up until 2017—Hartmann found higher abundances of genetic markers indicating resistance to antibiotic drugs.

"Because dust is the final resting place for everything that's been circulating in the air, it's a good source for information about air quality."

ERICA HARTMANN
Assistant Professor,
Civil and Environmental Engineering

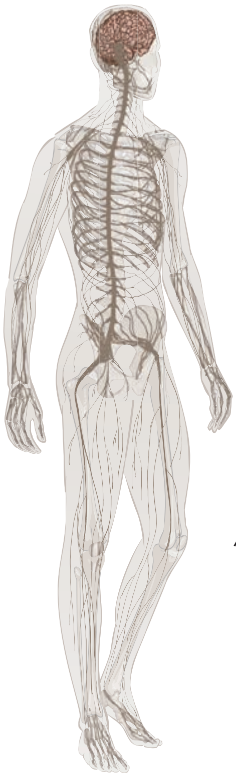


NEIGHBORHOODS INFLUENCE CHICAGOANS' TRANSPORTATION DECISIONS

Led by Professor Amanda Stathopoulos, a Northwestern University study compared the attitudes of Evanston residents toward various modes of transportation with those of Chicago's Humboldt Park residents. The researchers found that Evanston residents more readily accepted new active mobility modes, such as bikeshare programs, whereas Humboldt Park residents exercised skepticism, viewing these programs as signs of privilege and gentrification. The study's results could improve policy makers' understanding of the embedded norms and values of different neighborhoods and inform future decisions about transportation.

$700,000

Amount of funding for Northwestern Center for Water Research partners for seven collaborative projects that tackle water sensing, supply, and purification



PROTECTING JOINTS VIA THE CENTRAL NERVOUS SYSTEM

From running track to walking up stairs, muscle activation is a part of everyday life. Yet during such movements, the body's joints are at risk of pain or injury. A research team led by Professor Matthew Tresch found that when it comes to preventing excessive stress within the body's joints, the central nervous system is active and mindful of the body's well-being. The findings could influence injury rehabilitation and provide insights into the body's neurocircuitry.

"Understanding that the nervous system is actively involved here, we can take some important next steps," Tresch says. "We can go after questions about neural control and neurocircuitry more systematically, which can lead to some impactful findings for improving physiological movement."

GETTING BETTER PREPARED FOR CHICAGO'S EXTREME WEATHER

With funding from the National Science Foundation, a multidisciplinary research team from Northwestern University, the University of Illinois, and Argonne National Laboratory will work to ensure that Chicagoland stays ahead of severe weather.

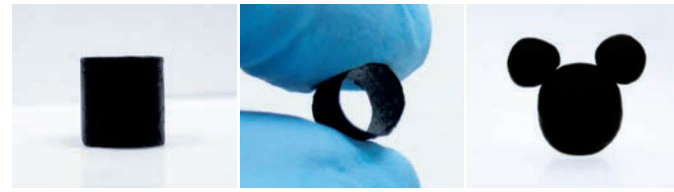
The newly funded project, called Systems Approaches for Vulnerability Evaluation and Urban Resilience (SAVEUR), combines natural science, social science, data science, and engineering to predict more accurately extreme events, such as heat waves, poor air quality, and flooding, as well as to assess vulnerabilities within neighborhoods. Led by Professor Aaron Packman, the research will eventually help ensure that proposed infrastructure changes are sustainable and adaptive.

3

Number of faculty joining Segal's Design Research Cluster: Jessica Hullman, Noshir Contractor, and Nicholas Diakopoulos

45

Number of days astronauts spend in HERA capsule simulator, which Northwestern professors studied



"GO Dough" Makes Graphene Easy to Shape and Mold

Professor Jiaxing Huang is reshaping the world of graphene—literally. He and his team have turned graphene oxide (GO) into a soft, moldable, and kneadable substance, called "GO dough," that can be shaped and reshaped into freestanding, three-dimensional structures.

Huang hopes the material's ease of use can help graphene meet its much-anticipated potential as a super material. "My dream is to turn graphene-based sheets into a widely accessible, readily usable engineering material, just like plastic, glass, and steel," Huang says. "I hope GO dough can help inspire new uses of graphene-based materials, just like how play dough can inspire young children's imagination and creativity."

UNRAVELLING THE MYSTERY OF THE BLACK WIDOW SPIDER'S WEB

Professor Nathan Gianneschi collaborated with researchers at San Diego State University (SDSU) to gain new insights into the complex process of how black widow spiders transform proteins into steel-strength fibers. The knowledge could aid scientists in creating equally strong synthetic materials.

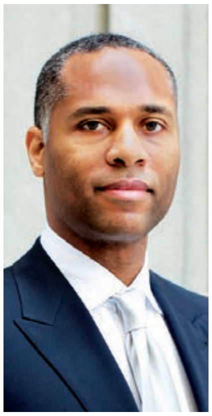
Using complementary, state-of-the-art techniques—nuclear magnetic resonance spectroscopy at SDSU, followed by electron microscopy at Northwestern—the research team was able to see more clearly inside the protein gland where the silk fibers originate, revealing a more complex, hierarchical protein assembly.

The researchers found that spider silk proteins do not start out as simple spherical micelle molecules, as previously thought, but instead as complex, compound micelles. This unique structure may be a requirement to create the black widow spider's impressive fibers.

If duplicated, practical applications for this type of material could include high-performance textiles for military and first responders and building materials for cable bridges and other construction.

"One cannot overstate the potential impact on materials and engineering if we can synthetically replicate this natural process to produce artificial fibers at scale."

NATHAN C. GIANNESCHI
Jacob and Rosaline Cohn Professor of Chemistry, Materials Science and Engineering, and Biomedical Engineering



Guillermo Ameer

Amanda Stathopoulos

Joseph Schofer

Jian Cao

James Hambleton

Randall Snurr

John Rogers

Jennie Rogers

Teresa Woodruff

Samuel Stupp

Stephen Carr

Neha Kamat

Faculty Awards

Guillermo Ameer and Jian Cao Named AAAS Fellows

Election as an American Association for the Advancement of Science fellow honors members who have made significant scientific contributions in research, teaching, and technology.

John Rogers Receives 2019 Benjamin Franklin Medal in Materials Engineering

The award is given by the Franklin Institute, one of the oldest centers for science education and development in the country, recognizing excellence in science and technology.

Samuel Stupp Elected National Academy of Inventors Fellow

Fellows are recognized for demonstrating a prolific spirit of innovation in creating or facilitating outstanding inventions.

Amanda Stathopoulos, James Hambleton, and Jennie Rogers Recognized with NSF CAREER Awards

Faculty Early Career Development Program awards from the National Science Foundation are the foundation's most prestigious honor for junior faculty members. Each will receive $500,000 over five years.

Stephen Carr Named SPE Fellow

The Society of Plastic Engineers selected Carr to its 2019 class of fellows, honoring his contributions in the field of plastics engineering.

Joseph Schofer Earns CUTC Lifetime Achievement Award

The Council of University Transportation Centers HNTB Lifetime Achievement Award for University Transportation Education and Research honors those with a long history of significant and lasting contributions.

Randall Snurr Elected to Saxon Academy of Sciences

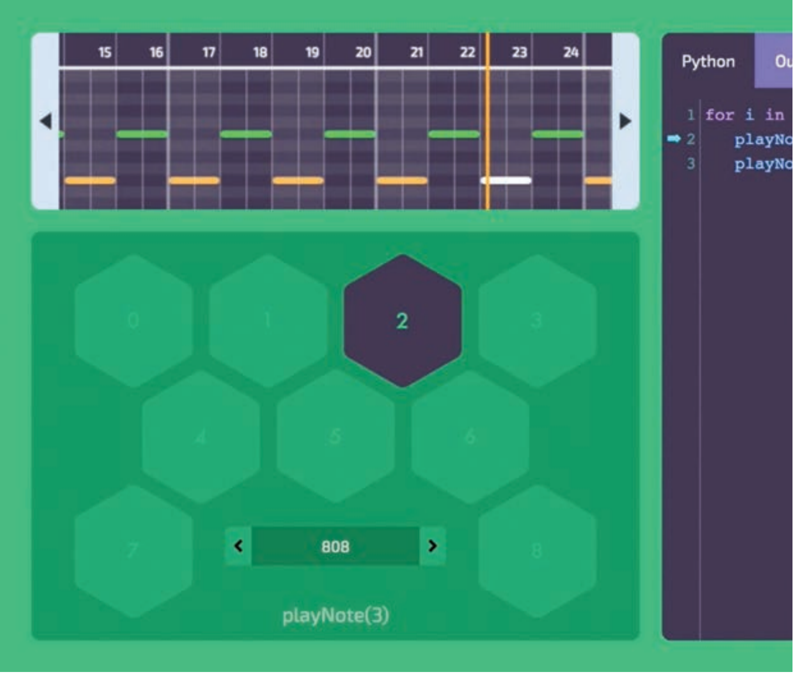
The German academy was founded in 1846 and assembles leading scientists of different disciplines for regular discourse.

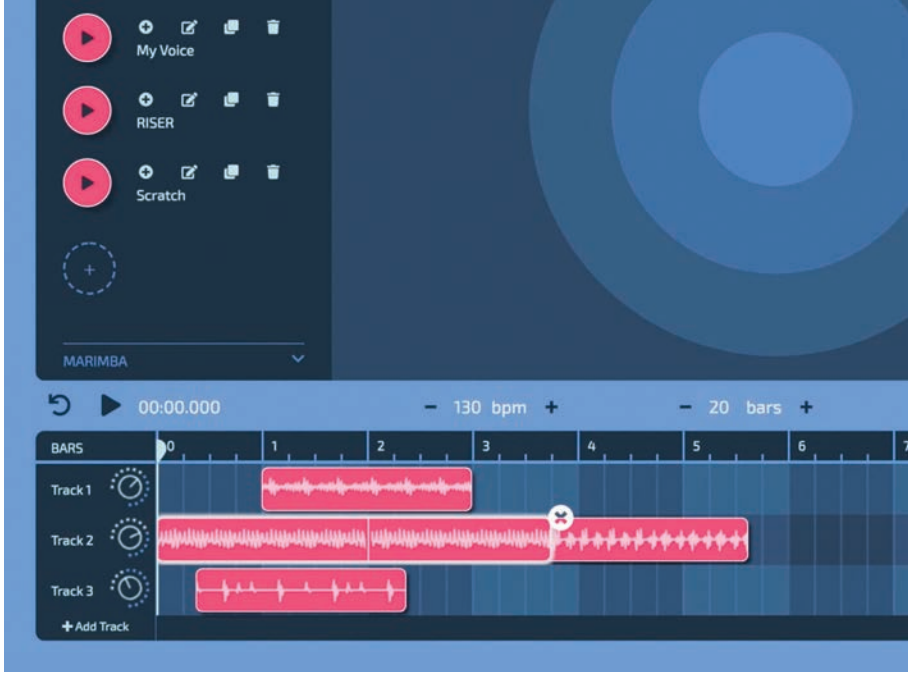
Teresa Woodruff Elected to National Academy of Medicine

Election to the academy is considered one of the highest honors in the fields of health and medicine, recognizing outstanding professional achievement and commitment to service.

Neha Kamat Receives Air Force Young Investigator Award

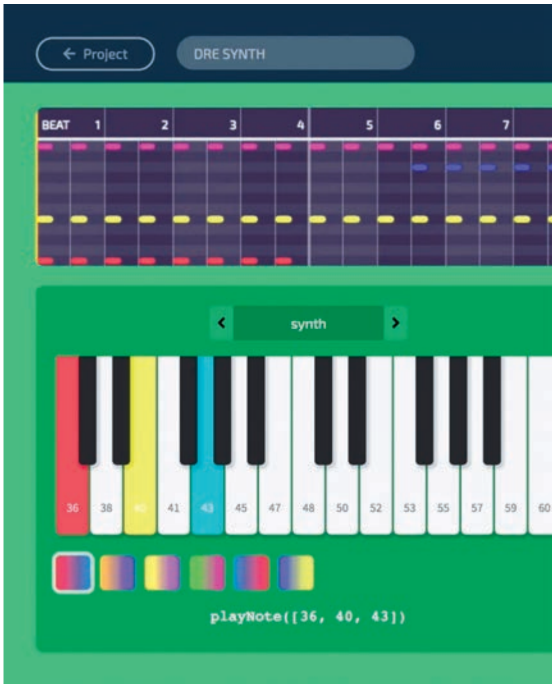
The award includes a three-year grant totaling $450,000 to study the role of cell membrane mechanics in sensing mechanical force.

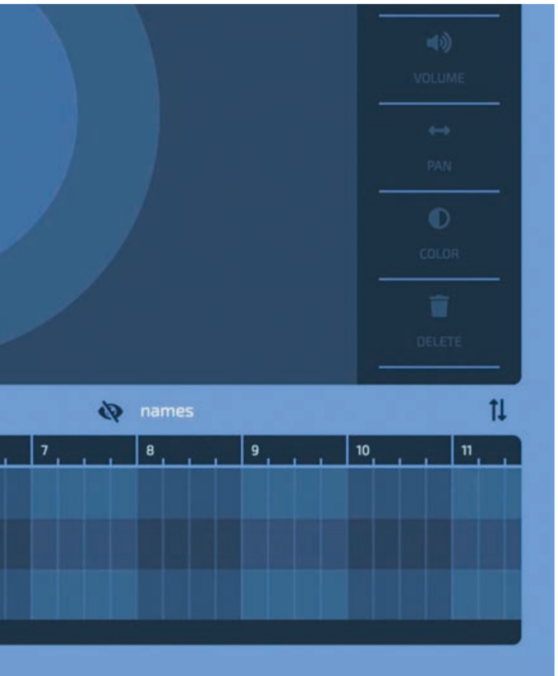


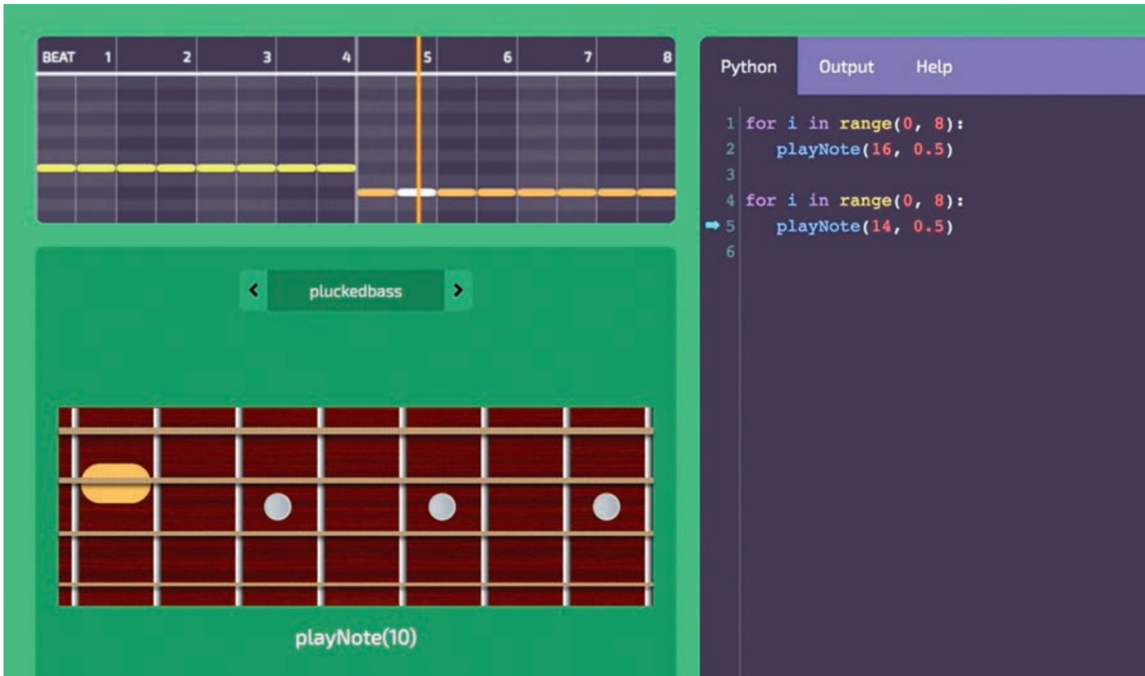


DIVERSIFYING COMPUTER SCIENCE THROUGH MUSIC

By finding novel ways to make coding fun and accessible to a broader spectrum of young students, Northwestern Engineering's Michael Horn aims to create a more diverse pool of computer scientists.







When Sandra Nissim's parents signed her up for a summer coding camp, she didn't want to go. She'd never coded before. Besides, many of her high school classmates viewed coding as boys' territory, and she didn't want to be ostracized for being a smart girl.

Nevertheless, she showed up on the first day of camp, and her life changed. "Within a week I was hooked. It totally changed what I wanted to do with my life," she recalls.

Now, the 20-year-old is a Northwestern Engineering sophomore computer science major who wants to pursue a career in cyber-security or artificial intelligence. Her adviser is Michael Horn, director of the Tangible Interaction Design and Learning (TIDAL) Lab, whose groundbreaking work aims to make computer science—a field with historic inequities—more attractive to a much younger, more diverse student audience.

TIDAL finds unique ways to introduce into K–12 classrooms a variety of coding activities—from old-fashioned puzzles and sticker books to mobile apps and touch screen exhibits—and other technology-based learning experiences that children and youth can easily use to solve challenges and create content in sophisticated ways.

MAKING MUSIC

The lab's most expansive project yet is TunePad, a website and free app that allows users to create musical compositions with the computer programming language Python. This initiative, part of a collaborative project with the Georgia Institute of Technology, is funded by the National Science Foundation.

It's easy to see how kids growing up with streaming media would find TunePad appealing: It lets them create an original piece of music by choosing from a library of bass, keyboard, and drum sounds, instrumental riffs, and hip-hop samples, or by uploading samples of their own. In no time, they're dragging musical elements in and out and controlling tempo, volume, and arrangement with the finesse of a studio producer.

Horn, an associate professor with a joint appointment in computer science and learning sciences, says the platform is designed to promote content sharing for getting and giving feedback, showing encouragement, and supporting collaboration. "We're trying to build youth-driven communities where coding is a tool of 'look what I can do,'" he says. "Seeing your peers get involved and then having the ability to go deep with them—that's a powerful way to connect with each other."

EXPANDING ACCESS TO PROMOTE DIVERSITY

Making coding both fun and accessible is critical for generating interest in computer science in children, especially those who get little exposure to it in the classroom, and for diversifying the next generation of coders. A 2016 survey by the Computing Research Association, a nonprofit advocacy group in Washington, DC, shows that undergraduate computer science majors are overwhelmingly

"We're trying to build youth-driven communities where coding is a tool of 'look what I can do.' Seeing your peers get involved and then having the ability to go deep with them—that's a powerful way to connect with each other."

MICHAEL HORN
Associate Professor,
Computer Science and Learning Sciences

male (82 percent); half are white, while about 23 percent are Asian, 8 percent Hispanic, and only 3 percent black.

Horn blames a lack of resources. For example, while Chicago Public Schools mandates computer science as a graduation requirement, schools in some areas of the city are unable to hire teachers with the relevant qualifications. Instead, computer science classes are often assigned to math teachers who may have little to no coding experience.

Nonprofit groups like Girls Who Code strive to even out the gender imbalance. In fact, it was a Girls Who Code summer camp that turned Nissim on to programming. Eventually, she served as copresident of a new Girls Who Code chapter at her high school. She says the organization helps even the playing field since most computer science groups and events focus on boys. "If an opportunity does present itself," she says, "it's hard to stick with it because you're outnumbered, and you don't fit in."

Horn's 12-person lab includes undergraduate and graduate programmers, researchers, and others who are refining TunePad while building an online community where kids can share music. Since the prototype launched publicly last year, TIDAL has been rolling out TunePad through several organizations.

For example, in DuPage County, west of Chicago, Horn's team is partnering with the National Association for the Advancement of Colored People (NAACP) to run a coding summer camp. In Chicago, TIDAL is helping the James R. Jordan Foundation run STEM popup workshops in four public K–8 schools, and this fall, in Evanston, TunePad will be preloaded on student tablets at Chute Middle School and Dr. Martin Luther King Jr. Literary and Fine Arts School.

Horn's team will refine TunePad further after collecting data to identify users' motivations and interests. Even if creating music isn't an individual kid's thing, he hopes the coding experience will inspire students to consider other benefits of gaining technical know-how, such as landing a high-paying job and enjoying a stable career.

"There can be deep bias in programming from homogeneous group-think," Horn says. "When it comes to important societal issues, we should have more voices at the table in technology companies."

This story was originally reported in the School of Education and Social Policy's magazine.

MARK GUARINO

UNTANGLING NICU CARE

Soft, flexible wireless sensors allow parents to hold their premature babies.

WHEN TASCHANA TAYLOR UNDERWENT AN EMERGENCY C-SECTION, her premature daughter Grace was rushed to the neonatal intensive care unit (NICU) and remained there for weeks.

Once Taylor recovered and was able to see her daughter, she encountered an unexpected obstacle: the cumbersome bundle of wires connected to sensors on Grace's body to monitor the baby's vital signs—heart rate, respiration rate, and body temperature.

"Trying to feed her, change her, hold her, with the wires was a little contained," Taylor says. "If she didn't have the wires on her, maybe we could go for a walk around the area. Maybe we could probably spend the night upstairs together. It would have made the entire experience more enjoyable."

Photography by Sally Ryan

“We know that skin-to-skin contact is so important for newborns—especially for those who are sick or premature. When you have wires everywhere, and the baby is tethered to a bed, it’s really hard to make skin-to-skin contact.”

AMY PALLER
Walter J. Hamlin Professor of Dermatology and of Pediatrics, Feinberg School of Medicine

LISTENING TO MOTHER

For years, a Northwestern University team co-led by a Northwestern Engineering researcher has been trying to solve this problem by developing wireless sensors that would allow a greater range of movement and interaction with newborns. The team came up with a pair of soft, flexible wireless sensors that work from opposite ends of the baby’s body. One sensor lays across the chest or back, the other wraps around a foot.

While existing sensors must be attached with adhesives that can scar and blister a premature newborn’s skin, the wireless sensors feature patches that use much weaker adhesives. “We wanted to eliminate the rat’s nest of wires and aggressive adhesives associated with existing hardware systems and replace them with something safer, more patient-centric, and more compatible with parent-child interaction,” says John A. Rogers, a wearable electronics pioneer who led the technology development.

This spring, the team completed the first human studies using the wireless sensors on premature babies at Prentice Women’s Hospital and Ann and Robert H. Lurie Children’s Hospital of Chicago. Taylor’s daughter Grace was among the 70 babies who wore the wireless sensors, which, for the studies, were used alongside traditional wired sensors. Having both sensors allowed the Northwestern team to compare the data collected from both types.

“When we were approached about the study, Grace’s father and I were really excited,” Taylor says.

The studies revealed that the wireless sensors provided data as precise and accurate as that from traditional sensors. “We were able to reproduce all of the functionality that current wire-based sensors provide with clinical-grade precision,” says Rogers, Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering and Biomedical Engineering in the McCormick School of Engineering and a professor of neurological surgery in the Feinberg School of Medicine. “Our wireless, battery-free, skin-like devices give up nothing in terms of range of measurement, accuracy, and precision—and they even provide some additional measurements that are clinically important.”

ENCOURAGING PARENTAL BONDING

The mass of wires that surrounds newborns in the NICU is often bigger than the babies themselves. Typically, five or six wires connect electrodes on each baby to monitors for apnea, blood pressure, blood oxygen, and heart rate. Although all those wires help ensure health and safety, they constrain the baby’s movements and create a major barrier to physical bonding during a critical period of development.

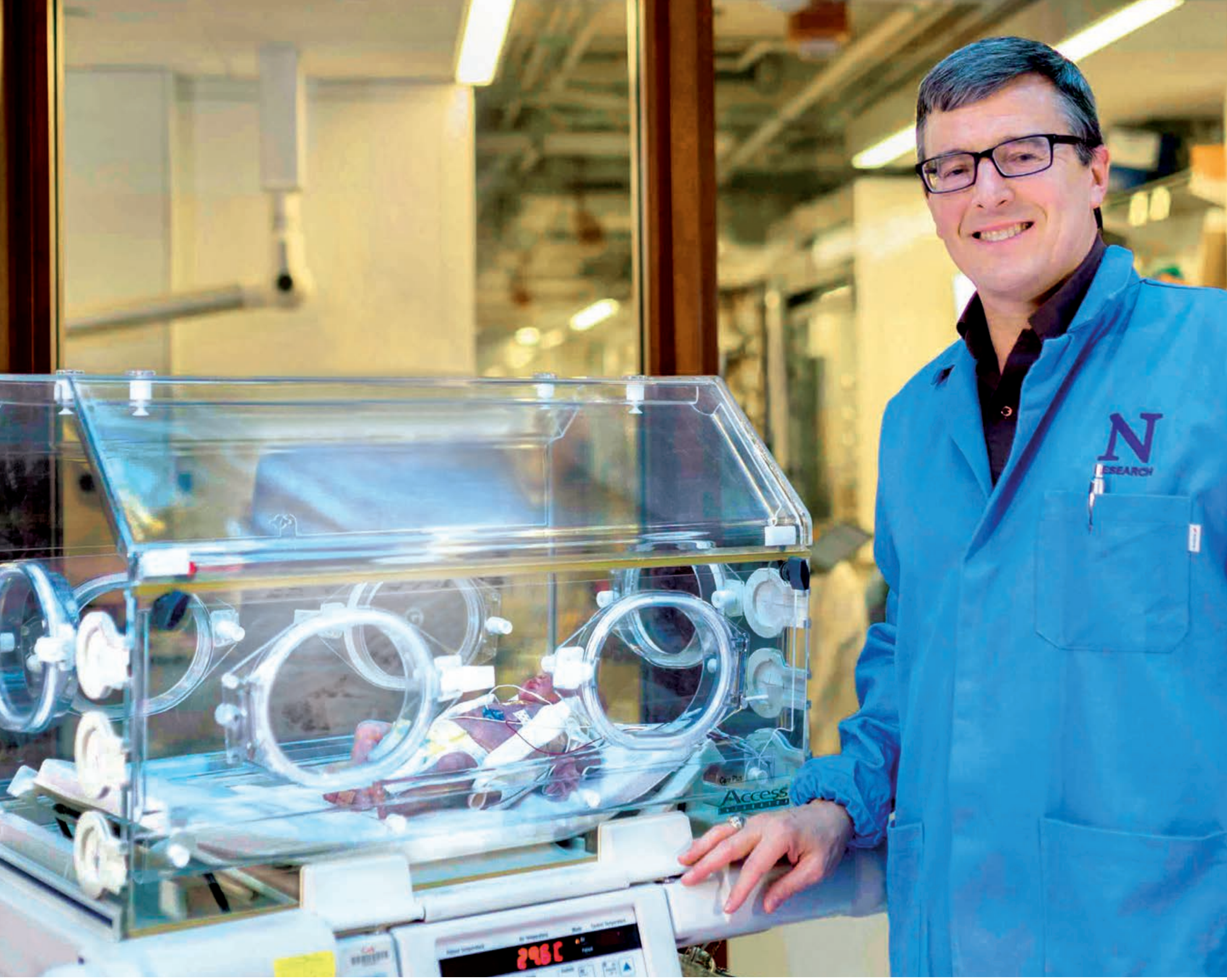
“We know that skin-to-skin contact is so important for newborns—especially for those who are sick or premature,” says Amy Paller, Walter J. Hamlin Professor of Dermatology and professor of pediatrics at Feinberg as well as a pediatric dermatologist at Lurie Children’s Hospital, who jointly led the research. “It’s been shown to decrease the risk of mortality, infections, pulmonary complications, and liver issues, and to increase the baby’s ability to gain weight. When you have wires everywhere, and the baby is tethered to a bed, it’s really hard to make skin-to-skin contact.”

The benefits of the Northwestern team’s new, small technology—the chest sensor measures 5 by 2.5 centimeters; the foot sensor is 2.5 by 2 centimeters—reach beyond its lack of wires. The dual-sensor system allows physicians to gather an infant’s core temperature as well as body temperature from a peripheral region.

“Differences in temperature between the foot and the chest have great clinical importance in determining blood flow and other aspects of health status,” Rogers says. “That’s something that’s not typically measured today.”

FILLING IN INFORMATION GAPS

Physicians also can measure blood pressure by tracking when the pulse leaves the heart and arrives at the foot. Currently, there is no good way to reliably measure blood pressure on infants. A blood pressure cuff can bruise or damage fragile skin. The other option is to insert a catheter into an artery, which is tricky because of the narrow diameter of a premature newborn’s blood vessels.



"OUR WIRELESS, BATTERY-FREE, SKIN-LIKE DEVICES GIVE UP NOTHING IN TERMS OF RANGE OF MEASUREMENT, ACCURACY, AND PRECISION—AND THEY EVEN PROVIDE SOME ADDITIONAL MEASUREMENTS THAT ARE CLINICALLY IMPORTANT."

JOHN A. ROGERS
Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering, and Neurological Surgery

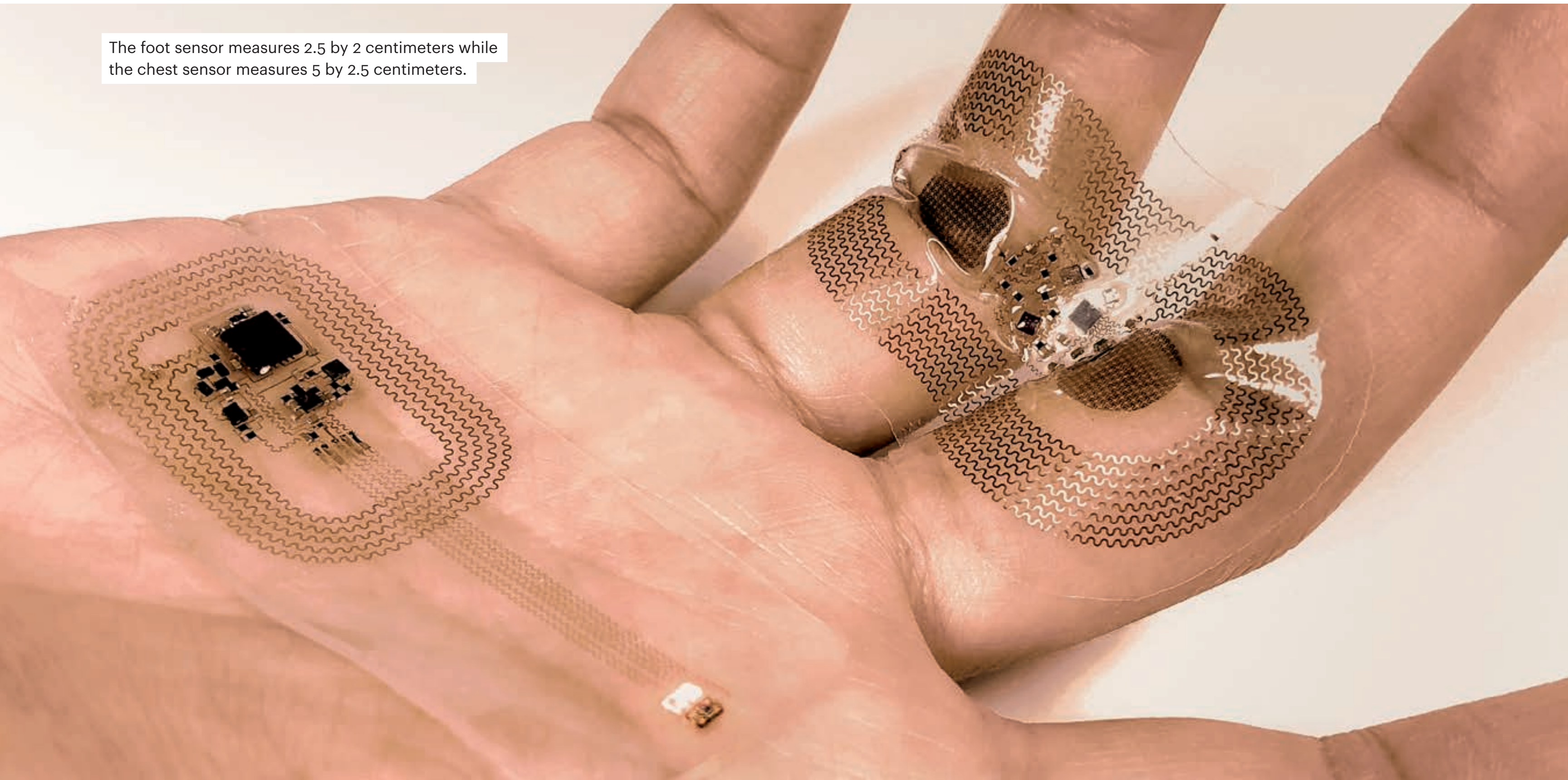
Photography by Monika Wnuk

Tiny, wireless sensors were developed at Northwestern Engineering.

The soft, flexible sensors work from opposite ends of the baby's body.

"WE WERE ABLE TO REPRODUCE ALL OF THE FUNCTIONALITY THAT CURRENT WIRE-BASED SENSORS PROVIDE WITH CLINICAL-GRADE PRECISION."

JOHN A. ROGERS
Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering, and Neurological Surgery



The foot sensor measures 2.5 by 2 centimeters while the chest sensor measures 5 by 2.5 centimeters.

The new device could also help fill in information gaps that exist during skin-to-skin contact. If physicians can continue to measure the vital signs of infants being held by their parents, they might learn more about how critical such contact might be.

Because the sensors are transparent and compatible with imaging, they also can be worn during x-rays, MRIs, and CT scans. "Wires are not just a physical impediment to interacting with the baby, they also disrupt imaging if left in place," says Paller, chair of the Department of Dermatology who worked with Shuai (Steve) Xu, an instructor of dermatology at Feinberg and a Northwestern Medicine dermatologist. "The technology has been developed so you can do imaging with the sensors in place and continue monitoring the baby."

"We hope that eventually this device can work not only for babies, but for anybody who needs special medical treatment."

YONGGANG HUANG
Walter P. Murphy Professor of Mechanical Engineering and Civil and Environmental Engineering

SAVING "INCREDIBLY FRAGILE" SKIN

The blood pressure cuff isn't the only potentially damaging aspect of current technology. As noted earlier, the sticky tape used to adhere wired sensors to the body can cause skin irritation, blisters, and infections. In some cases, this damage can lead to lifelong scarring.

"Premature babies' skin is not fully developed during the first weeks of life, so it's incredibly fragile," Paller says. "In fact, the thickness of the outer layer of skin in very premature infants is greatly reduced. The more premature you get, the more fragile the skin becomes. That means we have to be very careful."

So far, the Northwestern team has found no sign of skin damage from the wireless sensors. The sensor's skin-saving secret lies in its lightweight nature, thin geometry, and soft mechanics.

DEVELOPING A NEW DESIGN

To come up with an optimal design, Rogers worked with longtime collaborator and stretchable electronics and theoretical mechanics expert Yonggang Huang, Walter P. Murphy Professor of Mechanical Engineering and Civil and Environmental Engineering, and his group.

To meet the sensor system's requirements, the team developed flexible and stretchable near field communication antennas to ensure transmission of signals. They also designed substrates to ensure that the babies could not feel the sensors and developed electrodes that minimize the disturbance to the magnetic field associated with MRI scanning.

Though Huang and Rogers had worked together previously to design stretchable electronics, the electromagnetic systems needed for these new patches proved more difficult to design because they were more likely to suffer from electronic degradation when bent or stretched.

The final result was a paper-thin device made from biocompatible, soft elastic silicone that embeds a collection of tiny electronic components connected with spring-like wires that move and flex with the body. The wireless sensor communicates through a transmitter placed beneath the crib's mattress. Using radio frequencies with the same strength as those used in radio frequency identification tags, the antenna transmits data to displays at the nurses' station.

"The problem was fairly complex, involving many aspects of design," Huang says. "We hope that eventually this device can work not only for babies, but for anybody who needs special medical treatment."

The device is also cost effective. Although it can be sterilized and reused, the cost of the sensor is so low—about $10—that it can simply be discarded after 24 hours and replaced with a new one to eliminate any risk of infection.

WHEN WIRELESS SENSORS GO MAINSTREAM

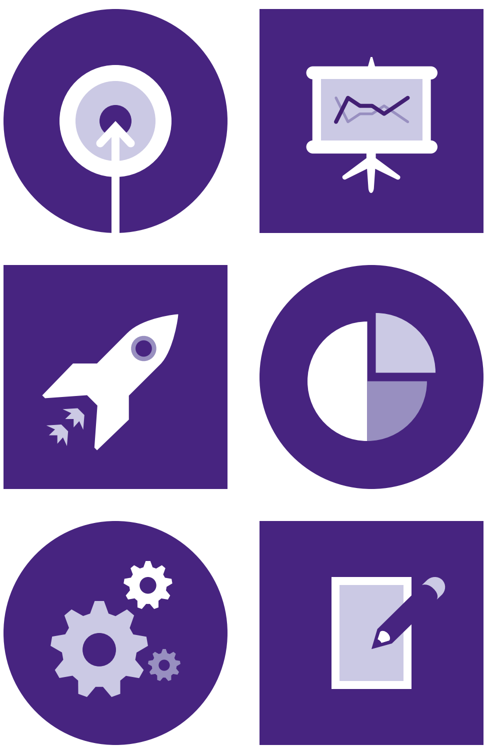
With support from two major nonprofit organizations, Rogers's team will send sensors to the families of 20,000 infants in India, Pakistan, and Zambia later in 2019. Rogers estimates that his wireless sensors will appear in hospitals in the United States within two to three years.

The next step could be sending sensors home with parents, so they can continue monitoring their newborns after they leave the hospital. The technology could play a role in better understanding and even preventing SIDS—sudden infant death syndrome—the leading cause of death of babies in the first year of life.

"Most parents get even more nervous when their baby is released from the NICU," Rogers says. "They're at home then and don't have monitoring capabilities. Deploying these devices in the home is certainly a possibility and could help parents feel more empowered."

AMANDA MORRIS

Photography by Monika Wnuk and Sally Ryan



SO, YOU SOLD YOUR STARTUP?

YOUR STARTUP IS SUCCESSFULLY UP AND RUNNING.
IS NOW THE TIME TO SELL?
THE VOICE OF EXPERIENCE SPEAKS.

Having learned the basics of starting a business in NUvention: Web, a flagship interdisciplinary course in Northwestern's Farley Center for Entrepreneurship and Innovation, three alumni entrepreneurs share their experiences in selling a startup and offer their takes on what's needed, where to focus your energies, and how to make room for yourself while in the throes of negotiation.

JONATHAN FRIEDMAN (MS '14)

Cofounder of TradeUp.io, an online learning platform

Sold to Apollo Education Group in May 2014

Northwestern beginnings Jonathan Friedman originally planned to become a lawyer, but after meeting Daniel Daks ('13) on his first day as a first-year student, the two began working together on projects, like building a website for ranking debate teams. Separately, each took NUvention: Web, a course which puts together interdisciplinary teams and charges them with building and launching web-based businesses. Friedman joined Daks's team after the course, and the two planned to take the team's idea—online continuing education for accounting professionals—and develop it into a startup.

Growth and scale The two applied for and were accepted into the Dreamit Ventures startup accelerator program. But when another team member who originated the idea for accounting education dropped out of the group, Friedman and Daks knew they had to pitch something else to the Dreamit investors. They landed on the idea of making education more effective, with a less traditional structure. TradeUp.io was born.

"THE EXPERIENCE STRUCTURED THE WAY I THINK ABOUT BUILDING TEAMS AND MOTIVATING PEOPLE."

Deciding to sell As they built and refined their education platform, Friedman and Daks had no plans to sell. When the Apollo Education Group, which runs the University of Phoenix among other companies, offered funding in 2014, Friedman and Daks accepted. Over the course of the next six months, however, Apollo executives decided that instead of investing, they wanted to buy TradeUp. The two partners joined Apollo, and Friedman moved into the role of senior software engineer.

Life after the sale Selling the company meant Friedman's career course changed once again, from cofounder of a startup to middle management at a large company. For the first time ever, he had a budget, managed a group of employees, and worked with outside consultants. "It was an incredible learning experience for me," he says. "The experience structured the way I think about building teams and motivating people."

Northwestern advantage Having exposure to working in interdisciplinary groups through NUvention helped Friedman get to where he is today, he says. Now he comes back to advise NUvention teams.

Lessons learned Friedman stayed with Apollo for little more than a year, then became an independent consultant. Now he works as a lead developer at a finance company. He's happy in his current position, though he doesn't rule out another entrepreneurial run. He advises young entrepreneurs not to think about selling their company. "If your goal is to sell, you're focusing on the end and not the idea or product that will position you to sell it. And if you have to sell, you're screwed. You want to be in a position where you don't want to sell."

NIKHIL SETHI ('10)

CEO of Adaptly, which helps advertisers purchase and optimize ad campaigns across digital platforms

Sold to Accenture in December 2018

"ENGINEERING IS REALLY ABOUT HOW TO SOLVE PROBLEMS. LOGICAL REASONING SKILLS AND PROGRAMS LIKE NUVENTION, WHERE YOU CAN APPLY THAT MINDSET TO SOMETHING PRACTICAL, ARE A WINNING COMBINATION OF INGREDIENTS."

Northwestern beginnings Adaptly began in 2010 as part of NUvention: Web at Northwestern Engineering. At the time, Nikhil Sethi had just returned from an internship at HBO, where he got a glimpse of the challenges big companies face in marketing.

"I realized that it was this huge space with so many complex pieces," Sethi recalls, "and that I could apply an engineering mindset to solve those problems." The result was a service that allowed businesses to buy ads on multiple social network ad platforms simultaneously.

Sethi says the McCormick School of Engineering's curriculum and culture helped set the stage to take the leap as an entrepreneur. "I was an electrical engineering major, and I'll be the first to say that I haven't used that curriculum practically," he says. "But engineering is really about how to solve problems. Logical reasoning skills and programs like NUvention, where you can apply that mindset to something practical, are a winning combination of ingredients."

Growth and scale By 2011, the company had raised $2 million and had 25 employees in its Manhattan office. As social media platforms grew and multiplied, businesses and brands increased their investments in social media advertising to reach more consumers. Adaptly continued to grow, eventually expanding to 150 employees in the United States and western Europe, and counted among its customers some of the most recognizable brands in the world, including Ford and Sprint.

Deciding to sell Because Adaptly had become a leader in social advertising, it was continually courted by other companies looking to purchase not only the platform but also the relationships Adaptly had formed. When approached by Accenture, a global management consulting firm, Sethi found that the two companies' visions were aligned. "We want to take the technology we built and the customers who were important to us and take everything to the next level, to a global scale, to every major company out there."

Structuring the deal took a year, and Sethi insisted that it be positive for the Adaptly family, as well. "Everybody is coming with us," he says. "Everybody is going to get a chance to take their career to the next level."

So, when the deal was finished, how did Sethi celebrate? "I had a nice dinner with my fiancée, and then we went back to work," he says. "The company is now like a rocket ship that's an inch off the ground. The engines are running, and we know we can go much higher, but we've just barely begun."

Northwestern advantage Northwestern Engineering provided contacts and access to mentors who helped shape the business, including Michael Marasco, director of the Farley Center. Sethi is now part of the NUvention: Web advisory board, where he stays in touch with the engineering community. "The engineering school brings together a group of like-minded people who have the kind of passion that's required to do something big," he says.

Lessons learned The yearlong process of selling the business was more involved and intense than Sethi expected. "Be prepared for a roller coaster," he says. "Nothing happens as seamlessly as one would think." He also noted that entrepreneurs should already understand that, because to become successful, they will need the tenacity and grit to get up and try again after things don't go as planned.

"Companies are looking for a management team that can run a business under constant pressure," he says. "Being able to keep your eye on the ball while running your business is key for these kinds of things to happen."

Ultimately, he says, companies don't buy companies—people connect with people, and companies acquire the knowledge and the relationships people have. He advises young entrepreneurs to "just get to know people, even if those people don't directly impact their business today. Those relationships can go a long way."

Along the way, entrepreneurs should remember to focus on self-care. Sethi does this by turning off his phone and walking his dogs. "It can be easy to forget to take care of yourself," he says. "Find the small moments and relationships that make you happy. That will help fill up your tank and push you through to the next stage of the deal."

NICK RENOLD ('11)

Former COO of Titan Aerospace, which built unmanned aerial vehicles

Sold to Google in April 2014

"THE FARLEY CENTER FOR ENTREPRENEURSHIP AND INNOVATION WAS A SPRINGBOARD THAT ALLOWED ME TO GET THE BACKGROUND AND EXPERIENCE I NEEDED TO WORK IN STARTUPS. THEIR GUIDANCE WAS QUITE VALUABLE."

Northwestern beginnings Nick Renold took NUvention: Web his senior year, and after graduation, he and his teammates created the startup Waddle, which offered an iPhone app that enabled groups to create private social albums. When the company folded a year and a half later, Renold met another alumnus who was working at Titan Aerospace, a startup that designed and built solar-powered unmanned aerial vehicles. Renold joined the company as its seventh employee.

Growth and scale As Titan Aerospace developed more in-depth technology and went through several rounds of funding, Renold became chief operating officer. Located in New Mexico, the company had lots of space to test its drones, and the small group of employees aimed to develop drones that could fly at 65,000 feet for several years without landing. "When you're in a small company and everyone is focused and working hard together, it's very exhilarating," he says. "It's one of the most fun experiences you can have."

Deciding to sell As the company grew, its leadership began exploring both investment and an acquisition. Ultimately, Google purchased the company in 2014. Renold found that having a good lawyer was key. "Good legal counsel will help guide you through negotiations and due diligence," he says, adding that once the sale went through, "It was really fun to tell all our family members and friends."

Life after the sale Titan Aerospace became part of Google X, and Renold became a technical program manager with the company. "Going from a startup to a bigger company takes a lot of flexibility," he says. "Processes change, growth rates change, and you become part of a much larger entity." Google X ultimately shut down the project in 2017, and Renold now works on Project Wing, Google's drone delivery initiative.

Northwestern advantage "The Farley Center for Entrepreneurship and Innovation was a springboard that allowed me to get the background and experience I needed to work in startups," Renold says. Farley Center director Michael Marasco and adjunct lecturer Todd Warren provided key mentorship and a sounding board when Renold had questions. "Their guidance was quite valuable," he says.

Lessons learned Renold encourages young engineers to try to build their own startups, even if they ultimately fail. "Your first startup isn't going to succeed," he says. "You have to fail, and try again."

EMILY AYSHFORD

IN TEAM SPORTS, CHEMISTRY IS A GAME CHANGER

THE DISCOVERY BY NORTHWESTERN ENGINEERING'S NOSHIR CONTRACTOR THAT PAST SHARED SUCCESS AMONG TEAMMATES IMPROVES THEIR ODDS OF FUTURE WINS HAS IMPLICATIONS FAR BEYOND THE PLAYING FIELD.

“There’s a general sense in sports about the importance of team chemistry, but it’s a nebulous concept. We wanted to be more rigorous about how we think about team chemistry.”

NOSHIR CONTRACTOR
Jane S. and William J. White Professor of Behavioral Sciences in the McCormick School of Engineering, the School of Communication, and the Kellogg School of Management

When LeBron James, Dwyane Wade, and Chris Bosh signed with the Miami Heat of the National Basketball Association (NBA) as free agents in 2010, sports fans heralded the arrival of the league’s first “super team.”

Despite boasting a lineup featuring three of the league’s best players, the Heat began the 2011 season with a disappointing 9–8 record as its stars acclimated to their new roles as teammates. Looking back at the team’s inauspicious start, Northwestern Engineering’s Noshir Contractor isn’t surprised.

“Of course, individual players on a team make a difference, but so much focus is spent on finding those with the most talent,” Contractor says. “Other factors, like how people get along together or how well they trust each other, suggest that teams are defined not just as an aggregation of individuals and their attributes, but also by the relationships that existed previously among them.”

Contractor, Jane S. and William J. White Professor of Behavioral Sciences and professor of industrial engineering and management sciences in the McCormick School of Engineering, put this paradigm to the test. Teaming up with Brian Uzzi, Richard L. Thomas Professor of Leadership and Organizational Change at the Kellogg School of Management, and Satyam Mukherjee, a former post-doctoral fellow in the Northwestern Institute on Complex Systems, Contractor analyzed statistical data from professional sports leagues and online games, and found that past shared success among team members improved their odds of winning future games—results that could have implications far beyond sports.

A FORMULA FOR SUCCESS

“There’s a general sense in sports about the importance of team chemistry, but it’s a nebulous concept,” Contractor says. “We wanted to be more rigorous about how we think about team chemistry. Psychology has shown that when you enjoy success together, you learn more from the experience, so we focused on players who played together on winning teams.”

The researchers studied individual player statistics from five data sets: NBA games and English Premier League soccer matches played between 2002 and 2013, Indian Premier League cricket matches from 2008 to 2012, and Major League Baseball games from 2002 to 2012. The group also studied 2011 game logs for Defense of the Ancients 2 (Dota 2), a multiplayer, team-based online battle game.

For each sport, researchers determined a team’s overall skill—the strengths of their individual players—by calculating player averages in key statistical categories, like points per game and assists per game in basketball, or goals per game and shots on goal in soccer. They also measured the number of times a pair of players were part of the same winning team, a metric they called “prior shared success.”

The group used linear regression modeling to examine the impact of a team’s past success on predicting the outcome of games during the season following each league’s data set. They found marked improvement in their predictions—between 2 and 7 percent—across each sport when prior shared success was included with the team’s overall skill compared to accounting for team skills alone.

“We looked at the results and thought, ‘Is this too good to be true?’” says Contractor, who also holds appointments in Kellogg and the School of Communication. “We even tested the robustness of the findings by using alternative measures of individual player statistics to compute skills variables, and the results held up.”

The outcome was surprising considering the distinct cultural differences between the sports that were studied. Baseball, for example, is driven by an “ethos of three”—three strikes before a player is out, three outs before an inning ends. Although the standard is unique to the American sport, the same patterns held true.

“You would think that differences that are more culturally constrained impact one-on-one team dynamics, but to find that they don’t, that our results transcend games and cultures—including a global enterprise like Dota 2—is notable,” Contractor says.

BEYOND THE PLAYING FIELD

While the availability of analytics made sports a natural industry to test, the insights gained from the team’s research applies in many more contexts, including business, academia, and even space travel. Contractor is currently working with NASA to study space crew simulations in hopes of better predicting the right combination of astronauts to maximize the crew’s performance and viability when teams are sent to Mars.

“Once you’ve gained as much as you can from bringing the right people together, you have to look for the next competitive advantage,” Contractor says. “Whether it’s in the workplace of the future on Earth or in deep space, understanding the relational predictors of team success is going to be very important.”

ALEX GERAGE

REPROGRAMMING THE GENOME

New Center for Physical Genomics and Engineering ignites a revolution in medical research and beyond.

> "I hope within years, our technologies can make a significant difference for a generation of patients, including cancer patients."

VADIM BACKMAN Walter Dill Scott Professor of Biomedical Engineering and Director, Center of Physical Genomics and Engineering

IMAGINE TAKING A DNA MOLECULE—THE SOURCE OF GENETIC INSTRUCTIONS FOR ALL LIVING THINGS—AND MAKING IT A MILLION TIMES LARGER. THE RESULT WOULD BE ABOUT THE WIDTH OF A SPAGHETTI NOODLE, BUT THE LENGTH WOULD TRAVEL FROM NEW YORK CITY TO DALLAS.

Now imagine taking that long DNA noodle and stuffing it into a small living room. That illustrates the highly-packed, dense structure of what is called chromatin, the three-dimensional organization of the genome which regulates patterns of gene expression.

Over the past decade, Northwestern Engineering's Vadim Backman and other researchers throughout the University have developed new techniques and technologies to better understand the physical forces involved in this packing, and how they might regulate global gene expression.

Their groundbreaking work is advancing an entirely new field called physical genomics. The findings to date have been striking: when researchers targeted chromatin structure to limit a cancer cell's ability to evolve and become resistant to chemotherapy drugs, the technique eliminated virtually 100 percent of cancer cells in cell cultures and animal models.

Armed with these initial results and with an eye toward tackling some of today's most complex medical problems, Backman is launching the Center for Physical Genomics and Engineering, a new collaborative force that will further secure Northwestern's spot at the forefront of this emerging field. "I hope within years our technologies can make a significant difference for a generation of patients, including cancer patients," says Backman, Walter Dill Scott Professor of Biomedical Engineering at the McCormick School of Engineering.

Hacking the body's software for good

Researchers have long known that the root of many of the intractable diseases that afflict human beings lies within their genes. In recent years, gene editing tools like CRISPR and Cas9 have been developed to try to solve this problem.

With these tools, researchers have asked: What if biomedical engineers could find a way just to edit out the genes that are associated with incurable or debilitating diseases? What if researchers in the field of epigenetics could simply turn on the genes they want expressed, and turn off the ones they don't?

Photography by Kyle Monk

> "Physical genomics falls right at the interface of physical sciences, biology, and computational sciences. You can't address it within the context of any one existing field of science. You need a convergence. Collaboration is critical. Nobody can do it alone."
>
> **VADIM BACKMAN** Walter Dill Scott Professor of Biomedical Engineering and Director, Center of Physical Genomics and Engineering

Even if researchers could achieve all that, they still would have solved only part of the problem because they wouldn't have taken an overall systems view: Many diseases involve an interplay among hundreds or even thousands of genes, all influenced by the structural organization of chromatin. Physical genomics aims to do just that—to take an all-encompassing approach and regulate global patterns of gene expression.

If we consider genes to be the body's hardware, then chromatin is its software, and the structure of chromatin is the operating system. Only by understanding how all three work together can researchers hope to take on complex diseases like cancer, which can involve the entire genome.

For the past 20 years, Backman has tried to understand just how this genomic software works. "To start addressing these questions, we had to develop the technologies first, which took a long time," he says. Those technologies include nanoscale super-resolution imaging, computational modeling of complex biological processes, and computational electrodynamics, all developed at Northwestern by researchers from disparate disciplines working together.

"Physical genomics falls right at the interface of physical sciences, biology, and computational sciences," Backman says. "You can't address it within the context of any one existing field of science. You need a convergence. Collaboration is critical. Nobody can do it alone."

To develop the needed technologies, Backman teamed up with researchers across Northwestern, including Allen Taflove, professor of electrical and computer engineering. For more than 40 years, Taflove has been solving Maxwell's equations, which are fundamental equations of classical electrodynamics.

Taflove and Backman have collaborated over the past 15 years, and Taflove helped with initial work using light to detect nanoscale changes in tissue that indicate cancer. Taflove is now working to use that technology to detect changes in chromatin.

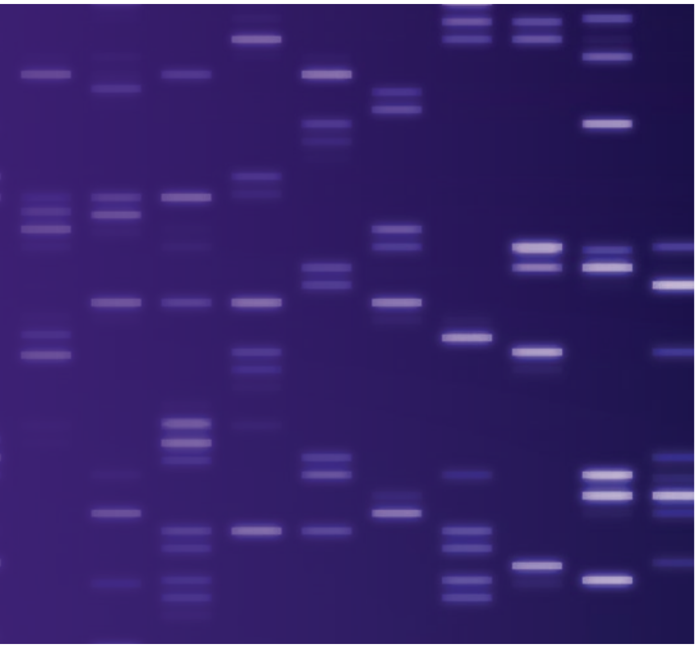
When the technologies were refined to the point that researchers could begin looking at never-before-seen parts of the genome, Backman and his collaborators began modeling the processes in play there, and a whole new world of possibilities opened up. "The research has shifted in an extremely exciting way," Taflove says. "How often does an engineer have the opportunity to say that we can really change the world? This center could spark a revolution in medicine."

Developing a new cancer therapy

The team's first target is cancer. Through the nanoimaging technologies, researchers discovered that the packing density of chromatin in cancer produced predictable changes in gene expression. In other words, the more disordered the density, the more likely the cancer cells were to adapt and survive, even in the face of chemotherapy. If their packing density was more ordered, the cancer cells were more likely to die from treatment.

Northwestern researchers realized they could control the chromatin by changing the electrolytes in the cell's nucleus using FDA-approved drugs already on the market. The drugs were prescribed for arthritis and heart conditions, but they also had a side effect of altering chromatin packing density.

Researchers call the technique chromatin protection therapy and found when they used it in conjunction with chemotherapy drugs in both cell cultures and animal models, it almost completely eliminated cancer cells. The combination regulates chromatin's structure in a way that prevents cancer from evolving to withstand treatment, making the disease an easier target for existing drugs. "In the near term, this could become a broad-spectrum therapy for cancer," Taflove says.



Harnessing the power of the genome

Cancer isn't the only target for this type of therapy. Other complex diseases, like Alzheimer's and atherosclerosis, could potentially be treated by regulating global patterns of gene expression.

In fact, given that every organism is ultimately defined by its genome, the technique could be used in any living thing for a variety of purposes. Backman speculates that perhaps plants could be altered to better withstand climate change, or cells could be altered to create new kinds of fuels.

One of most encouraging aspects of physical genomics is that, unlike gene editing, the results are completely reversible. If genes are the hardware, then editing any gene would make the changes permanent. But, Backman adds, if chromatin is the software, and chromatin structure is the operating system, then changes can be dynamically altered and shifted, then changed back, even in real time.

For collaborator Guillermo Ameer, Daniel Hale Williams Professor of Biomedical Engineering and Surgery and director of the Center for Advanced Regenerative Engineering, the technology could help him and his team better understand how cells interact with surfaces and each other, leading them to design better materials to promote regeneration in the body.

"This is a new frontier," Ameer says. "We have the opportunity at Northwestern to be at the center of what could impact millions down the road."

For researchers in the Feinberg School of Medicine's Department of Obstetrics and Gynecology, the center could further their goal of successfully treating ovarian cancer, a disease that is particularly difficult to cure. Backman has worked with Daniela Matei, Diana, Princess of Wales Professor of Cancer Research, to use his technology to image the chromatin of ovarian cancer stem cells to see how the chromatin structure changed with treatment. Backman is also working with Shohreh Shahabi, John and Ruth Brewer Professor of Gynecology and Cancer Research, to develop a clinical trial to use his chromatin protection therapy in ovarian cancer patients.

"Vadim goes out of his way to make collaborations possible," Matei says. "He opened the door for us to explore this new therapy, and the new center will only facilitate more of these intersections between engineering and translational oncology."

Because the nature of physical genomics research is so interdisciplinary, one of the goals of the new center is to educate the next generation of researchers who can think and communicate across disciplines. "The traditional educational paradigm is not the best to train highly interdisciplinary researchers," Backman says. "You need an engineer who can think like a biologist and know enough about biology to talk with biologists, and vice versa."

The center hopes to develop curricula and training for high school students all the way to postdoctoral fellows that will help develop thinkers who can speak multiple scientific languages. "It's one of the best times ever to begin studying engineering," Backman says. "With knowledge of the convergence of all these fields, like artificial intelligence, biotechnology, physical sciences, and medicine, engineers will be the leaders in this new world. There's no doubt about it."

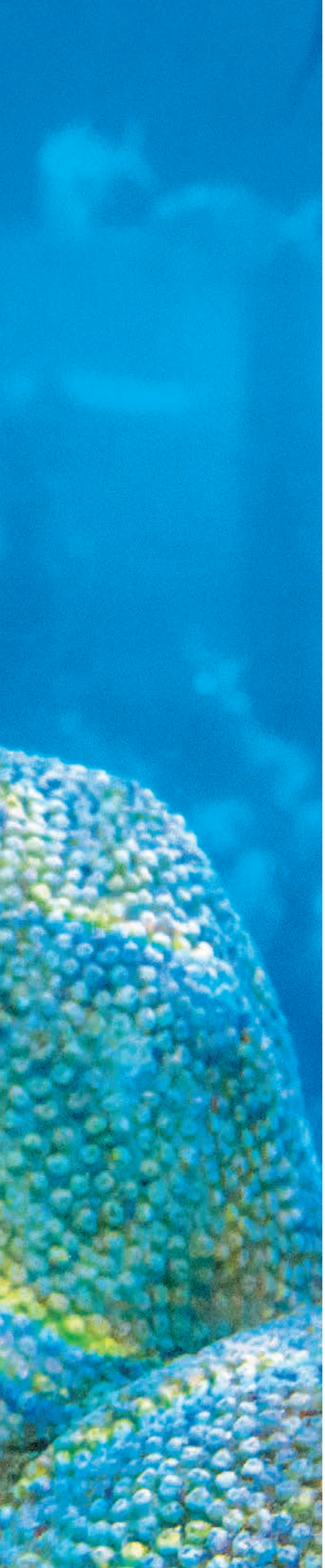
Though much work remains to be done, Backman and his collaborators hope that, through the efforts of the Center for Physical Genomics and Engineering, this technology and the therapeutics it provides could be in the hands of physicians for clinical use within a decade.

"My goal is to save one patient," he says. "And then we'll go from there."

EMILY AYSHFORD

DEEP DIVE

Northwestern Engineering students continue to delight Shedd Aquarium scientists year after year with innovative, collaborative solutions to important challenges.



"I'M REALLY EXCITED JUST TO SEE THE PROTOTYPE IN ACTION. SEEING IT BEING USED LIKE THIS UNDER WATER BY A DIVER IS REALLY AMAZING."

KATHERINE MCILREE
Senior, McCormick Integrated Engineering Studies Program

ON A QUINTESSENTIAL WINTER DAY IN CHICAGO, as the temperature barely approached zero, a group of Northwestern Engineering undergraduates remained firmly focused on the Bahamas.

With the frigid waters of Lake Michigan lapping on the edge of the city's Museum Campus, five students in the Design 384: Interdisciplinary Design Projects course stayed warm inside the stately neoclassical Shedd Aquarium's octagonal vestibule, eyes locked on the Caribbean Reef exhibit.

Just minutes before, they'd had the chance to go behind the scenes of Shedd's well-known exhibits celebrating aquatic life to prep the aquarium's volunteer diver on how to test a prototype caliper they had designed to help scientists measure queen conch shells in the Bahamas.

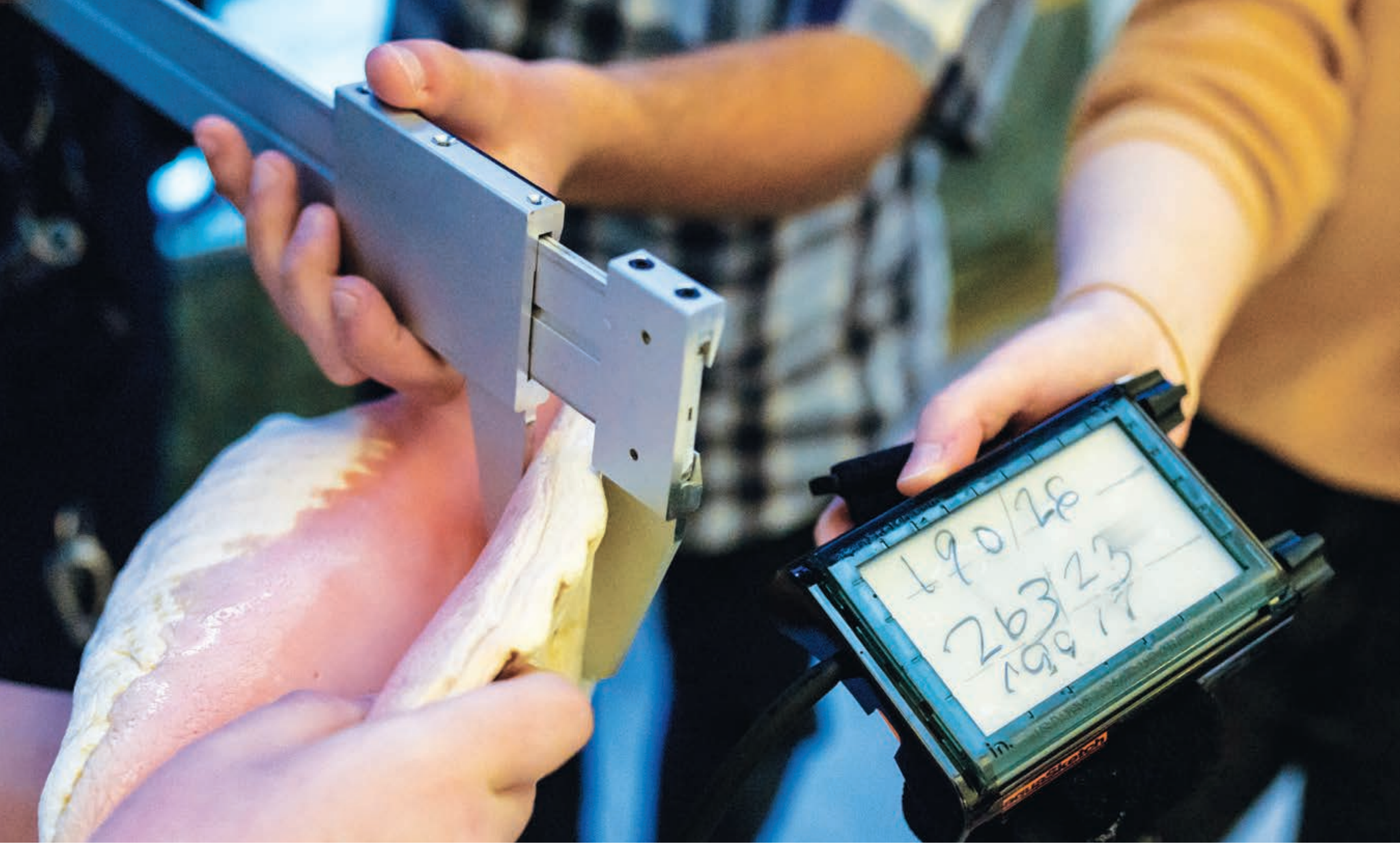
Work on the prototype started in the classroom at the Segal Design Institute as part of a unique collaboration between Shedd and the McCormick School of Engineering that spans nearly 14 years. This team of Northwestern students comprises one of five Design 384 groups collaborating with Shedd this academic year—more groups than ever before.

The project is all the more important because conch populations are threatened. "We're at a critical tipping point right now for the Bahamian conch," says Shedd research biologist Andy Kough, who uses numerical modeling and dive surveys to explore conch populations. "The species has been widely fished for many, many moons, and most populations are in decline. They're approaching a state of serial depletion, which means that regulations are needed in order to stop them from disappearing."

Into the reef

As the hands of Shedd's brass clock—its face emblazoned with fish instead of numbers—indicated 2 p.m., Rich Fluck, the diver, entered the 90,000-gallon Caribbean Reef habitat specifically stocked with conch shells for him measure. "I'm really excited just to see the prototype in action," said Katherine McIlree, a senior in the McCormick Integrated Engineering Studies program as she watched Fluck. "Seeing it being used like this under water by a diver is really amazing."

Photography by C. Jason Brown



The collaborative project aims to help scientists like Kough learn more about the ages and sizes of conchs in certain populations in the Bahamas. The tools currently available to him and the citizen scientists he recruits to measure thousands of shells annually are less than ideal.

"The idea was that the students could help create a new generation of calipers that solve some of the problems we've encountered—which include everything from curious barracudas that are attracted to the shiny metal in our hands to degradation of the tools in the saltwater environment," Kough says.

It's exactly the type of assignment Segal students have tackled over the years, which have yielded practical solutions used regularly by Shedd staff. For instance, Northwestern students designed a fish anesthesia machine that continues to evolve more than a decade after its creation.

"We want the students to understand the process for doing design work," says Stacy Benjamin, lead instructor for Design 384 and director of the Segal Design Certificate, a set of courses and projects that build design knowledge and skills. "As much as we want to produce a useful end deliverable, the real goal for students is to learn the process of problem solving. They're learning how to explore, how to consider a wide range of stakeholder viewpoints and challenges, and to think critically about their own work."

Long-time partners

The collaboration began in 2005 when Bill Van Bonn, Shedd's vice president for animal health, met McCormick Advisory Council member Bob Shaw ('70, MM '81) and told him about the challenges aquariums face. This included the lack of a commercial market to supply equipment for aquarium-specific veterinary practice or enrichment activities for marine mammals, which meant solutions were in short supply.

Shaw suggested to Van Bonn that he approach Segal's Benjamin about forming a client relationship with the design institute through which students could develop potential solutions for industry problems. In addition to participants from Design 384, students in the first-year course, Design 106: Design Thinking and Communication, also work on Shedd projects.

The results have been satisfying for both sides of the partnership. "It's a wonderful opportunity for the students. They always get very excited about working with Shedd," says John Anderson, codirector of the Segal Design Certificate and an instructor for Design 384. "There's always a sense that we're really doing something that is helping them out and will have an impact."

Van Bonn agrees. "Some of us had been working on these issues for 10 years," he says. "When we give these challenges to the students, a lot of times they come up with fantastic ideas that none of us have ever thought of."

> **"As much as we want to produce a useful end deliverable, the real goal for students is to learn the process of problem solving. They're learning how to explore, how to consider a wide range of stakeholder viewpoints and challenges, and to think critically about their own work."**
>
> **STACY BENJAMIN**
> Director, Segal Design Certificate

New territory

The first collaborative projects revolved around needs for the aquarium's on-site animal hospital. Over the years, however, interest has grown, and collaborations now include working with the animal care teams on husbandry and with Shedd's Daniel P. Haerther Center for Conservation and Research.

"The students get very engaged because it's not a traditional engineering project. They're engineering problems but in a really cool context," says Dan Brown, an instructor for the Design 384 class and director of the Ford Prototyping Lab, who is co-leading the conch group.

Another one of this year's projects challenges students to create a "smart" penguin egg embedded with sensors to collect information about how penguins care for their eggs. With penguins facing declining populations, a fake egg that could collect information, such as temperature, humidity, movement, and rotation, could help animal care staff learn more about penguins' breeding habits.

"We're trying to figure out what we can do to help our animals breed more successfully and what can we do to help their counterparts in their natural environment do the same," says Nikki Mason, senior trainer for marine mammals at Shedd.

Photography by C. Jason Brown

"Testing should always be done in the most realistic conditions possible. With Andy's help as our organizer and liaison, we were able to get the closest thing to the Bahamas that Chicago has to offer."

LAUREN BURNS
Senior, Manufacturing and Design Engineering

"THEY CREATE PHYSICAL PROTOTYPES FOR US, AND WE GET THE SATISFACTION OF CONTRIBUTING TO THESE STUDENTS' EDUCATION AND GETTING THEM EXCITED ABOUT OUR WORLD." **BILL VAN BONN** Vice President for Animal Health, Shedd Aquarium

The students' work, which helps them acquire professional skills, could also contribute significantly to protecting wild populations by using the smart egg with many other species of birds.

"Working this closely with Shedd has reaffirmed that working in the product development sphere is what I'd love to do going forward," McIlree says. "It has definitely shaped my view on how comfortable I feel with my communication and design skills."

And, Shedd staff benefits from products that make their jobs easier. A puzzle maze created in 2013 serves as an enrichment tool for sea otters as they retrieve food trapped in a ball by navigating through an adjustable maze.

Sharks on the move

Another team of students in Design 384 is helping animal care staff and veterinarians who care for sharks. When sharks need medical attention, they are moved to a smaller habitat to allow animal care staff and vets better access. Students are working to create a solution to help give staff more comfortable access to the sharks.

Observing sharks behind the scenes at Shedd provided Vivien Ng, a senior studying manufacturing and design engineering, a new learning experience. As Ng stood near a giant exhibit where sharks swam around, she watched Shedd staff working together restocking a refrigerator with labeled plastic bins containing food for the sharks.

"I'm from Chicago, and when we were little, we'd go on field trips to Shedd," Ng says. "I remember really liking the dolphins and penguins, but I never really understood how Shedd scientists cared for the sharks. I now have a lot more respect for that work."

Meanwhile, back at the reef

After Fluck surfaced from his dive to try out the new caliper prototype, the student team met behind the scenes with Fluck, another diver, and Kough to debrief. The students learned the prototype could be streamlined for diver comfort while reducing the risk of damaging the reef.

"The feedback they gave us was all actionable. That was really awesome because it included things we knew we could check off our list immediately and continue going forward in that design direction," McIlree says.

For instance, O-rings attached to the shoulder straps of the dive gear could allow the diver to carry the tool handsfree, making it easier to swim to the conch. "That really surprised us. We hadn't thought of that," McIlree adds. "But once we saw the caliper in the water and how it would react with objects around it, it became incredibly apparent what was needed."

The team also learned that duller tools would prevent accidental cuts for the diver or the conch. "Every extra piece of equipment introduces a variable that increases the risk of damaging the reef," says Lauren Burns, a senior studying manufacturing and design engineering. "Our team was able to learn so much more seeing our devices in action."

The students met with Kough throughout the quarter to refine the prototype. The team made several calipers, which could be used for years—or perhaps decades—to come, for Kough to use on upcoming research trips to the Bahamas.

"Testing should always be done in the most realistic conditions possible," Burns says. "With Andy's help as our organizer and liaison, we were able to get the closest thing to the Bahamas that Chicago has to offer."

The collaboration might grow to involve projects beyond the aquarium walls—including animal rescue and rehab and endangered species protection. "For us, it's a small investment in attention to the students. But the return is really incredible," Van Bonn says. "They create physical prototypes for us, and we get the satisfaction of contributing to these students' education and getting them excited about our world.

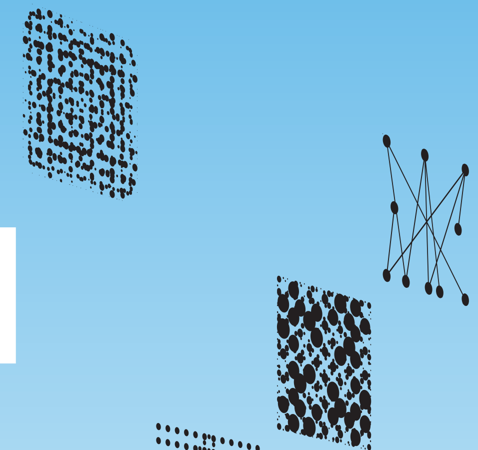
"When you combine the resources that McCormick brings with those that Shedd makes available to the students," he adds, "it's pretty cool."

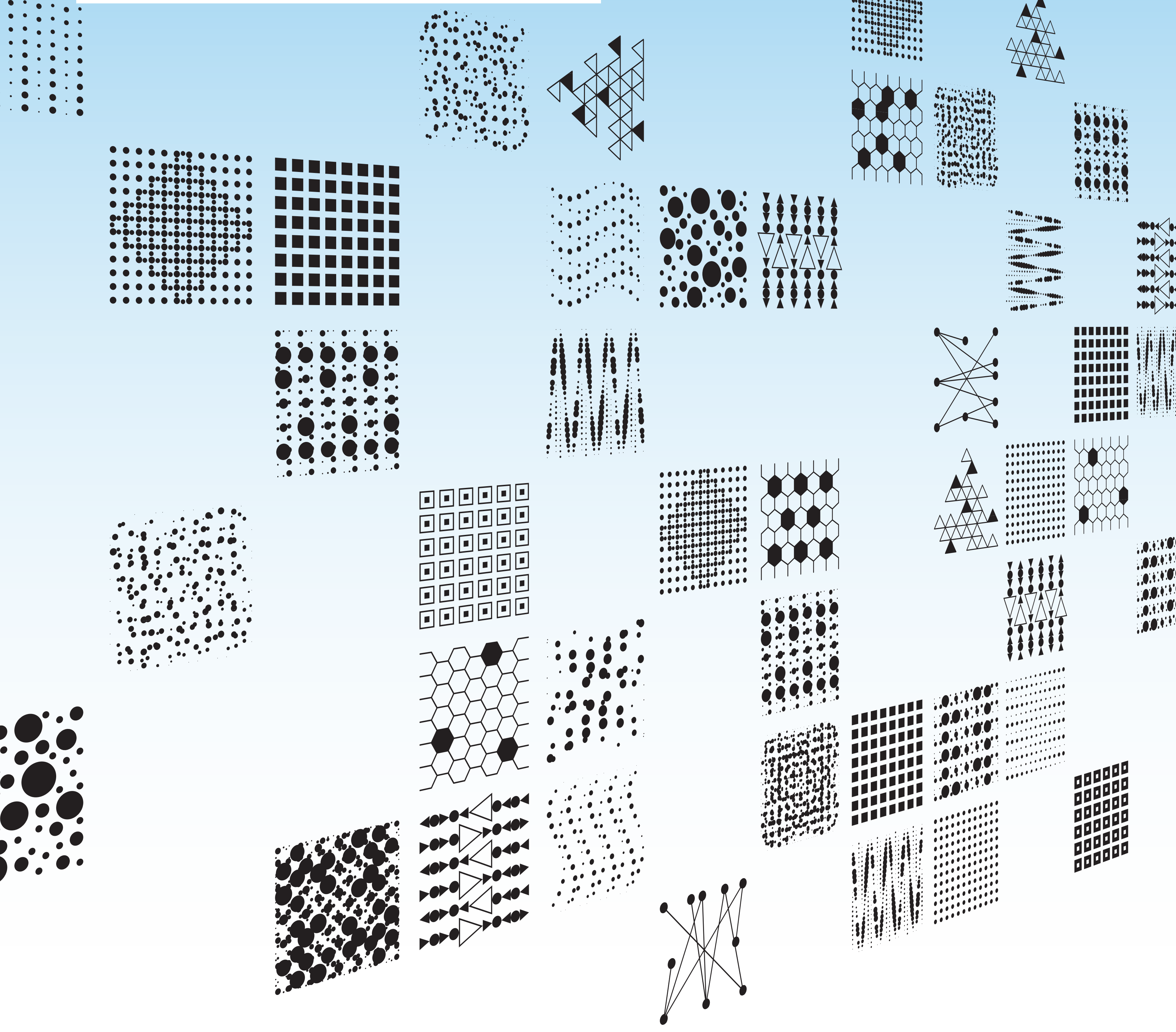
ALEXANDRIA JACOBSON

Photography by C. Jason Brown

REDESIGNING MATERIALS DESIGN

THE NORTHWESTERN-LED CENTER FOR HIERARCHICAL MATERIALS DESIGN BUILDS A REVOLUTION FOCUSED ON HOW ENGINEERS WORLDWIDE CREATE NEW MATERIALS.





"CHiMaD is broadening the materials design strategy from metals to just about every materials class you can imagine."

PETER VOORHEES Frank C. Engelhart Professor of Materials Science and Engineering, and Codirector and Managing Director, CHiMaD

About 30 years ago, after his daughter was born, Greg Olson moved from being a research scientist at MIT to becoming a faculty member at Northwestern Engineering's Department of Materials Science. Fatherhood had inspired him to make the world a better place.

"As a scientist, you take things of known technological value and try to understand how they work. But I wanted to engineer solutions instead," he says.

With that motivation firmly intact, Olson, Walter P. Murphy Professor of Materials Science and Engineering, now serves as one of three codirectors of the Northwestern-led Center for Hierarchical Materials Design. Known as CHiMaD, the center is a collaboration among 53 principal investigators at eight institutions with the "humble" aim of revolutionizing the way the world designs new materials.

"CHiMaD is broadening the materials design strategy from metals to just about every materials class you can imagine," says Peter Voorhees, codirector and managing director of CHiMaD and Frank C. Engelhart Professor of Materials Science and Engineering at the McCormick School of Engineering.

The vision

Launched five years ago through a $25 million award from the National Institute of Standards and Technology (NIST), CHiMaD is tasked with developing databases, computational tools, and experimental techniques to drastically decrease the time and expense of discovering and commercializing novel materials. Already, the center's work has led to the creation of new, high-performance materials for everything from computers to space travel. In January 2019, NIST renewed CHiMaD's funding to fuel another five years of advances, which fit within the vision of a larger national project called the Materials Genome Initiative.

Olson notes, "Just as DNA acts as a database that directs the assembly of living things, we're building databases of the parameters that direct the assembly of nonliving things. Together with computer programs that analyze them, these databases take much of the guesswork out of the process of mixing substances to create new ones with specific properties, like strength.

"All materials are intrinsically hierarchical because their structures can be analyzed on multiple length scales," Olson continues. "To design them, we have to address all those scales, starting with their quantum interactions."

Idea to market

Iteration is key to the process. The engineers begin with a list of desired characteristics, then build a computer program to search for them in a dataset of theoretical or experimental data. They use the program's predictions to make a few materials in the lab, and then test their properties, sometimes with highly specialized equipment, like the advanced photon source that Voorhees uses at Argonne National Laboratory, another CHiMaD partner. With more accurate data and some machine learning, the algorithms' predictions improve with each round of the process.

Once a new material is discovered, engineers still have much work remaining to get it to market. This is where industry partners, like QuesTek Innovations, cofounded by Olson in 1996, come into play. In collaboration with CHiMaD, the company is now applying its computational tools to the field of 3D-printed metals, even for objects as large as naval ship propellers. Meanwhile, Mark Hersam, Walter P. Murphy Professor of Materials Science and Engineering, is printing atomically precise 2D electronic materials, which are already being distributed by MilliporeSigma.

From metals to polymers and beyond

Another CHiMaD innovation to reach industry comes from Juan de Pablo, the third codirector of CHiMaD and the Liew Family Professor in Molecular Engineering at the University of Chicago, a partner institution. His wheelhouse is organic polymers—large, carbon-containing molecular chains or networks made up of smaller, repeated units.

"Databases and design methods for metals have been worked on for decades," he says, "but we are just beginning to develop them for polymers and softer materials." His computational tools for predicting the self-assembly of special polymers into nanometer-thick "wires" are already being used by the semiconductor industry to design microchips.

Thermoelectrics is the focus of another ongoing project at CHiMaD. The project is led by G. Jeffrey Snyder, professor of materials science and engineering, in collaboration with Chris Wolverton, Jerome B. Cohen Professor of Materials Science and Engineering, who brings expertise in machine learning. The two are searching for optimal materials to solve one of the world's most challenging energy problems: how to harness the approximately two-thirds of the world's energy use that's wasted as heat. While some existing thermoelectric materials have the potential to do that by generating electricity, they're too inefficient to be cost effective.

"This is exactly the kind of problem for CHiMaD to tackle," Wolverton says. "We're all about accelerating the discovery process."

The computational tools and data the CHiMaD collaborators are creating hold the long-term promise of truly revolutionizing new materials design worldwide and making the world a better place. As Voorhees says, "The impact will be felt for generations."

CATHERINE GARA

"AS LONG AS I CAN REMEMBER, I ENJOYED SOLVING PROBLEMS AND FINDING SOLUTIONS. IT JUST MADE SENSE TO ME TO STUDY ENGINEERING. IT FELT LIKE A GOOD MATCH."

BY APPLYING ENGINEERING AND DESIGN THINKING TO THE WORLD OF FINANCIAL SERVICES, YIE-HSIN HUNG HAS BECOME ONE OF THE MOST POWERFUL WOMEN IN HER INDUSTRY.

SEIZING OPPORTUNITY TO MAXIMIZE POTENTIAL

If there's one piece of advice Yie-Hsin Hung ('84) has for future engineers, it's to take chances. "Stepping outside of my comfort zone has been a constant theme of my career," she says.

That willingness to explore unexpected opportunities has propelled Hung to the top of the financial ladder as chief executive officer of New York Life Investment Management LLC (NYLIM). Under her leadership, NYLIM has seen a nearly three-fold increase in third-party assets under management to $325 billion today.

Twice named one of the Most Powerful Women in Finance by *American Banker*, Hung hopes her successful finance and investment management career demonstrates to the Northwestern Engineering Class of 2019 the wide-ranging power of an engineering education when she speaks at this year's commencement ceremony.

"I realize that by sharing my journey I have the potential to influence the next generation in terms of how they view their own potential and where they might take it over their lifetimes," she says. "My career started in one place and ended up in a different place altogether."

A GOOD MATCH

Her journey has roots at the McCormick School of Engineering. When she was born, her father was earning a PhD in civil engineering. Growing up, she shared his love of math and science, and she decided to follow in his footsteps.

"As long as I can remember, I enjoyed solving problems and finding solutions," she says. "It just made sense to me to study engineering. It felt like a good match."

While at Northwestern studying mechanical engineering, Hung made another good match. She met her future husband, fellow undergraduate Stephen Farinelli (CAS '84). They have been married for more than 25 years, have three children, and live in New York City.

Hung remembers her undergraduate years as a period of growing independence. "I learned to take control of my life, set my own goals, and decide what was important to me," she recalls. "I think of those four years as a very liberating and exciting time."

Summer internships at IBM served as one of her most formative experiences. She enjoyed the projects she worked on and learning about her mentors' career paths. "I became increasingly curious about the strategy of the company that was building these products and the senior people who were making the decisions," she says. "That experience ultimately led me to where I am today."

A TALENT FOR STRATEGY

Hung's next stop was Harvard Business School, where she earned an MBA and became intrigued by financial services. "I realized that with investment banking, I could combine the analytical skills that I developed studying engineering and marry that with my interest in strategy," she says. "It turned out to be even better than I expected."

Her first position was with Dean Witter Reynolds in New York, specializing in the real estate industry. At a time when an enormous number of private companies were going public, she found the constantly changing atmosphere exciting.

Every transaction was different, with various ownership structures and tax implications, requiring her to draw heavily on the analytical and creative problem-solving skills gained at Northwestern. She advised CEOs and CFOs at major real estate companies about strategy—how to grow and position themselves in a competitive marketplace. "I loved the pace, the intellectual challenge, and the chance to learn," she says.

BUILDING A PORTFOLIO OF EXPERIENCE

Hung worked her way up to managing director, but eventually began to crave a new challenge. She joined Morgan Stanley in 1997 in the real estate investment banking group before moving to Morgan Stanley Investment Management. On her way to becoming global head of strategic acquisitions and alliances, she led their private equity and hedge fund businesses and also participated on its management committee. "All of my different roles and responsibilities gave me a chance to gain a variety of valuable skills and experiences," she remembers.

In 2008, she spent two years with Bridgewater Associates as a management committee adviser, before joining NYLIM as head of alternative investments in 2010. After serving as its head of institutional investments and copresident, a time when she pursued geographic expansion and other initiatives to grow the business, Hung was named NYLIM CEO in 2015.

It wasn't the career path she expected. "None of it was planned, but it was rather fortuitous because all of my experiences prepared me well to become CEO," she says.

LEADING THE WAY

As CEO, Hung has helped build the company into a global third-party asset management business with many independent entrepreneurial investment boutiques specialized by asset class or geography. Since Hung entered leadership, NYLIM has tripled its assets under management through a combination of strong organic growth and selective acquisitions that include European-based Candriam Investors Group, an ETF firm called IndexIQ, and Tristan Capital Partners, a premier European real estate manager.

"When I joined New York Life, I thought this was the perfect environment to build a long-lasting investment management franchise," Hung says. "It's afforded me the opportunity to craft a strategy and realize a vision to achieve growth while staying true to the value of bringing together the entrepreneurial energy of NYLIM's boutiques with New York Life's financial strength and long-term orientation."

While leading this growth is satisfying, the most gratifying part of her job is fostering an environment in which people can do their best work, she says. "I try to devote my energy to creating a culture of collaboration, while also giving my leaders the freedom and accountability to deliver results for our clients."

AN INFINITE NUMBER OF PATHS

Hung learned her collaboration skills at Northwestern. Her gratitude for that strong foundation is one reason she serves on the McCormick Advisory Council.

Hung says the constant in her career has been a core grounded in solving problems by combining analytics with other disciplines—in essence, engineering thinking. She says the lessons that McCormick taught her, combined with her willingness to be comfortable with uncertainty, has gotten her to where she is today.

"I hope the new graduates truly embrace opportunities along the way without a preconceived notion of where they may take them," she says. "What lies ahead is an infinite number of exciting potential paths."

SARA LANGEN

CLASS NOTES

The Human Side of Business

"Northwestern Engineering taught us to have this ability to constantly push to be better, to be technical, and to bring smartness."

CHRISTINA KOSMOWSKI KNOWS A LOT ABOUT TEAMWORK AND GROWTH, AND SHE PUTS IT TO GOOD USE EVERYWHERE LIFE AND HER CAREER TAKE HER NEXT.

When Christina Kosmowski ('98) started working at Salesforce as a consultant in 2002, the customer relationship management platform had 200 employees and $20 million in annual revenue. When she left in 2017 as senior vice president of revenue lifecycle management and customer success, she had helped Salesforce grow to 25,000 employees and $8 billion in revenue.

Today, she serves as vice president, global head of customer success at Slack, the cloud-based collaboration software company. During her tenure, the five-year-old San Francisco company more than doubled in size.

"Northwestern Engineering taught us to have this ability to constantly push to be better, to be technical, and to bring smartness," she says. "We also learned to understand the human side of business and have empathy. People comment that's what my teams bring to the table, and I completely credit it to my education."

On a campus visit before her senior year of high school, Kosmowski learned that Northwestern would launch a women's soccer team the following year. That clinched the deal for the Kansas City teen passionate about both soccer and STEM. "Northwestern had that perfect blend of academics and the ability to play Division I soccer," she says.

After a brief stint as a chemistry major, Kosmowski switched to industrial engineering. "I was able to connect the dots between technology and science, as well as the people and the business side," she adds.

She put the teamwork and leadership skills learned in the classroom into practice on the soccer team, eventually becoming captain. Her junior year, the Northwestern team went to the NCAA tournament, and in her senior year, the team placed second in the Big Ten.

After graduation, Kosmowski worked at Tenneco Packaging, now Pactiv, in Lake Forest, Illinois, focused on efficiently manufacturing and distributing products including Ziploc bags and Hefty trash bags. But during the dot-com craze, tech caught Kosmowski's eye.

"I knew that technology had all this power to really make businesses more efficient and more productive," she says.

That led her to Salesforce, shifting her career toward customer success leadership and helping the platform become the largest of its type. After 15 years, however, Kosmowski wanted to take what she had learned and apply it to another new company. She landed at Slack.

Now, while traveling the world, Kosmowski proudly connects with fellow alums. "It feels so warm and welcoming to have such a strong community," she says.

She stays involved with Northwestern by serving as a mentor for industrial engineering students and chairing her 15th and 20th class reunion committees. Recently, she played in a tournament with former soccer teammates.

"I'm just so thankful for my experience, and I'm excited for the next generation of leaders who are coming through Northwestern, especially in engineering," Kosmowski says.

ALEXANDRIA JACOBSON

AGILE ADVOCATE

Jorgen Hesselberg (MSIT '07) combines his communication skills and tech training to help companies unlock agility.

"EVEN THOUGH TECHNOLOGY CHANGES QUICKLY, THE FUNDAMENTALS I LEARNED IN MSIT ARE THE SAME, AND THOSE SKILLS HAVE STAYED EVERGREEN. THE PROGRAM WAS LIFE CHANGING FOR ME."

Growing up in Norway, Jorgen Hesselberg was always curious about other people's stories. After high school, he came to the United States, fully intending to return home after college to become a journalist.

But when he met the woman who would become his wife, his life took one of many turns that would take him down new paths he could not foresee—paths that would ultimately lead him to understand the importance of adaptability.

"I've learned it is impossible to create a five-year plan and expect those plans will work out," he says. "The more open you are to planning and replanning, the better off you're going to be."

After attending journalism school at the University of Missouri-Columbia and earning his MBA from Iowa State University, he settled in Chicago with his wife, and "suddenly I was doing this American thing, which I never thought I would do." It was 2000, and software developers were in high demand. Even though he lacked a technical background, Hesselberg found he could learn the required skills quickly and that his journalism background helped him determine what software users really wanted.

As he eyed moving into a leadership position, he felt he needed a better balanced set of technical and business skills. He enrolled in Northwestern Engineering's Master of Science in Information Technology (MSIT) program and settled in with an interdisciplinary cohort that called itself "Brute Force." The members spent long nights together in study groups learning how to solve a diverse set of business and technology challenges—ranging from network engineering to marketing strategy.

"The program filled an important gap—removing the divisions between business and technology," he says. "It increased my confidence quite a bit."

After earning his degree, Hesselberg eventually landed at Navteq, a provider of geographic information systems data, which was struggling to compete with Google Maps. That's when he began to research agile project management, which optimizes organizations for fast learning, adaptation, and change. After presenting the idea of instilling a more agile way of working to the CEO, he worked across the company to implement the strategy.

"That ultimately became the beginning of a whole new career for me," he says. In fact, it led to an agile transformation lead role in Intel's Norway office in 2013, which allowed Hesselberg to move with his wife and two children back to his home country.

In 2017, he left Intel to start his own company, Comparative Agility, which offers companies a platform for agility assessment and continuous improvement. He also wrote a book about his experiences, *Unlocking Agility: An Insider's Guide to Agile Enterprise Transformation*, published by Addison-Wesley in 2018.

Today, he lives the life he wants—spending time with his family in the Norwegian mountains while working with senior leaders in finance and marketing to help them create more agile companies. He still returns to Northwestern to speak to students in the MSIT program, which created such a strong foundation for his career.

"Even though technology changes quickly, the fundamentals I learned in MSIT are the same, and those skills have stayed evergreen," he says. "The program was life changing for me."

EMILY AYSHFORD

SOOD & SOOD

Computer science brings true love to **Sara** and **Sanjay Sood** as they move from here to HERE and here again.

IN FALL OF 2002, during the first week of graduate school classes, Sara Owsley, a recent graduate of DePauw University, was setting up her office at 1890 Maple Avenue, then home to Northwestern Engineering's computer science department.

Then, Sanjay Sood walked in. At that moment a conversation began that would last a lifetime, lead to marriage and children, and actually influence the future of computer science.

Sara Owsley Sood is now Chookaszian Family Teaching Professor in the Department of Computer Science at the McCormick School of Engineering. Sanjay Sood is vice president of the Unit of Highly Automated Driving at HERE Technologies, which earned him a spot on *Crain's 40 Under 40*.

A VERY NORTHWESTERN FIRST DATE

When Sanjay, a recent Northwestern grad from Downers Grove, Illinois, first met Sara, a native of Louisville, Kentucky, 16 years ago, he recalls, "I thought she was smart and funny. She was from the South with a little bit of an accent. I was amazed by this woman who was a math major but picked up computer science later."

Unlike Sanjay and many others in their 20-person cohort, Sara was relatively new to coding. During her junior year in college, her life-long ambition to become a math teacher shifted when a professor advised her to take a computer science class to stave off the boredom of her math studies.

That interaction with a faculty member helped Sara realize she wanted to teach at the college level. "I never would have found CS otherwise," she says. "My professor really guided me. I wanted to have that type of impact."

So, when Sara met Sanjay, she was intrigued but a little intimidated.

"Sanjay was part of a group of guys in McCormick's Intelligent Information Lab who had a lot of experience in coding. They were cool. They were into Chicago's band scene. They already were a crew," she says. "And I was one of the few women in the cohort."

But, by week's end, Sanjay and Sara went on their first date—a lecture on campus by Judd A. and Marjorie Weinberg College of Arts and Sciences Professor Gary Galbreath about moon bears, followed by a field hockey game and dinner at a Chinese restaurant.

"It was a very Northwestern-style date," Sanjay says.

That evening quickly led to three more dates. "We definitely knew 'this is it' right away," Sara says. The duo became almost inseparable, taking all the same classes and buying a South Evanston condo together.

Sara switched advisers to work with Kris Hammond, Bill and Cathy Osborn Professor of Computer Science, who focuses on artificial intelligence and mentored Sanjay as an undergrad. "That's where all the fun was," Sara says.

Throughout graduate school, the couple's work intertwined on several projects, including a sentiment analysis system that was trained on product reviews. "Writing code together was a fairly traumatic time in our relationship," Sanjay says. "We were looking over each other's shoulders and trying to be super nice to each other while trying to get work done. It was a little tricky."

It was also very productive. Sara's thesis project, called Buzz, led to Sanjay's first job out of grad school. Buzz mined the web for interesting, emotional blog stories. Then, a text-to-speech engine and 3D rendering created theatrical performance pieces enacted by avatars. The project was set up as an exhibit at The Second City, Chicago's fabled improvisational comedy club.

Sanjay finished his program a quarter earlier than Sara, just as the Intelligent Information Laboratory received seed money from AT&T to launch a project. The lab chose Buzz, creating BuzzLabs.

"We ended up taking the guts of what Sara had done for Buzz and brought in professional designers and developers to build technology to create thousands of high-fidelity virtual performances," says Sanjay, who served as chief technology officer for about a year.

CALIFORNIA DREAM

Sanjay and Sara married in June 2007. After Sara graduated, she landed her dream job—assistant professor of computer science at Pomona College in Claremont, California, near Los Angeles. "I wanted to be at a small liberal arts school where I could focus on teaching," she says. "It was exactly what I wanted to do."

Sanjay moved with her to Southern California but took a job as chief technology officer at a San Francisco startup called Allvoices, which licensed InfoLab technology from Northwestern. For three years, he commuted to Northern California each work week.

"We lived in that pretty town near LA where Sara could focus on being an awesome teacher," Sanjay says. It worked. Sara earned the liberal arts college's Wig Distinguished Professor Award for Excellence in Teaching.

"I loved Pomona College," Sara says. "I was tenured. I had 20 to 40 students, and I felt I was having impact—teaching, researching, and doing service."

By 2010, just before their first child was born, Sanjay was over the 400-mile commute. Through his connections at BuzzLabs, he landed the job as chief data architect at AT&T Interactive near Los Angeles. Eventually, he moved up to senior vice president of successor company YP, running the 200-person team that developed a successful website and mobile app offering information from the US consumer Yellow Pages.

MIDWEST IS BEST

But in 2014, with two children and the desire for a third, the couple felt a tug to return to the Midwest and their families. "LA was not where we wanted to raise our kids," Sara says. "And, I wanted to focus on only teaching."

A recruiter called Sanjay about a job in Chicago at HERE Technologies, a billion-dollar tech company that creates location software, services, and content used by the likes of Facebook, Microsoft, SAP, and almost every global auto company. He accepted the job.

Meanwhile, Sara talked to universities around town, and ultimately was offered a position as an associate professor of instruction at Northwestern with a sole mission of teaching. "It is the perfect job for me," she says.

The opportunity came just as a tsunami of interest hit the Department of Computer Science, with hundreds of students flooding into undergraduate courses that once had attracted only a few dozen. "Northwestern quickly realized it needed to scale up its program," Sara says.

She credits Dean Julio M. Ottino with raising the profile of teaching computer science by giving her the first named position for a nontenured person in the McCormick School of Engineering. "He understands how important CS is to the future," Sara says.

Meanwhile, Sanjay's work has evolved along with the technology. He now leads a team of more than 300 at HERE working to develop systems that allow automated cars to navigate roads and their obstacles—critical developments for safe and smooth rides.

Both alumni, it seems, are influencing the future of computer science professionally and at home. Their two oldest children, Lincoln, 8, and William, 5, already are coding. Their youngest, Amara, is just 3.

"I would love for our kids to go to Northwestern when it comes time for college," Sanjay says. "You can get a great foundational education and a great start on life."

JULIANNE HILL

Photography by Sally Ryan

SOLVING COMPLEX SOCIETAL CHALLENGES

At NuMat Technologies, CEO and entrepreneur **Benjamin Hernandez** uses high-performance computing to design and build sophisticated nanomaterials to create solutions for critical issues.

When Benjamin Hernandez ('06, JD-MBA '13) received a letter about a summer program at Northwestern, the 17-year-old Maryland high school student had no idea that it would change the course of his life.

"The intent of the program, sponsored by the Kellogg School of Management, was to give students of color exposure to a top-tier business education, with the goal to increase the future pipeline of diverse executive leadership," remembers the CEO and cofounder of NuMat Technologies. "It was transformational for me—I was able to get access to a program that my family would not have been able to afford."

When the time came to attend college, Hernandez was set on returning to Northwestern. He knew he'd like to pursue a joint JD-MBA degree one day, but industrial engineering quickly captured his attention as an undergrad. "What spoke to me was that the program applied the engineer's toolkit to solving business challenges," he says.

After graduating from Northwestern Engineering, Hernandez used that toolkit as a management consultant with Booz & Company in its Chicago operations strategy practice, where his work included commercial aerospace, advanced manufacturing, and healthcare projects. Next, he became an operations professional at Arcapita, a global private equity and venture capital firm, working on board-level management initiatives across portfolio companies.

"I was fortunate to be around very talented people," he says. "That gave me the confidence to take risks on what came next in my own career."

"The education I received at Northwestern about design thinking and asking the right questions has served me well. It's the difference between an okay engineer or leader and an outstanding one."

His biggest risk came after he decided to return to Northwestern to earn the joint JD-MBA degree. There, he met Christopher Wilmer (PhD '12), a PhD student in chemical engineering, and Omar Farha, professor of chemistry and, by courtesy, chemical and biological engineering.

The two were researching how to apply high-performance computing to design metal-organic frameworks, an emerging class of nanoporous materials that could solve complex societal challenges, such as carbon capture or energy storage. Hernandez bought into their shared vision of creating a better future by using the new technology to reduce the time it took to commercialize material technologies from decades to years.

Today, he leads the Skokie, Illinois-based company born out of that vision, NuMat Technologies, a leader in the field of molecular manufacturing. NuMat, which has raised more than $20 million in venture funding since its 2013 launch, designs and builds material-enabled systems that uniquely store, harvest, and produce high-value resources. Farha serves as chief science officer, while Wilmer still collaborates on computational initiatives.

"We use high-performance computing to design nanomaterials to selectively soak up gasses or liquids like a sponge soaks up water," Hernandez says. One project for the US Department of Defense involves developing next-generation gas masks that use nanomaterials to remove chemical and biological agents and toxic industrial chemicals from the air.

As CEO, Hernandez draws particularly from the lessons he learned at the McCormick School of Engineering about the importance of teamwork, communication skills, and applying one's self wholeheartedly to a task. "The education I received at Northwestern about design thinking and asking the right questions has served me well. It's the difference between an okay engineer or leader and an outstanding one."

SARA LANGEN

IN MEMORIAM

Courtesy of Northwestern University Archives

Professor Emeritus William Brazelton

William Brazelton, professor emeritus of chemical engineering and a former associate dean, passed away at age 97 on January 8, 2019. He was a member of Northwestern's faculty for 40 years and served as associate dean for 29.

A native of Danville, Illinois, Brazelton arrived at Northwestern as a first-year student in 1939, the start of more than five decades at the University as a student, professor, and member of the McCormick School of Engineering's leadership team. He received his bachelor's, master's, and PhD degrees in chemical engineering from Northwestern, and joined the school's faculty as an instructor in the Department of Chemical Engineering in 1947.

Brazelton's research interests were in petroleum catalysis, heat transfer in fluidized systems, and mass transfer operations. Along with teaching undergraduate and graduate students, he shared his expertise as a consultant, working with companies like Abbott Laboratories as well as schools including the University of South Dakota and Michigan Technological University.

After being chair of the Department of Chemical Engineering from 1956 to 1957, Brazelton served as associate dean of the engineering school from 1962 until his retirement in 1991. During his tenure, he strived to build a strong minority and female student body. He supported the formation of Northwestern's student chapters of the National Society of Black Engineers and the Society of Women Engineers.

In 1986, the American Society for Engineering Education presented Brazelton with the Vincent Bendix Award for "outstanding achievement by an engineering educator to increase participation of minorities and/or women in engineering."

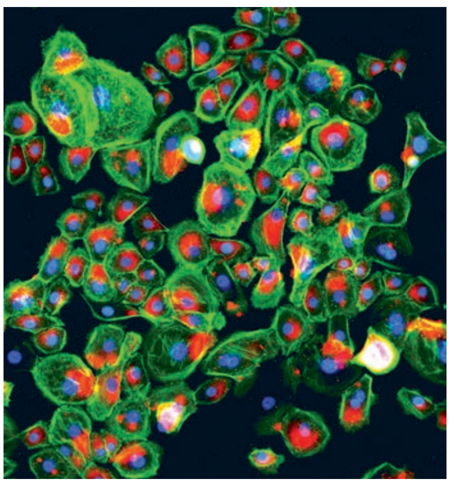
"It almost goes without saying that his steadfast promotion of the program for minorities has established a remarkable degree of trust and close support between him and the minority students," Brazelton's Bendix Award nomination read. "This is true of Bill Brazelton and the undergraduates at Northwestern in general: He is rightly regarded as carrying the undergraduate engineering program on his shoulders in the most thoughtful, personal, and professional way."

He was a member of Tau Beta Pi, Sigma Xi, the American Institute of Chemical Engineers, the American Chemical Society, the Society for the History of Technology, and the Society for Industrial Archeology.

William T. Brazelton '43, '48, '52
George H. Coleman '43
Raymond H. McLeod '44
Stuart W. Wells '45
Archibald MacLean Jr. '46
Andrew A. Mueller '46
Mason A. Clark '47, '49
John Ritchie Jr. '48
Laurence O. Stine '48
Maurice F. Dunne Jr. '49, '80
Patrick Kimball '49
Kenneth A. Mortonson '49
V. O. Harkness Jr. '50
Embert L.C. Larson '51
C. Ray Carlson '52
James I. Webb '53
Robert D. Durand '54
Allan B. Schaffer '54, '57
W. Donald Kingsley '57
Peter C. Klingeman '57, '59
Robert W. Meyers '57
Marion J. Balcerzak '58, '61
Wallace C. Solberg '58
Robert J. Hathaway '59
Charles H. Wyatt Jr. '59
Maitland R. Edwards '60
James B. Delill '61
James L. McCabe '61
Jerry J. Fjellberg '62, '64
Thomas E. Bowman '64
Nix O. Bodden '65
Rene Amon '66
Walter T. Feldt '66, '68
David E. Novitski '69, '72
Donald J. Schroeder '69
Howard E. Woodward Jr. '69
Robert V. Rouse '70
Stephen J. Wersan '70
Philip I. Hazen '71
Thomas F. Rabczak '74
John H. Wharton '76, '77
Parwez Alam '79
Lee H. Wilson '80
Bruce Tracy Bennett '81
Kwan-Hwa Jan '84, '91
Alexander A. Klein '84
Jennifer E. Salem '98
Michael Thuma '05

"Catalyst" for Accelerating Research

DONOR SUPPORT ALLOWS PROMISING HIGH-RISK IDEAS TO BECOME BREAKTHROUGH RESEARCH



Guillermo Ameer

"The Catalyst Awards allow our most innovative research to get up and running in the right direction, and the return on investment has been tremendous."

RICHARD LUEPTOW Senior Associate Dean, Operations and Research

AT NORTHWESTERN ENGINEERING, faculty and students conduct collaborative research to help solve the world's most pressing problems.

But sometimes, researchers need a little boost to get innovative projects off the ground and to produce initial results that increase the success of securing major research funding. Enter the Catalyst Awards: small seed grants that have enabled engineering researchers to undertake promising, sometimes high-risk research that often leads to breakthroughs and additional funding from other sources.

The awards began in 2014 with a $1 million gift from David Porges ('79) and Gabriela Porges and a $500,000 donation from the Sherman Fairchild Foundation. That funding has resulted in 24 Catalyst Awards, which have led to 41 publications, 34 research proposals, two patents, and five invention disclosures. The initial research initiatives funded by these awards have led to more than $8 million in additional federal grants.

Guillermo Ameer, Daniel Hale Williams Professor of Biomedical Engineering and Surgery, and Vadim Backman, Walter Dill Scott Professor of Biomedical Engineering, received a Catalyst Award in 2014 to fund preliminary research in using optical techniques to identify atherosclerotic plaque that was vulnerable to rupture. If such plaque could be identified, physicians could work to prevent the rupture and therefore prevent a stroke.

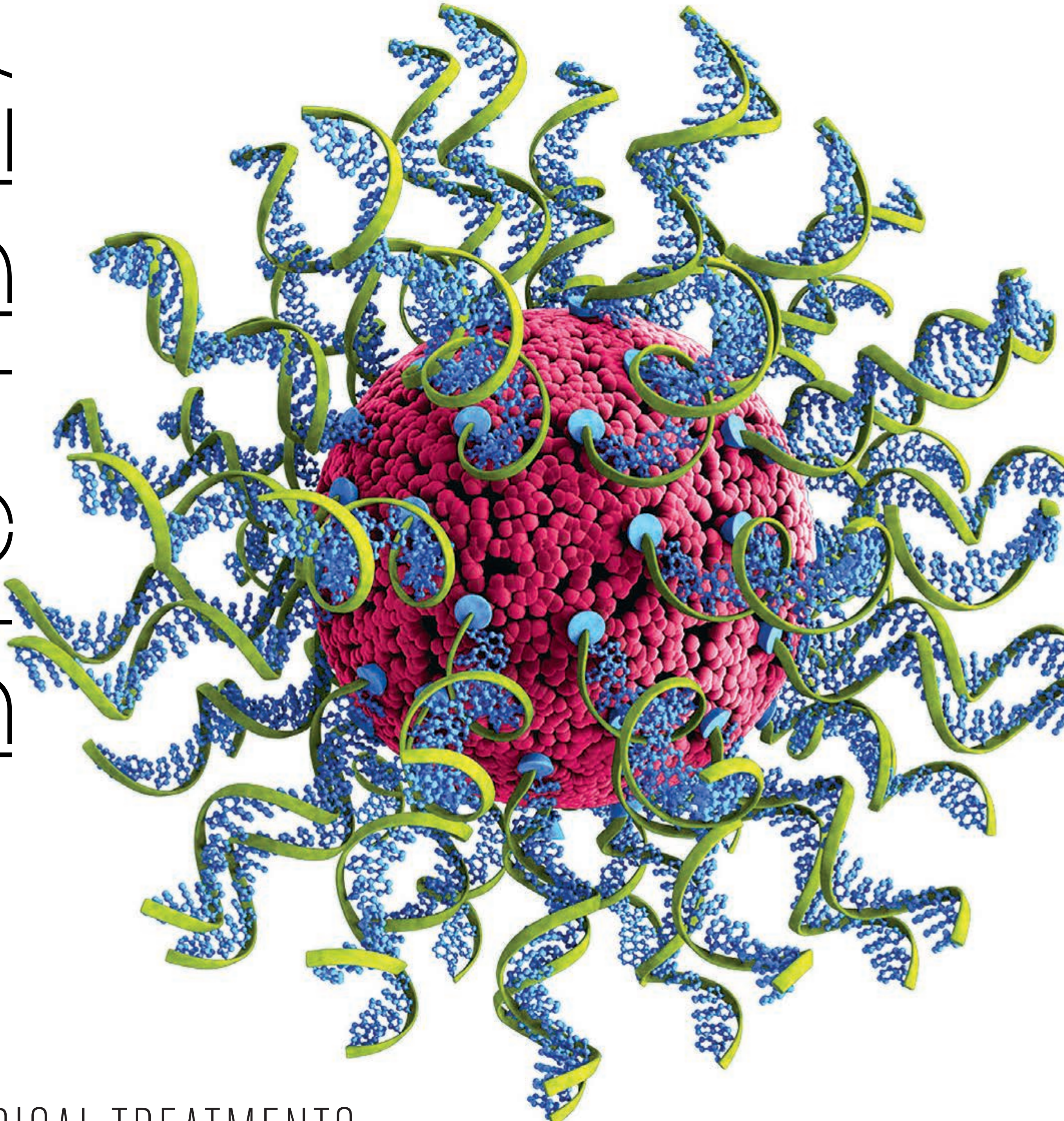
"Catalyst Awards are great if you want to generate new, collaborative ideas that could be high risk," Ameer says. "These grants give us a way to gather preliminary data, which is necessary to apply for federal grants. This funding fills that gap and allows us to be competitive."

For the Porgeses, such success has been a gratifying confirmation of their support for the school. "Advancing science and engineering through research is one of the most important roles of a place like Northwestern," says David Porges. "Gabriela and I are pleased that this initial support has allowed Northwestern Engineering to continue to grow in its research excellence."

Other funded projects have included anti-icing surfaces, nanocapsule vaccine delivery, and super-resolution imaging. Many projects like these would not have gotten off the ground if it weren't for the Catalyst Awards, says Richard Lueptow, senior associate dean for operations and research.

"Federal funding for research is highly competitive, so we need to provide more opportunities than ever before for our researchers to be successful," he says. "The Catalyst Awards allow our most innovative research to get up and running in the right direction, and the return on investment has been tremendous."

BIG IDEA



SPHERICAL TREATMENTS

Spherical nucleic acids (SNAs) are ball-like forms of DNA and RNA arranged on the surface of a nanoparticle. A Northwestern team developed a direct route to optimize SNAs, advancing one step closer to making them viable treatment options for many forms of cancer, genetic diseases, neurological disorders, and more.

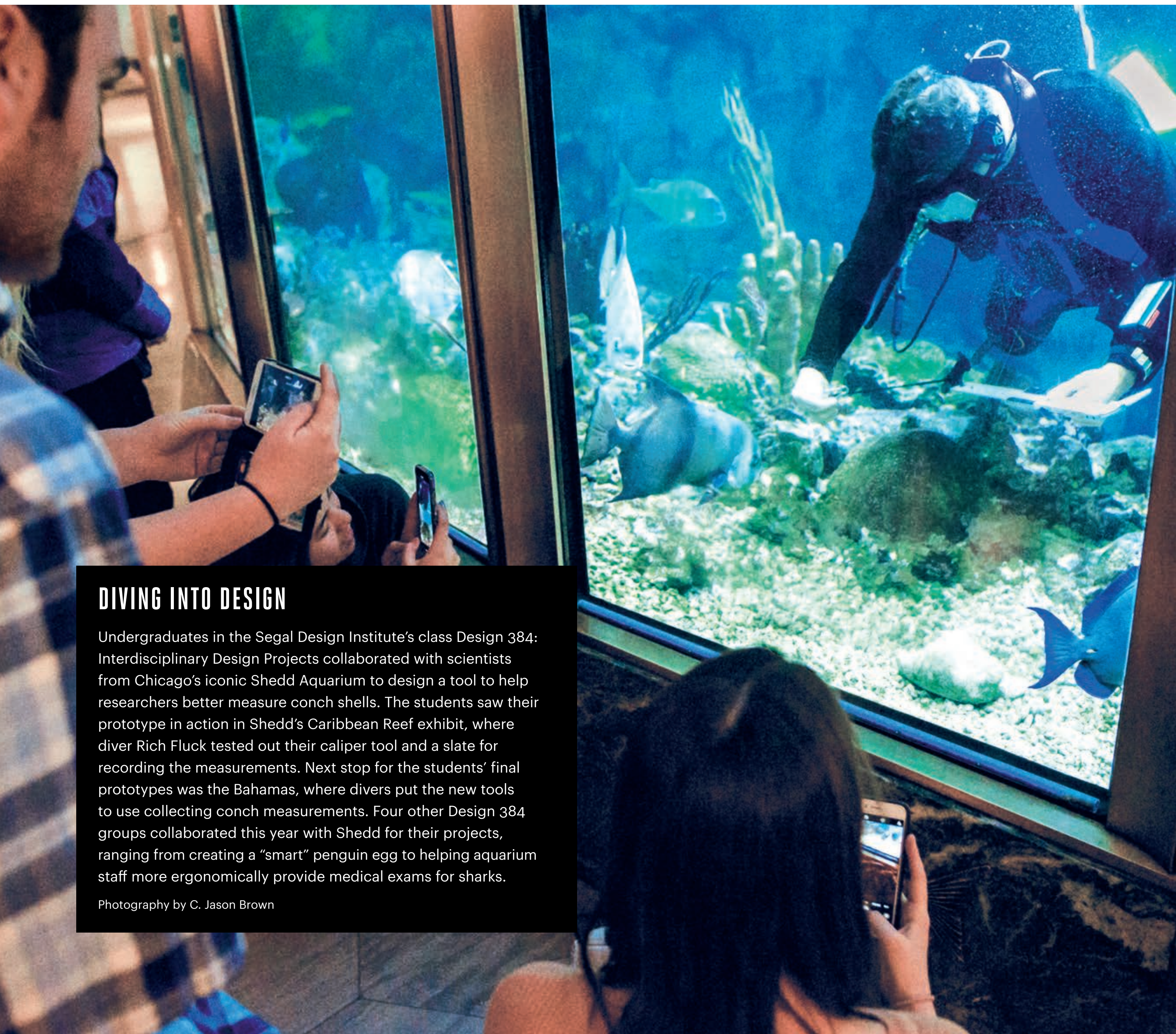
Researchers can digitally design SNAs to serve as personalized treatments that shut off genes and cellular activity and as vaccines to stimulate the immune system. Professor Chad Mirkin led the research. Professors Milan Mrksich and Neda Bagheri served as coauthors.

Northwestern | McCORMICK SCHOOL OF ENGINEERING

Robert R. McCormick School of
Engineering and Applied Science

Northwestern University

Technological Institute
2145 Sheridan Road
Evanston, Illinois 60208–3100



DIVING INTO DESIGN

Undergraduates in the Segal Design Institute's class Design 384: Interdisciplinary Design Projects collaborated with scientists from Chicago's iconic Shedd Aquarium to design a tool to help researchers better measure conch shells. The students saw their prototype in action in Shedd's Caribbean Reef exhibit, where diver Rich Fluck tested out their caliper tool and a slate for recording the measurements. Next stop for the students' final prototypes was the Bahamas, where divers put the new tools to use collecting conch measurements. Four other Design 384 groups collaborated this year with Shedd for their projects, ranging from creating a "smart" penguin egg to helping aquarium staff more ergonomically provide medical exams for sharks.

Photography by C. Jason Brown