Northwestern | RESEARCH

IMPACT REPORT 2018

Photo by Nathan Mandell

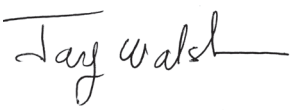
Creating knowledge with beneficial social impact is core to Northwestern's research and teaching mission. That's always been the case. Over the past decade, we've significantly grown the depth and breadth of our research enterprise, investing in a discovery ecosystem that allows thought leaders from every field to flourish. This happens in many ways, organically and by design — including through cross-disciplinary collaboration, such as what occurs within our 50+ University Research Institutes and Centers.

But no matter where you look on our campuses, you will encounter an incredible array of talent, making Northwestern a vibrant, exciting place. It's a place where scientific curiosity, creativity, and passion combine to pursue solutions to the world's most important challenges. It's also where the arts and humanities are celebrated for their expressive power and ability to investigate the human experience. Truly, there is a universe reflected in our University.

Across all fields, Northwestern has cultivated tremendous disciplinary strengths. Because of this success, we can bring together people and ideas in unique ways to explore opportunities for transformative innovation at the intersection of fields, too. This even happens in a setting like the Robert H. Lurie Comprehensive Cancer Center of Northwestern University, where one might expect only to find "medical" faculty. In fact, though, faculty from the schools of medicine, engineering, and the liberal arts combine their expertise to develop new disease diagnostics and treatments. As a result of this collaborative commitment, the Lurie Cancer Center this year earned a near-perfect score for excellence from the National Cancer Institute, along with a grant award of $31.5 million.

That award was part of the overall $702.1 million in sponsored research funding that Northwestern attracted in FY2018. This overall figure represents yet another record-breaking total and a 4 percent increase over the previous year, underscoring the University's multifaceted research strengths.

While the funding is impressive and vital, it matters most because of what it can provide: the ability for Northwestern faculty, students, and staff to pursue pathbreaking discoveries that improve the world and deepen our understanding of humanity's place in it.



Vice President for Research

On the cover, clockwise from top left:

Michael Rakowitz (art, theory, practice) used 10,000 tin cans to create "The Invisible Enemy Should Not Exist," a recreation of a stone statue called a lamassu destroyed by ISIS militants in 2015. The 14-foot sculpture was installed in London's Trafalgar Square in March 2018 as part of his long-term project to reconstruct all of the objects looted from Iraq's National Museum. "I had the idea of these lost artifacts coming back as ghosts to haunt us," says Rakowitz, second from right. With him, from left: London Deputy Mayor Justine Simons; London Mayor Sadiq Khan; and Chair of Fourth Plinth Commissioning Group Ekow Eshun. Photo by Caroline Teo.

Megan Roberts (communication sciences and disorders) is principal investigator of Northwestern's Early Intervention Research Group, which examines how to support language development in children with developmental delays. Roberts' recent research looks to accelerate reliable screening of children for autism spectrum disorders, potentially reducing the wait time for specialty autism diagnostic evaluations while enabling earlier intervention.

Developing eye of a fruit fly. The new **NSF-Simons Center for Quantitative Biology** at Northwestern studies the emergence of complexity in organisms, including *drosophila*. The Center, launched in 2018 with a $10 million grant from the National Science Foundation and the Simons Foundation, enables innovative science at the intersection of mathematics and biology.

In 2018, the **Robert H. Lurie Comprehensive Cancer Center of Northwestern University** earned an "exceptional" rating from the National Cancer Institute — along with $31.5 million in research funding — positioning it among the nation's top cancer centers. Lurie and its affiliated hospitals treat about 15,000 new cancer patients each year, providing access to some 300 active clinical trials for nearly every type of cancer. Highly interdisciplinary, Lurie brings together faculty from medicine, engineering, and the liberal arts.

Larry Hedges, a preeminent global scholar in education policy, was awarded the 2018 Yidan Prize. The award comes with $3.9 million in support and recognizes Hedges (statistics, social policy) for his groundbreaking statistical methods for meta-analysis, work that's foundational for evidence-based education policy. Hedges is also a fellow of Northwestern's Institute for Policy Research.

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3,366
TOTAL AWARDS

$702.1 MILLION
SPONSORED RESEARCH FUNDING
A 4% INCREASE OVER FY17

50+
UNIVERSITY RESEARCH INSTITUTES AND CENTERS

55
CORE FACILITIES

4,226
TOTAL CORE FACILITY USERS

$56.8M
SPONSORED RESEARCH FUNDING AWARDED TO UNIVERSITY RESEARCH INSTITUTES AND CENTERS

$355M
GRANT DOLLARS SUPPORTED BY CORES

10TH
NATIONAL UNIVERSITIES RANKING
(US NEWS AND WORLD REPORT)

FACULTY RECOGNITION

18TH
INCITES CITATION RANKING
(2013-17)

86
AMERICAN ACADEMY OF ARTS AND SCIENCES MEMBERS

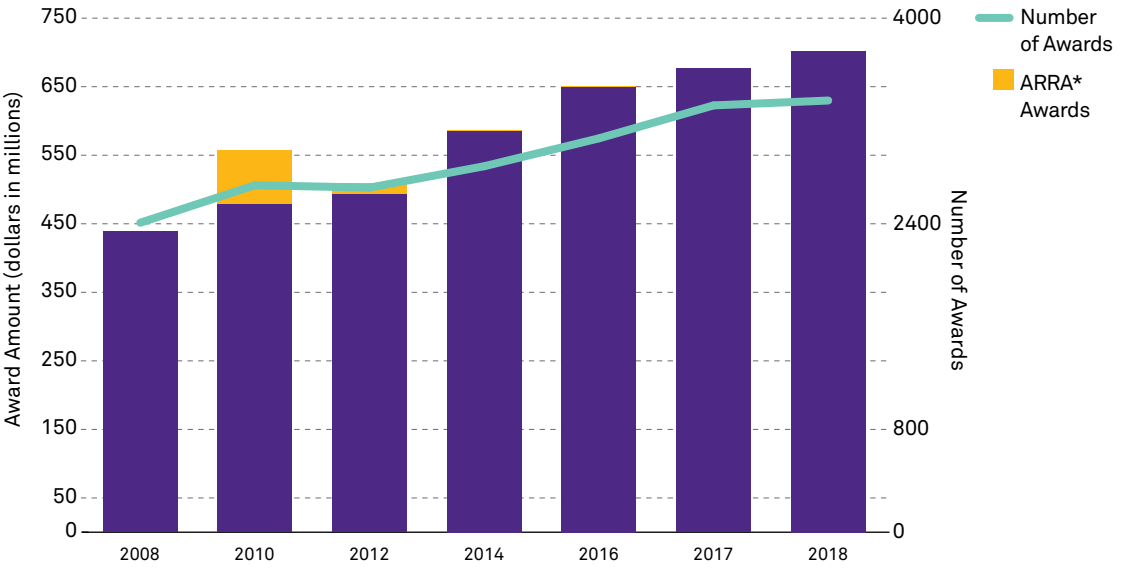
48
NATIONAL ACADEMY MEMBERSHIPS
(MEDICINE, ENGINEERING, SCIENCES, EDUCATION)

9
NUMBER OF STARTUP COMPANIES FOUNDED BY FACULTY DURING FY18

210
INVENTION DISCLOSURES

156
ISSUED PATENTS

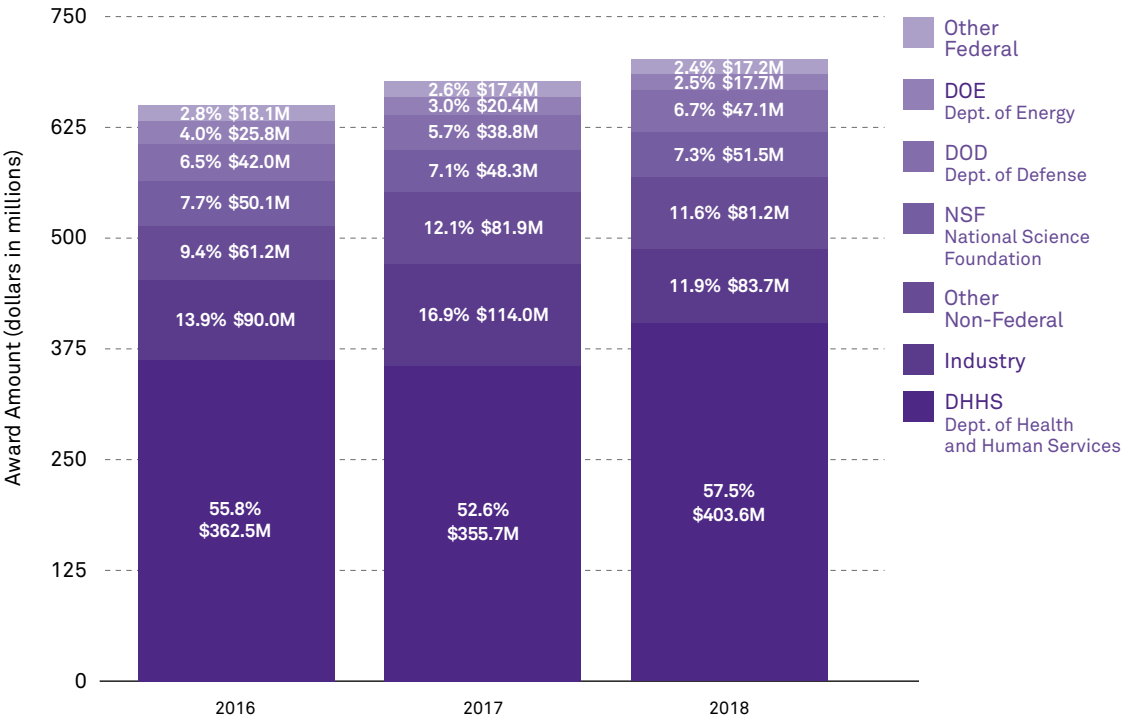
SPONSORED RESEARCH AWARDS



	FY2008	FY2010	FY2012	FY2014	FY2016	FY2017	FY2018
NUMBER OF AWARDS	2,415	2,707	2,688	2,855	3,072	3,328	3,366
AMOUNT IN MILLIONS	$438.9	$556.7	$508.6	$587.1	$649.7	$676.5	$702.1

60 Percent Funding Increase FY2008-2018

AWARDS BY SPONSOR



* American Recovery and Reinvestment Act

INNOVATIVE DRUG DELIVERY BREAKTHROUGHS

Northwestern researchers led by **Danielle Tullman-Ercek** (chemical and biological engineering) have discovered a new way to manipulate a virus shell that self-assembles from proteins, a finding that could aid in disease detection, drug delivery, and vaccinations. Virus shells — including the soccer-ball shape of the MS2 bacteriophage in this study — are notoriously tough. But if this strength could be harnessed to heal, not hurt, the structure may be used to protect medicines to provide targeted therapies. The Northwestern team, with colleagues at Berkeley, developed a new technique to examine protein mutations that broke or changed the virus scaffold. Understanding how mutations alter the scaffolding could lead to repurposed and medically useful virus proteins. Similarly, groundbreaking interdisciplinary research by **Nathan C. Gianneschi** (chemistry) has revealed how organic nanoparticles collide and fuse, increasing understanding that could aid in developing new drug delivery methods. His team used liquid-cell transmission electron microscopy to directly image changes in nanoparticles that Gianneschi's lab is developing for treating cancer and heart disease. The imaging opens a new window on the molecular world and promises immense benefit for those working with synthetic materials.

Photo by Sally Ryan

REINVENTING LOCAL MEDIA TO SAVE DEMOCRACY

With local journalism in crisis, Northwestern this year assembled a team of experts in digital innovation, audience understanding, and business strategy. The goal: help reinvent the relationship between news organizations and audiences to elevate enterprises that empower citizens. Medill's **Local News Initiative (LNI)** is a data-driven research effort that aims to solve this challenge impacting both the market and society. "The stakes are very high for democracy," says **Tim Franklin,** senior associate dean for Medill, which leads the effort in partnership with three major media players who have provided more than 13TB of customer data for the team to analyze. "The political fabric starts in the community, so it's crucial that citizens understand what's happening in these local ecosystems." Medill's Spiegel Digital and Database Research Center, a leader in consumer and audience-based research, is analyzing anonymous data about reader engagement and subscription behaviors. Northwestern's Knight Lab (a Medill and McCormick School of Engineering collaboration) will use that analysis, along with field research it led, to create new digital storytelling tools and approaches to strengthen local news organizations. LNI data scientists, including **Ed Malthouse** (integrated marketing communications), have completed their initial analysis and reported their insights to executive partners, resulting in a rich strategic conversation that Franklin says will shape the coming year of continued "real-time, real-world" research.

Photo by Jenna Braunstein Photography

Journalism students work on *The Daily Northwestern.*

NORTHWESTERN THOUGHT LEADERSHIP SPURS NEW KNOWLEDGE HUBS

A research center that combines mathematics and developmental biology, another poised to improve outcomes for brain cancer patients, and a pair pursuing next-generation energy solutions were among Northwestern's interdisciplinary knowledge hubs garnering national recognition in 2018. The University received one of four highly competitive $10 million grants from the National Science Foundation (NSF) and the Simons Foundation to fund research that uses mathematics to describe and analyze the development of living organisms. Led by Director **Richard Carthew** (molecular biosciences) and Co-Director **William Kath** (engineering sciences and applied mathematics), the Center uses model organisms to address fundamental questions about development and growth. For example, **Carole LaBonne** (molecular biosciences) and **Madhav Mani** (engineering sciences and applied mathematics) study how pluripotent stem cells transition to differentiated fates.

Northwestern also received $15 million from the Department of Energy to fund two national Energy Frontier Research Centers. The Center for Bio-Inspired Energy Science — led by **Samuel Stupp** (materials science, chemistry, medicine, and biomedical engineering) — and the Center for Light Energy Activated Redox Processes — led by **Michael Wasielewski** (chemistry) — pursue fundamental advances in energy and related fields, exemplifying the high-impact science associated with Northwestern's 50+ University Research Institutes and Centers.

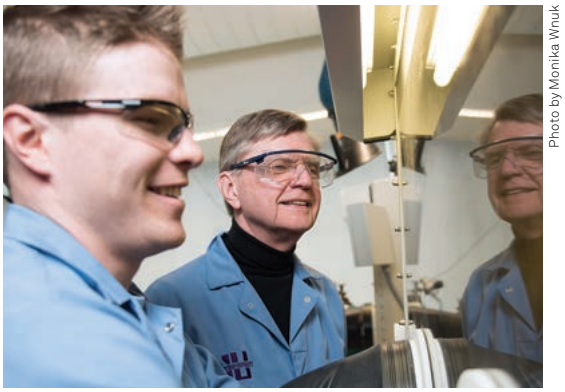


Photo by Monika Wnuk

Michael Wasielewski, chemistry, with graduate student **Joseph Christensen**

Photo courtesy of Health Aware Bits Lab

TEAM SCIENCE TACKLES GRAND HUMAN HEALTH CHALLENGES

Northwestern investigators are advancing novel research throughout the lifespan, including through maternal-fetal medicine; the development of new tools to interpret rare genetic variants of heart disease; and a pathbreaking study exploring the role of protein quality control in human aging and neurodegenerative diseases. **Katherine Wisner** (psychiatry) is examining the effects of medication and mental health during pregnancy to better inform decisions on interventions. Wisner, **Catherine Stika** (obstetrics and gynecology), and **Alfred George Jr** (pharmacology), launched a study to optimize medical management for mothers with depression. A small bandage developed by **John Rogers** (materials science and engineering and biomedical engineering) will unobtrusively capture and record physiological signs of stress, such as maternal heart rate. An algorithm being developed by **Nabil Alshurafa** (preventive medicine and computer science, *pictured above* with student members of his Health Aware Bits Lab) combines the sensor data with self-reported stress levels collected via smartphone.

Expanding early intervention, **Lauren Wakschlag** (medical social sciences; psychiatry) has assembled a diverse team of biomedical and social scientists to explore the impact of prenatal stress reduction on maternal well-being and early neurodevelopment. Aging is another Northwestern research focus. The University received a $12.6 million grant from the National Institute on Aging at the National Institutes of Health to study the role of protein quality control in human aging and neurodegenerative diseases such as Alzheimer's disease. Northwestern's **Richard Morimoto** (molecular biosciences) will lead a team of scientists from Stanford, Harvard, The Scripps Research Institute, and University of California. Having developed new tools to interpret rare genetic variants and working to identify modifiers of genetic heart disease, which are targets for developing new drugs, **Beth McNally** (medicine: cardiology) was elected to the National Academy of Inventors this year. She joins **Samuel Stupp** (materials science, chemistry, medicine, and biomedical engineering) as a member of the 2018 class.

POLICY EXPERTS TAKE ON CRIME AND POLICING

Andrew Papachristos is using network science — the study of how social relationships affect behavior — to understand how crime and gun violence spread. The sociologist and Institute for Policy Research (IPR) fellow likens this violence to an epidemic, one that's concentrated within networks of people and is socially "contagious." In studying Chicago's gun violence, he discovered that almost 90 percent of shootings were within a single, large network composed of just 6 percent of the city's population. In addition, he found that individuals were just "2.5 handshakes" away from obtaining a gun. In a study of Chicago police officers, law professor and IPR associate **Max Schanzenbach** has determined that a small number of officers (just 1 to 5 percent) account for a disproportionate amount of misconduct cases. Just 1 percent of officers with the most serious allegations generated nearly five times the number of payouts and four times the total damage payouts in civil rights litigation compared with the average officer. This research suggests that civilian allegations can provide an "early warning" system to help predict which officers pose the highest risk, creating an opportunity for intervention.

Photo courtesy of Andrew Papachristos

DIGITAL HUMANITIES PROJECT BRINGS POET, SCHOLARSHIP TO LIFE

A leather-bound manuscript overlooked for centuries provides the impetus for a modern digital collaboration between **Wendy Wall** (English) and Brock University colleague Leah Knight. But really the **Pulter Project** — named after the obscure 17th-century English writer Hester Pulter whose poems explored themes of revolution, religion, science, and personal reflection — showcases the scholarly process even as it advances scholarship. The innovative online platform does so by inviting readers to engage with multiple, different readings of Pulter's verse, rather than pushing a single "authoritative" one. This way, readers gain insight into editorial choices that shift and shape canonical content. The open-access website, developed by Weinberg College's Media and Design Studio, features curated virtual exhibits and educational tools, as well as a unique "Versioning Machine" that permits students, teachers, and the public to make detailed comparisons among each poem's versions, including high-resolution zoomable facsimiles of manuscript pages. The Project's goal is to showcase Pulter's poems and contextualize her work to enrich our understanding of women's relationships to the emergence of science, natural history and experimentation, and the classics. Equally important, says Wall, is making visible the creative process that is responsible for bringing historical figures to life for today's audiences. By allowing for many more editorial voices and approaches, the Pulter Project critiques what scholarly editing is, and what it can be.

Photo by Jim Prisching

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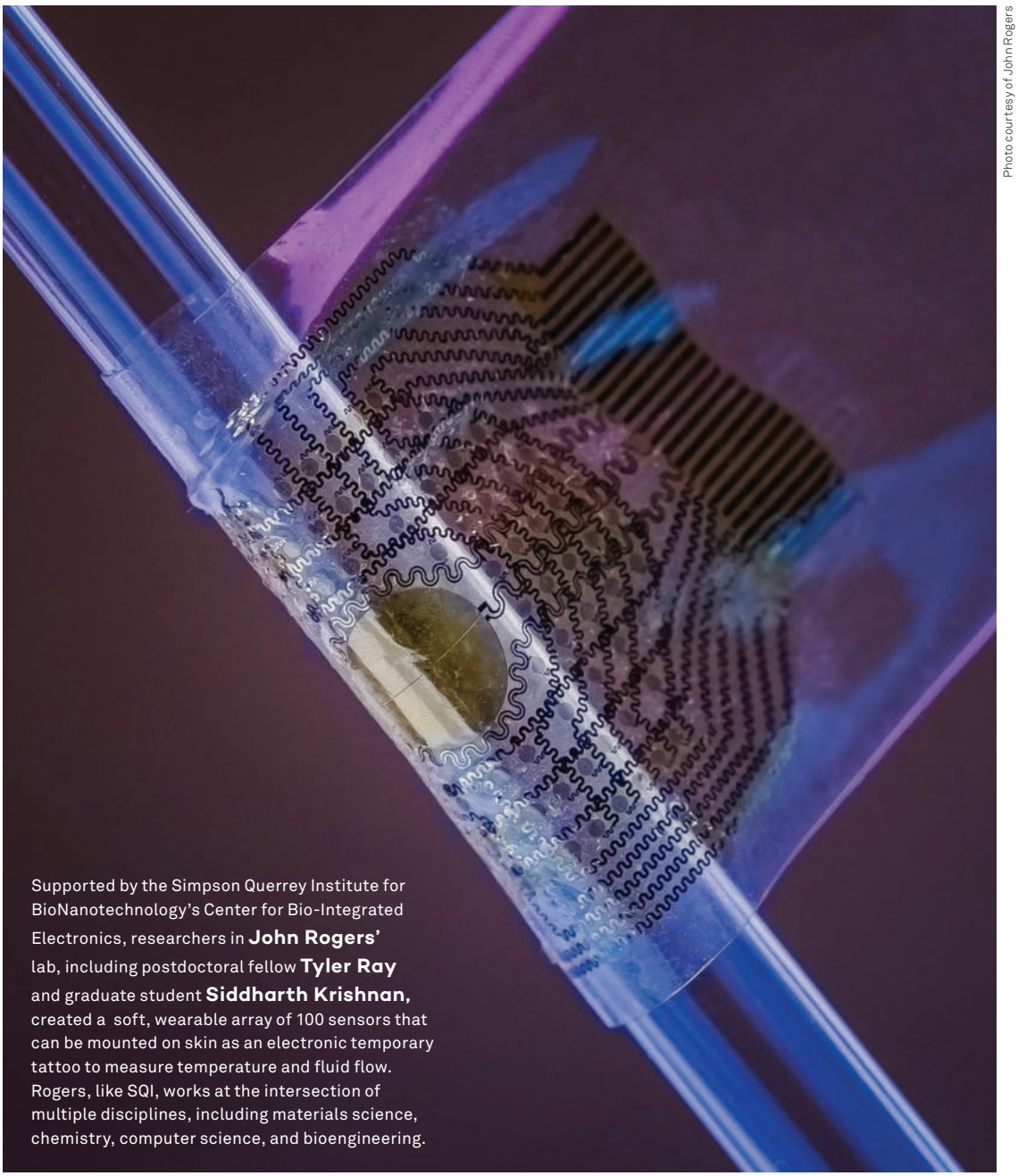

Photo courtesy of John Rogers

Supported by the Simpson Querrey Institute for BioNanotechnology's Center for Bio-Integrated Electronics, researchers in **John Rogers'** lab, including postdoctoral fellow **Tyler Ray** and graduate student **Siddharth Krishnan,** created a soft, wearable array of 100 sensors that can be mounted on skin as an electronic temporary tattoo to measure temperature and fluid flow. Rogers, like SQI, works at the intersection of multiple disciplines, including materials science, chemistry, computer science, and bioengineering.