



Photo by Eileen Molony

Over the past decade, Northwestern has grown into a research powerhouse, and today it ranks among the nation's Top 10 universities. Northwestern distinguished itself again in 2019 with a remarkable 14 percent year-over-year increase in sponsored research funding to achieve a record-high of nearly \$800 million in research awards. Of that, \$351 million came from the National Institutes of Health, up from \$184.5 million in 2009.

This investment happens because Northwestern has consistently produced high-impact research that improves the world and reshapes entire fields of study. Our success is anchored by our multidisciplinary approach that transforms foundational sciences and fuels translational innovation. This work enhances human wellbeing in many ways. Our pioneering investigations in physics, chemistry, medicine, materials science, engineering, and other areas produce breakthroughs in healthcare, energy and sustainability, and communications and national security. Our arts and humanities remain vibrant, represented in some 35 programs at the University. Northwestern also continues to distinguish itself for its social policy and education scholarship, and for communication and brand-building in the digital age.

Northwestern's diverse academic strengths harness excellence from across schools and departments. To cite just one example: the intersection of medicine, engineering, and nanotechnology here creates new possibilities for drug discovery and delivery, surgical procedures, and therapies resulting in hundreds of clinical trials to help patients. Northwestern is exceptionally good at building such faculty collaboration, and this year we took a further bold step in doing so. With the opening of the **Simpson Querrey Biomedical Center**, we created a state-of-the-art research space that will spur even more transdisciplinary work and are excited to have an entire floor dedicated to engineering for the life sciences.

This year also marks a century and a half of coeducation at Northwestern, and the University has been celebrating trailblazing female faculty members and alumni as part of "**150 Years of Women.**" Programs and events are highlighting these catalysts and their contributions to academia and society — including leaders like UT-San Antonio biochemist Susan Weintraub who delivered the keynote at our annual Core Facilities Colloquium in November. Northwestern is proud to have been a pioneer in educational equality and we continue to cultivate an environment where all can contribute and thrive.

This *Report* provides just a glimpse of the research taking place here. Still, it reveals Northwestern as a community where curiosity, creativity, and talent combine in extraordinary and unique ways.

Milan Mrksich

Interim Vice President for Research

On the cover, clockwise from top left:

Dr. Amy Paller (dermatology) was part of a cross-disciplinary team involving materials scientists, engineers, and pediatricians that developed pioneering **flexible wireless sensors** to replace the wire-based sensors that monitor babies in neonatal intensive care units. The innovation maintains diagnostic accuracy while allowing for more physical bonding with parents. "Skin-to-skin contact is so important," says Paller. "It's been shown to decrease the risk of pulmonary complications, liver issues, and infections."

Northwestern scientists collaborating with Google have shown how machine learning can **detect breast and lung cancer sooner**, resulting in possible earlier treatments and better outcomes. "This is a huge advance," says **Dr. Mozziyar Etemadi** (anesthesiology and engineering), the study's co-author.

A **detailed simulation** of a black hole's accretion disc created by a global team of computational astrophysicists — including **Alexander Tchekhovskoy** — solved a decades-old mystery. The accretion disc is matter that orbits and then falls into a black hole. Researchers discovered how the disc aligns with the hole's equator, details vital to understanding the dynamics and galactic influence of these massive celestial objects.

Northwestern breakthroughs at the intersection of engineering and medicine continue. An additional \$10 million gift from trustees **Kimberly K. Querrey** and **Louis A. Simpson** has established the Querrey Simpson Institute for Bioelectronics, which integrates efforts to develop biocompatible electronic, photonic, and microfluidic technologies. Multidisciplinary scientist **John Rogers** (second from right) is the Institute's founding director. He and **Yonggang Huang** (civil & environmental engineering) have developed a wireless system that adds a sense of touch to any virtual reality experience — a potential boon for telemedicine and prosthetics.

The **Center for Synthetic Biology**, one of some 40 University Research Institutes and Centers, attracts top talent to pursue science that builds new biological systems to create sustainable chemicals, novel materials, or targeted therapies. Northwestern has emerged as a leader in this field, thanks to award-winning faculty such as (from left) **Arthur Prindle** (biochemistry and molecular genomics), **Neha Kamat** (biomedical engineering), and **Gabriel Rocklin** (pharmacology).

Northwestern | RESEARCH

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Photo by Eileen Maloney

BUILDING NEW DEPTH IN AFRICAN AMERICAN LITERARY STUDIES

With the addition of four scholars, the **Weinberg College of Arts and Sciences** has significantly elevated Northwestern's ability to explore exciting themes in African American literature and culture — an area of keen interest to students. Assistant professors **Nicole Spigner, Justin Mann, Lauren Jackson and Marquis Bey** (pictured, from left) bring expertise that spans more than 150 years of African American fiction, nonfiction, poetry, music, and other cultural production. Their research examines subjects such as Black speculative fiction, the aesthetics of racial feeling, Black identity, Black feminism, and transgender subjectivity. The strategic hires — jointly appointed to the Department of English

and Department of African American Studies — allow Northwestern to apply intellectual depth and breadth to an important knowledge domain. While the scholars' research ranges from the mid-19th century through the 21st century, the questions they examine are still vital today. "African American literature is an area where the relationships between artistic and literary production and critical and theoretical work are really tight," says **Nick Davis** (English and Gender & Sexuality Studies) who chaired the committee that conducted the faculty search. "We're making a robust case that literature, in multiple genres, remains a crucial way to understand history, culture, and politics. This initiative could not be more timely."

HOW JET LAG MAY PROTECT YOUR BRAIN FROM DISEASE

A surprising discovery by **Dr. Ravi Allada** (neurobiology) has shown that a little stress on the body's circadian clock — the cellular timing devices composed of protein molecules and present throughout the body — could help stave off neurodegenerative diseases. The associate director of Northwestern's **Center for Sleep and**



Circadian Biology, Allada led a team that identified a circadian clock-controlled gene involved in protein folding that, when knocked down, protected the brain from disease. The researchers studied a fruit fly model of Huntington's disease, a neurodegenerative condition marked by motor deficits and protein build up in the brain. Allada's lab also altered the sleep-wake cycle by inducing a 20-hour (rather than 24-hour) daily rhythm in the flies to stress the circadian clock. The results were unexpected: rather than increasing the Huntington's symptoms, disruption of the protein-folding gene or change in the daily rhythm appeared to improve the health of the insects, as evidenced by fewer neurons dying. While fruit flies may seem a distant biological relative to humans, it was the study of the fruit fly that has allowed scientists to uncover the "molecular logic of circadian clocks, conserved even to humans," says Allada. His findings could point the way to new treatment paths to slow or prevent neurodegenerative diseases.

EXTENDING RESEARCH-BASED CLINICAL CARE INTO THE COMMUNITY

A \$46 million, five-year renewal grant from the National Institutes of Health is helping fuel Northwestern's latest medical discoveries — and accelerate the benefits of that research for patients. The funding continues the mission of the **Northwestern University Clinical and Translational Sciences Institute** (NUCATS), founded in 2007 as a transdisciplinary knowledge hub and composed of 10 centers and programs that have served thousands of investigators and assisted in the publication of more than 1,500 scientific papers. The renewal helps NUCATS continue to contribute to digital research infrastructures across the University and its clinical partners. The funds will enhance Northwestern's clinical trials management system so patients are empowered to participate in research more easily. NUCATS also will focus on expanding research opportunities across the entire academic health system and collaborating with patients and communities throughout the Chicago area. For example, the new **Research Enabled and Accelerated in Community Healthcare** (REACH) initiative will further integrate



Photo courtesy of Feinberg School of Medicine

NUCATS Director Dr. Donald Lloyd-Jones

research into clinical care systems and processes. "This new award will catalyze efforts to bring cutting-edge science and opportunities to participate in research studies to point-of-care for doctors and patients across our growing health system and our community," says NUCATS Director **Dr. Donald Lloyd-Jones**. "We also will train the next generation of scientists to answer the critical questions needed to improve human health."



Photo courtesy of McCormick School of Engineering

McCormick Engineering professors Aaron Packman, left, and William M. Miller

FLOOD PLAN: NORTHWESTERN'S HOLISTIC APPROACH TO WATER SECURITY

Northwestern researchers including **Aaron Packman** (civil and environmental engineering), **Sera Young** (anthropology), and **Will Dichtel** (chemistry) are among those whose multidisciplinary insights are helping address water crises like drought, flooding, and contamination. Affiliated with the University's **Center for Water Research** (CWR), these scientists are designing materials and processes to reduce the risk of water disruption globally, nationally, and locally. Dichtel's team has created an innovative material to remove PFOA — a toxic yet widely used industrial pollutant — from water, and his start-up company, CycloPure, is developing the solution for commercial use. Young's global field research on food scarcity led her to create the pioneering Household Water Insecurity Experiences Scale, a measure attracting

global attention and making possible a new field of study. As CWR director, Packman is sounding the alarm about water crises while revealing the problem's true breadth and using data to inform design of resilient next-generation systems. As principal investigator of the multi-institutional NSF-funded project SAVEUR, Packman aims to better predict extreme weather events and help reduce their impacts. Partnerships between Northwestern and The Nature Conservancy and World Wildlife Fund, as well as with Tel Aviv and Ben-Gurion Universities in Israel, include explorations of how next-generation green infrastructure can help both catastrophic and chronic, low-grade flooding — including in urban settings like Chicago. "If we do not do this work, we will see a major city run out of water in the next 10 years," says Packman.

ASCEND: HELPING GREAT FACULTY SOAR EVEN HIGHER

A new initiative is providing expert training for Northwestern faculty to help them flourish. Through workshops and one-on-one coaching, **ASCEND** is a nine-month program that offers post-tenure faculty in the humanities and social sciences tools to identify their strategic priorities while gathering the resources to pursue their research and teaching. The initiative, a partnership between the **Office for Research** and the **Office of the Provost**, includes an emphasis on the latest tools for professional productivity, accountability, and idea generation. It also creates networking opportunities for these senior faculty to manage increased responsibilities while continuing to produce

high-impact knowledge that benefits society. Directed by Associate Vice President for Research **Celeste Watkins-Hayes** (sociology and African American Studies, pictured), ASCEND takes a comprehensive view of the research enterprise. “After tenure and promotion, new doors open and exciting new projects (and obligations) flood in,” says Watkins-Hayes, a fellow at Northwestern’s **Institute for Policy Research**, who completed her 2019 book *Remaking a Life: How Women Living with HIV/AIDS Confront Inequality*, while developing ASCEND. “Balancing our evolving personal commitments while staying true to our professional ambitions and demands is at the core of this innovative initiative.”



Photo by Eileen Molony

LAUNCH OF LARGEST BIOMEDICAL CENTER WILL ACCELERATE ‘LIFESAVING SCIENCE’

With the opening of the 12-story, 625,000-square foot **Simpson Querrey Biomedical Research Center** on the Chicago campus last summer, Northwestern created an ultramodern research facility unlike any at an American medical school. Designed to encourage trailblazing collaboration among physicians and scientists from the **Feinberg School of Medicine**, the **McCormick School of Engineering**, and top-ranked clinical affiliates like the **Stanley Manne Children’s Research Institute**, the Center provides space on each floor for 23 principal investigators and their teams to pursue scientific inquiry into cancer, heart disease, neurodegenerative disorders, diabetes, and more. It also features “research neighborhoods” to promote engagement among different groups. The space is flexible to allow teams to scale up or down based on new discoveries and funding, and the Center itself accommodates vertical expansion to 16 additional floors as Northwestern’s projected research growth continues (this year saw a record \$800 million in sponsored funding). The facility, made possible by the generous philanthropy of trustees **Louis A. Simpson** ’58 and **Kimberly K. Querrey**, is expected to enable Northwestern to attract an additional \$150 million in research funding per year, while also creating 2,000 new

high-paying jobs and generating nearly \$400 million a year in economic activity in Chicago. “Inside this modern building, scientists will pioneer discoveries that will impact the practice of medicine and transform human health, accelerating the pace of lifesaving medical science that fuels the economy,” says Feinberg Dean **Dr. Eric G. Neilson**.



Photo courtesy of Global Marketing and Communications

3,289

TOTAL AWARDS

\$798.3 MILLION

SPONSORED RESEARCH FUNDING
14% INCREASE OVER FY18

40+

UNIVERSITY RESEARCH
INSTITUTES AND CENTERS

55

CORE FACILITIES: SHARED
LABORATORIES AND
EXPERT TECHNICAL
SUPPORT

\$351M

NIH FUNDING
#15 AMONG AAU PEERS

#1

REHABILITATION HOSPITAL
SHIRLEY RYAN ABILITYLAB

\$70.4M

SPONSORED RESEARCH
FUNDING AWARDED TO
UNIVERSITY RESEARCH
INSTITUTES AND CENTERS

\$357M

GRANT DOLLARS
SUPPORTED BY CORES

#9

NATIONAL
UNIVERSITIES RANKING
(US NEWS AND WORLD REPORT)

#10

HOSPITAL
NORTHWESTERN
MEMORIAL HOSPITAL

FACULTY RECOGNITION

17TH

INCITES CITATION
RANKING
(2014-19)

88

AMERICAN ACADEMY
OF ARTS AND SCIENCES
MEMBERS

65

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

12

NUMBER OF START-UP
COMPANIES FOUNDED BY
FACULTY DURING FY19

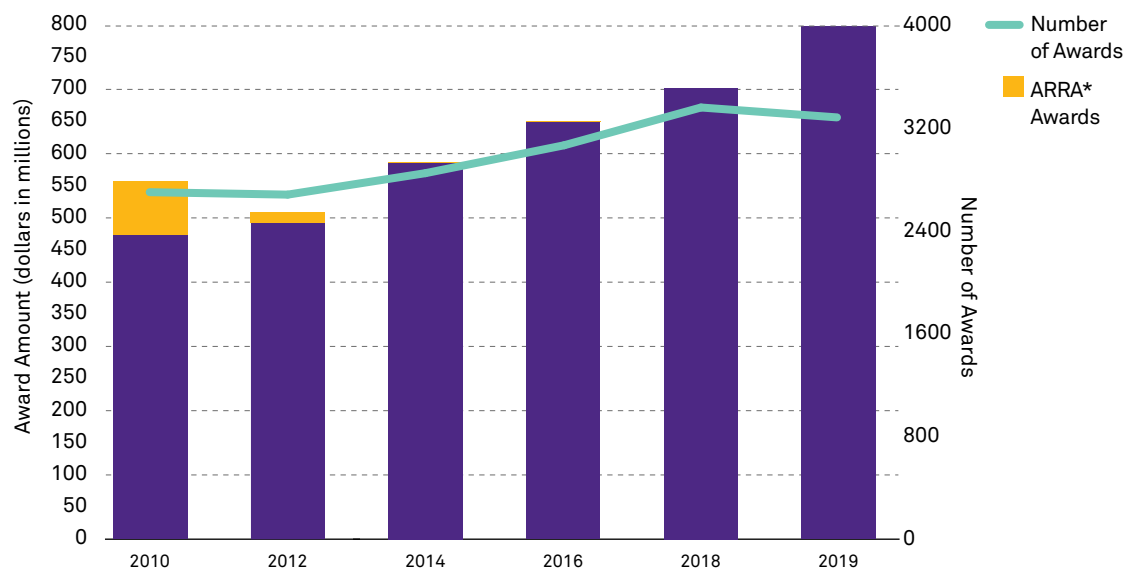
230

INVENTION
DISCLOSURES

172

ISSUED PATENTS

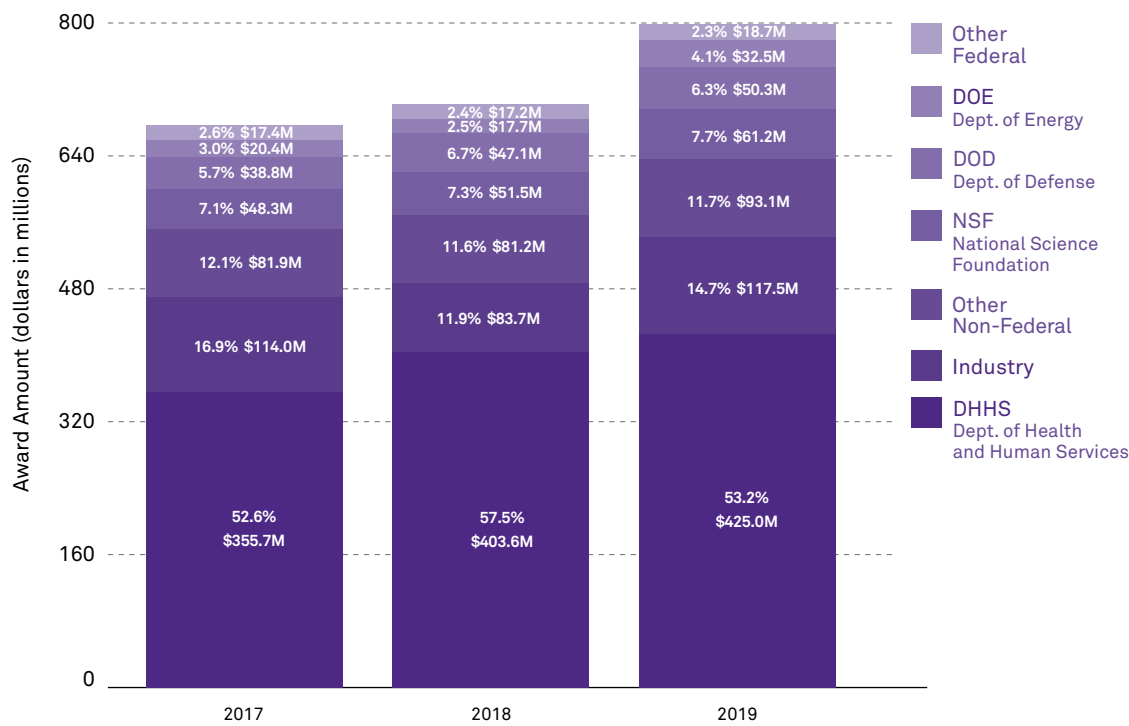
SPONSORED RESEARCH AWARDS



	FY2010	FY2012	FY2014	FY2016	FY2018	FY2019
NUMBER OF AWARDS	2,707	2,688	2,855	3,072	3,366	3,289
AMOUNT IN MILLIONS	\$556.7	\$508.6	\$587.1	\$649.7	\$702.1	\$798.3

43 Percent Funding Increase FY2010-2019

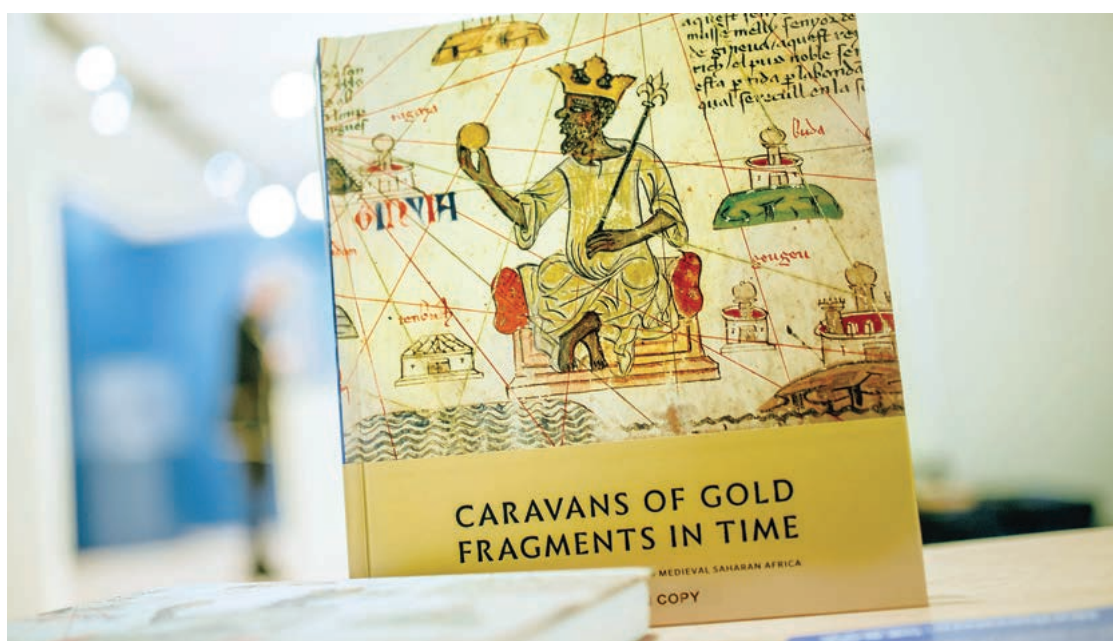
AWARDS BY SPONSOR



* American Recovery and Reinvestment Act

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Photos by Sean Su Photography



With its celebrated *Caravans of Gold, Fragments in Time*, Northwestern's **Block Museum** again presented a pioneering, multidisciplinary, research-based exhibition. *Caravans* revealed the untold story of art and cultural exchange across medieval Saharan Africa and Africa's role in medieval history. Including rare archeological discoveries and more than 250 artworks — some never before seen in North America — the exhibit included performances and drew upon partnerships with institutions in Mali, Morocco, and Nigeria. This year, *Caravans* travels to Toronto's Aga Khan Museum and the Smithsonian in Washington, DC. *The New York Times* named The Block one of America's Top 10 university museums.

