INDIANA UNIVERSITY

ANNUAL REPORT 2017–2018

OFFICE OF THE VICE PRESIDENT FOR RESEARCH

Amatria, a work of "sentient art" by Canadian artist and architect Philip Beesley, was recently installed in the glass atrium of Luddy Hall, the new home for the IU School of Informatics, Computing, and Engineering.

The 2017-18 year marked another milestone for Indiana University. The university received $604.4 million in external funding for research and other activities. This achievement is the second highest in IU history and includes a record $203.1 million in nongovernmental grants. These figures reflect the work of more than 1,200 faculty and thousands of students and staff. When announcing this news to IU Trustees, President Michael A. McRobbie called IU "the state's research powerhouse." I could not agree more.

IU is also a collections powerhouse, and we have welcomed Heather Calloway as IU's first executive director of university collections. Under an initiative launched by President McRobbie in his 2017 State of the University address, Calloway will provide expert oversight and support for IU's vast collections of objects, art, cultural artifacts, archives, manuscripts, and more. We've also launched collections.iu.edu, a new website that begins to offer access to IU's collections assets under one public-facing portal.

Expanding our efforts to compete more effectively for research funding, the Office of the Vice President for Research was delighted to support the IU School of Medicine in hiring Dr. Chandan Sen as director of IU's new Center for Regenerative Medicine and the university's first associate vice president for military and applied research. And Laura Kolton joined the research team as director of federal research relations.

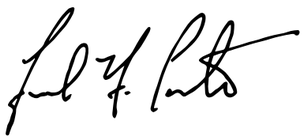
During the last year, IU also announced the Responding to the Addictions Crisis initiative, the third in the university's Grand Challenges program aimed at deploying IU expertise to solve issues that vex humankind. In partnership with Governor Eric Holcomb, IU Health, Eskenazi Health, and local communities, the initiative is one of the nation's largest and most comprehensive state-based responses to the opioid addiction epidemic. IU's $50 million investment will yield comprehensive approaches to reduce the incidence of addiction in the state, decrease opioid overdose deaths, and reduce the number of babies born with Neonatal Abstinence Syndrome.

IU also launched two new research initiatives as part of its Emerging Areas of Research funding program on the Bloomington campus. The first initiative will improve public health by analyzing what makes food systems sustainable and resilient; the second will harness the power of quantum physics to create new materials and develop sensitive sensors.

Further demonstrating IU's ongoing commitment to support faculty research, this year President McRobbie established the Major Scientific Equipment Fund. The goal is to provide critical scientific research infrastructure through strategic investments in equipment on the Bloomington campus.

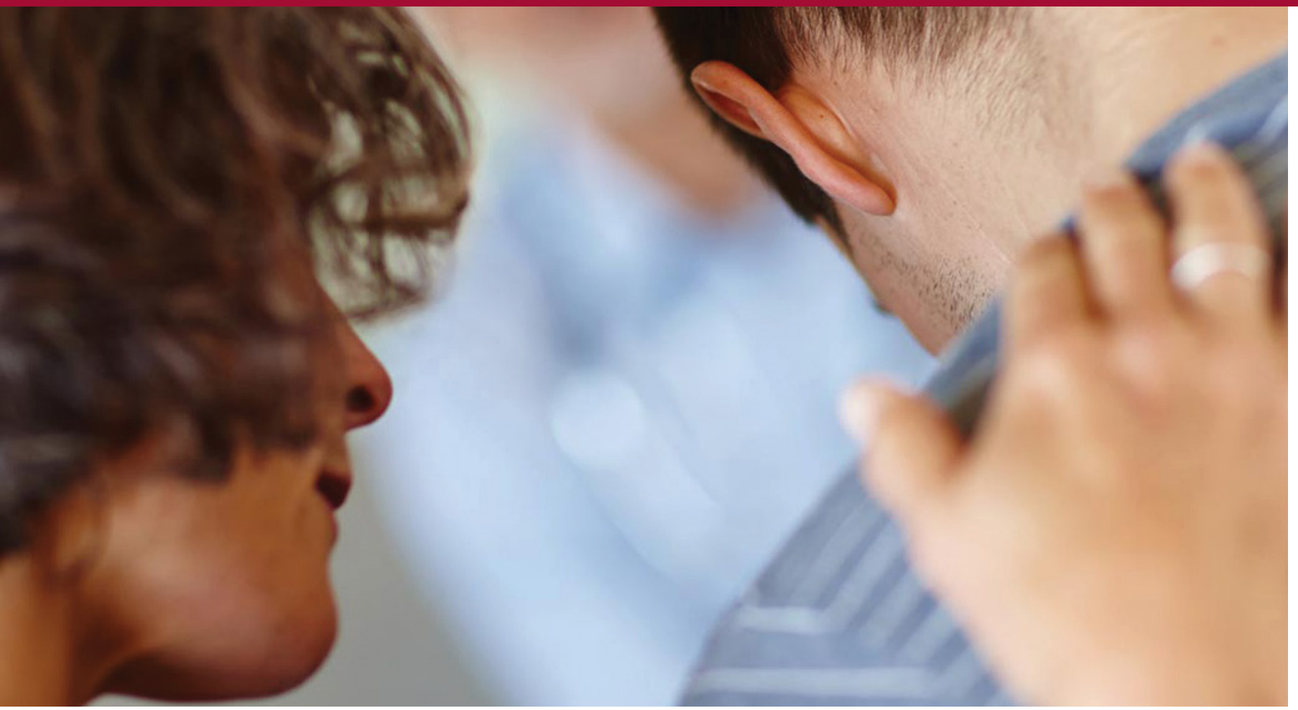
At IU, we are committed not only to making new discoveries, but also to transferring those innovations to the public. IU researchers are ably assisted in this process by IU's Innovation and Commercialization Office, which was honored as the Tech Transfer Unit of the Year by Global University Venturing in 2018. Working to streamline IU's efforts to engage with corporate entities, IU's Corporate Relations team and ICO were brought together under the leadership of Simon Atkinson, vice chancellor for research and Chancellor's Professor at IUPUI. Also in 2018, the IU Philanthropic Venture Fund, managed by a restructured IU Research and Technology Corp., was officially launched to provide early-stage capital to establish and grow IU startups.

With each year, it becomes increasingly clear that IU research, and researchers, play an important role not only in advancing the mission of the university, but in improving the lives of Hoosiers and all citizens across the globe. This report provides only brief highlights of the extraordinary work taking place across IU's campuses every day.



Fred H. Cate
Vice President for Research
Distinguished Professor
C. Ben Dutton Professor of Law

COLLABORATING TO DELIVER SOLUTIONS TO THE STATE'S OPIOID CRISIS



The tragic statistics are all too familiar: in 2017, more than 1,700 Hoosiers died from a drug overdose, an all-time high. The vast majority of those deaths can be attributed to opioids. Hoosiers are now more likely to die from a drug overdose than a car accident.

In addition, economic damages resulting from the opioid epidemic are expected to eclipse $4 billion in Indiana in 2018, according to a spring 2018 report by *Indiana Business Review*.

To combat this growing epidemic, Indiana University launched its third Grand Challenge initiative, Responding to the Addictions Crisis, in cooperation with Indiana Governor Eric Holcomb, IU Health, Eskenazi Health, and many other business and community partners. The initiative—a $50 million commitment to prevent, reduce, and treat addictions—is led by IU School of Nursing Dean and Distinguished Professor Robin Newhouse.

In phase one of the initiative, 16 projects were undertaken, funding projects such as an in-depth analysis of legal and policy responses to the crisis and a community-based addiction reduction program. *Innovations in Opioid Law and Policy Interventions*, a report issued following a study by IU experts Nicolas Terry, Ross Silverman, and Aila Hoss, provides examples of interventions in four primary areas: rethinking criminalization; strengthening public health; increasing and improving treatment; and effecting change.

Terry and Silverman also met with congressional delegates on Capitol Hill and briefed agency officials in partnership with the Addiction Policy Forum. In May 2018, Terry also delivered testimony in front of the U.S. Senate Special Committee on Aging, during a hearing titled "Preventing and Treating Opioid Misuse Among Older Americans."

The CARE Plus program, aimed at training community health workers in the process of screening, brief intervention, and referral to treatment, hired and trained two full-time addiction recovery coaches and developed a free text messaging platform to support recovery of women with substance use disorders.

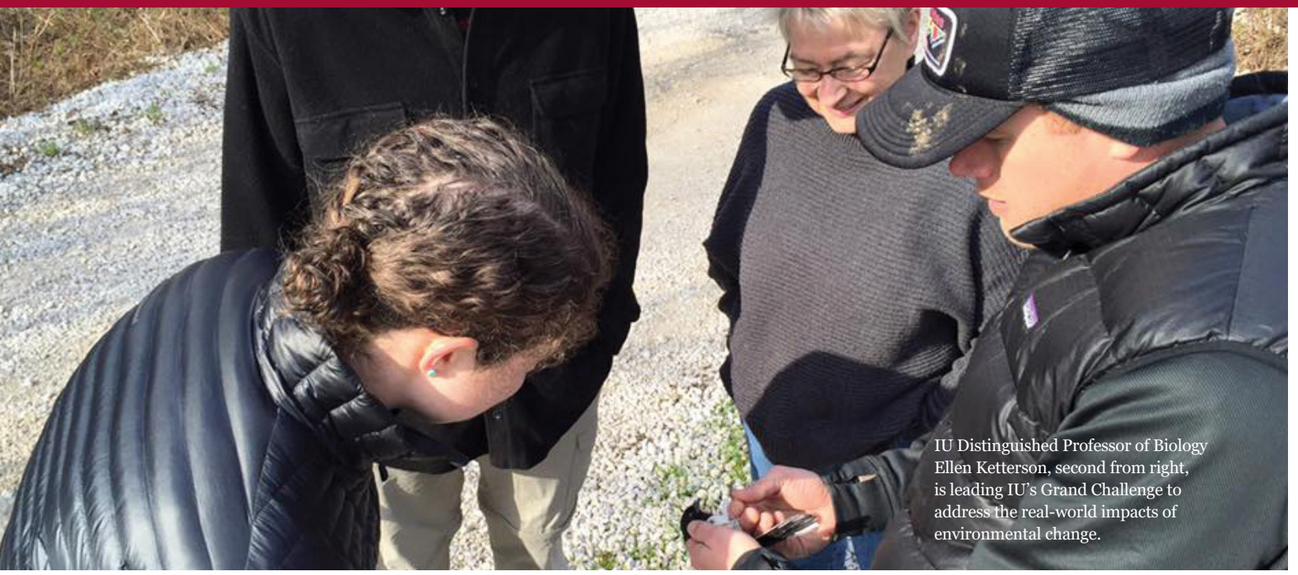
A. Heidi Barnett, IU Health pharmacy manager, talks with a visitor at ar overdose reversal training held by IU, IU Health, and partners in September 2018. **B.** IU President Michael McRobbie announces IU's Re..ponding to the Addictions Crisis Grand Challenge alongside Indiana Gov. Eric Holcomb in October 2017. **C.** and **D.** As part of its third Grand Challenge, IU partnered with IU Health to distribute naloxone kits to the public during an overdose-reversal training event in September 2018.

Other phase one projects partnered with hospital systems, public health departments, health care research institutes, and others. Progress includes the development of preventive assessment tools, treatment center capacity-building, and the creation of online education centers for health care professionals.

Fifteen new projects have received funding as part of phase two of the initiative. Examples include assessing public stigma around opioid addiction, hiring and training in the midst of the opioid epidemic, and developing a better naloxone. Projects involve a wide array of external partners such as IU Health, Eskenazi Health, Overdose Lifeline, the Indiana State Department of Health, the Indiana Family and Social Services Administration, the Indiana Rural Health Association, several county public health offices, elementary and middle schools, and others.

The strong partnership between IU, state and local government, Indiana businesses, and community organizations promises real impact on opioid abuse in Indiana and throughout the nation.

PREPARING HOOSIER COMMUNITIES, ECONOMY FOR ENVIRONMENTAL CHANGE



IU Distinguished Professor of Biology Ellen Ketterson, second from right, is leading IU's Grand Challenge to address the real-world impacts of environmental change.

With funding from IU's Prepared for Environmental Change Grand Challenge initiative, the Environmental Resilience Institute launched in 2017. Since then, ERI has been facilitating collaborations between scientists, local officials, businesses, nonprofits, and community leaders to develop and distribute accurate predictions, feasible solutions, and effective communications that prepare Indiana for the impacts of environmental change.

Predicting

- In partnership with the Environmental Protection Agency's Climate Change Adaptation Resource Center (known as ARC-X), ERI launched the online **ERI Toolkit** aimed at Indiana and surrounding Midwestern states. ERIT enables communities to build customized packages of information about preparing for environmental change specifically tailored to their topics of concern.

> *"Some towns are worried about flooding, others about drought, and still others about heat waves. Cities and towns can come to ERIT to learn what's likely to take place near them and find solutions to the crises they face."*
>
> **— Ellen Ketterson**
> leader of IU's Prepared for Environmental Change Grand Challenge

- The Prepared for Environmental Change **webinar series** offers cost-free trainings for mayors and other local government officials. The monthly series includes topics such as managing storm sewer flooding and more frequent river flooding as well as incorporating wind and solar energy into communities.
- ERI researchers lead **Project Vector Shield**, an early warning system mapping the presence of insects that spread human diseases, such as the Zika virus and Lyme disease. Collecting ticks and mosquitoes at 20 sites in southern Indiana, the ERI team is testing samples for pathogens and will make the results widely available.
- In partnership with colleagues from Purdue, Notre Dame, and others, ERI team members led three of five reports released by the **Indiana Climate Change Impacts Assessment**. ERI researchers also contributed data analysis to IN CCIA's major report, *Indiana's Past and Future Climate*. Data are available at the county level to meet growing needs of local decision-makers.

Solving

- In the **Greening the Pleasant Run Waterway** project, ERI researchers are studying 30 urban greenspace locations across Indianapolis to measure the impact of native plants on the diversity, abundance, and health of birds. The results will yield insights on how we can reduce the impact of human development on wildlife.
- The **Urban Green Infrastructure Analysis Project** is helping two communities understand how green infrastructure promotes resilience. Green infrastructure—the installation of vegetation to manage stormwater—helps with flood protection, cleaner air, cleaner water, increased biodiversity, and urban heat management. The project will yield an interactive, online map that allows visitors to explore types of green infrastructure, socioeconomic variables, and predicted flood levels. Flooding is already increasing in Indiana, and this project will help communities understand, alleviate, and manage water inundations.

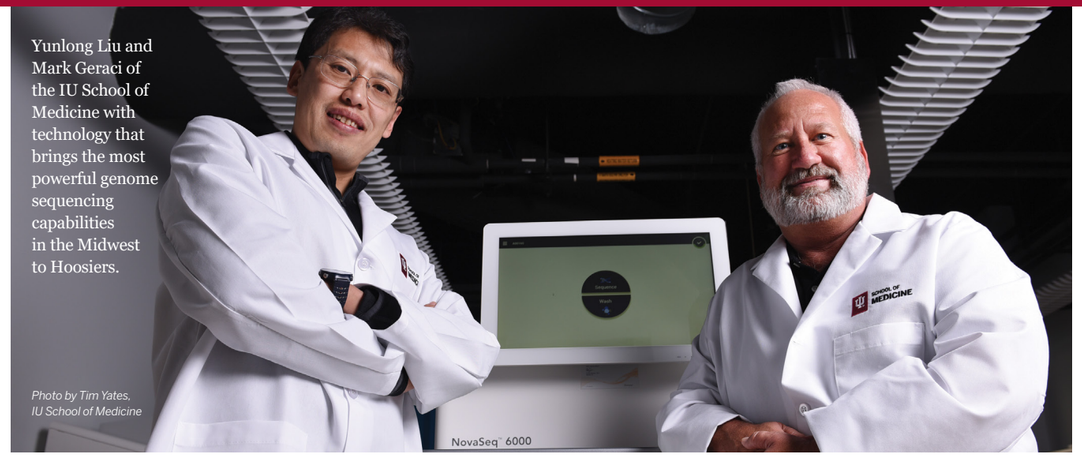
Communicating

- To help the public understand what they can do in the face of environmental change, ERI founded the editorially independent **Indiana Environmental Reporter**, in partnership with the IU Media School. And with ERI support, Indiana Public Media has hired a journalist to cover environment and energy issues in Indiana.
- Focusing on future generations, ERI launched a **teacher-training program** in partnership with the WonderLab Museum of Science, Health and Technology in Bloomington. A summer 2018 workshop hosted 19 middle- and high-school science teachers from around Indiana. Activities included classroom-based modules on global climate science, field-based research on soil carbon respiration, and stakeholder exercises integrating scientific and policy approaches to address climate change. Two teacher workshops are planned for summer 2019.
- Over the next year, ERI plans to release the **Hoosier Social-Environmental Survey**, which documents community responses to climate change, and to launch and gather community feedback on the **Hoosier Resilience Index**, an online tool that evaluates progress toward resilience.

As ERI and the Prepared for Environmental Change Grand Challenge move forward, four new faculty have been joined by 12 new fellows in the natural and social sciences, arts, history, business, and law, who are exploring projects such as how to communicate with farmers about climate change adaptation and mitigation, how different species respond to environmental changes, and how art can help us re-envision our human interactions with ecosystems.

Top: IU Professor Heather Reynolds collects data on plant species.
Bottom: Climate change is projected to increase the frequency and intensity of storms in the U.S., which can lead to extreme flooding.

HEALTHCARE SOLUTIONS FOR HOOSIERS



Yunlong Liu and Mark Geraci of the IU School of Medicine with technology that brings the most powerful genome sequencing capabilities in the Midwest to Hoosiers.

Photo by Tim Yates, IU School of Medicine

The Precision Health Initiative is IU's big healthcare solution, established in 2016 with a $120 million investment by the School of Medicine and the IU Grand Challenges program. The initiative incorporates scientific areas with the social sciences, ethics, education, data, and informatics in pursuit of better treatments, cures, and preventions.

Thanks to the efforts of PHI scientists and researchers, a promising therapy for the treatment of cancer has come to Indiana. CAR T-cell therapy harnesses the disease-fighting power of a patient's own immune T cells by taking them out of the patient's blood, changing them in a laboratory, then infusing them back into a patient's body to attack cancer cells. The therapy was recently administered for the first time in Indiana to a lymphoma patient at IU Health. Pediatric patients are able to receive CAR T-cell therapy at IU Health Riley Hospital for Children.

As a result of the Precision Health Grand Challenge, IU Health is the only approved site in Indiana to administer these FDA-approved CAR T-cell therapies, widely considered by some as a cure for certain types of leukemia and known for improved remission rates in certain lymphomas.

PHI is led by Anantha Shekhar, associate vice president for clinical affairs at IU and executive associate dean for research at the IU School of Medicine. Precision Health leaders recently announced goals for developing cures and preventive treatments that focus on specific diseases prevalent among Indiana residents.

More than 33 research faculty from throughout the country were successfully recruited by IU to:

- Develop new approaches for treating triple negative breast cancer and multiple myeloma;
- Cure more children with pediatric sarcoma, a particularly deadly cancer found in tissues such as tendons, bones, and muscle;
- Prevent the onset and progression of Type 2 diabetes by discovering what biological factors trigger the disease and tailoring treatments to individuals; and
- Slow the progression of Alzheimer's disease by researching the role of the immune system and developing new immunotherapies.

Another outcome of the Precision Health Initiative is acquisition of new genomic research technology that can perform a staggering 200 whole genome sequences per week—giving IU the most powerful genome sequencing capabilities in the Midwest. The Good Manufacturing Practice Cell Therapy Lab allows IU scientists to research and develop new cell, gene, and immunotherapy-based treatments.

And recently, a Precision Health team of social scientists led by IU Bloomington's Bernice Pescosolido, a Distinguished Professor of sociology, began canvassing rural Indiana to collect information and DNA samples from 2,000 Indiana residents of all backgrounds. The data collected will help researchers understand how genetic, behavioral, and environmental factors influence a person's health.

ARTS FOR THE ENVIRONMENT, FOOD AND PHILOSOPHY, RACISM IN LITTLE LEAGUE

Over more than a decade, IU's New Frontiers in the Arts and Humanities program has invested more than $12 million in projects involving more than 500 IU faculty members across the state. In 2017-18, the program supported dozens of projects in the arts and humanities. The following are a few examples.

Art and science intersect to help us "believe what we know"

What do the arts and humanities have to do with environmental science? A multimedia performance piece and symposium hosted at IU Bloomington illuminated that question.

Rob Davies performs in *Rising Tide* at IU Bloomington

Combining spoken word, painting, photography, live music, and audience feedback, *Rising Tide* was developed by Rob Davies of Utah State University as part of the Crossroads Project. The event leverages emotions generated through the arts and humanities to convey science and facts about climate change, urging viewers to "believe what we know." IU Bloomington hosted a performance of *Rising Tide*, followed by a symposium featuring creators and performers, as well as a workshop focused on developing cross-disciplinary projects.

Following the performance, The Crossroads Project: IUB has been created to continue fostering understanding of the challenges that Indiana faces from environmental change.

In addition to New Frontiers, project partners include the Integrated Program in the Environment, the Environmental Resilience Institute, Jacobs School of Music, the Arts and Humanities Council, and the IU Cinema.

A serving of philosophy and food

When he's not thinking philosophy, Matt Shockey is thinking food. An associate professor of philosophy at IU South Bend, Shockey has spent years reading about the U.S. food system and talking to people who work in it, learning how to grow, cook, and preserve his own food, including curing meats.

With a New Frontiers Experimentation Fellowship, he has combined his interests to explore questions about ethical issues surrounding the human consumption of animals, the value of skilled food/farm labor, the complex factors that shape our senses of taste, the role of health risk in deciding how to produce and consume food, and the cultural and political assumptions that shape government regulation.

Engaging in the everyday world of food, Shockey is involving students and community members in his exploration of the moral and political issues surrounding how we produce and consume our food.

Racism in the Little League

When the 11- and 12-year-olds on the Cannon Street YMCA Little League all-star team registered for the Charleston, South Carolina, tournament in 1955, it put the team on a collision course with segregation, bigotry, and racism. The Cannon Street all-stars became, in the words of one player, "the team nobody would play."

Chris Lamb, a professor of journalism at IUPUI, is writing a book about the first black Little League team in South Carolina, and how the mere presence of a black team in the segregated South was enough to cause the greatest crisis in Little League history.

Supported in part by an IU New Frontiers grant, the book will look at the young team in social, historical, and legal contexts, including the *Brown v. Board of Education* ruling that came a few weeks after the Cannon Street YMCA Little League began its first season in 1954.

According to Lamb, within a few years of the stymied all-star appearance, Little League Baseball disappeared from much of the South, and it took decades before another boy wore a Little League uniform in Charleston.

ADRIAN MATEJKA, IU'S THIRD STATE POET LAUREATE

"Now, more than ever, we need poetry to remind us of the beauty that still surrounds us despite all of the seemingly unending anger and strife."

Adrian Matejka — Photo by Stephen Sproll

With those words, Adrian Matejka stepped into his role as Indiana's State Poet Laureate. Matejka, the Ruth Lilly Professor and poet-in-residence in the Department of English in the College of Arts and Sciences at IU Bloomington, is the state's sixth poet laureate and the third from IU since the state created the program in 2005. He will serve in the role through 2019.

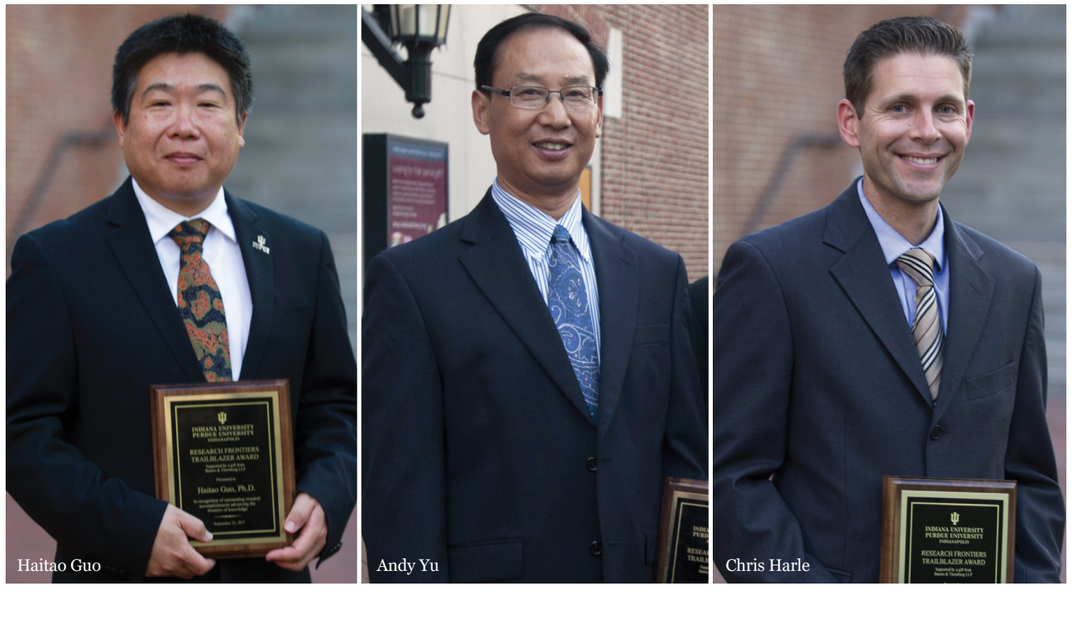
Following his selection by the Indiana Arts Commission in December 2017, Matejka has maintained a busy schedule of readings and appearances at conferences, high schools, universities, libraries, and book festivals around the state and nation. In between appearances, he is working on a graphic novel and a new collection of poems, *Hearing Damage*.

Born in Nuremberg, Germany, Matejka grew up in California and Indiana, attending Pike High School in Indianapolis and IU Bloomington before receiving his MFA from Southern Illinois University in Carbondale. He returned to teach at IU Bloomington in 2012.

Matejka's previously published work has received considerable attention. *The Devil's Garden* (Alice James Books, 2003) won the New York/New England Award; *Mixology* (Penguin, 2009) won the 2008 National Poetry Series; and his third collection, *The Big Smoke* (Penguin, 2013)—focused on Jack Johnson, the first African American heavyweight champion of the world—was awarded the 2014 Anisfield-Wolf Book Award and was also a finalist for the 2013 National Book Award, a 2014 Hurston/Wright Legacy Award, and a 2014 Pulitzer Prize in poetry.

For all his accolades and achievements, though, Matejka describes his view of being poet laureate modestly. "I'm thinking about the poet laureate position as being more like a teacher and standard bearer of poems," he said in a Big Ten Network interview. "Let me get out there and be the poetry Johnny Appleseed."

IUPUI TRAILBLAZER AWARD RECIPIENTS TACKLE CHRONIC PAIN, DISEASES



Haitao Guo

Andy Yu

Chris Harle

Three IUPUI faculty received the campus's Research Frontiers Trailblazers Award in 2017-18. Their work may lead to better treatments for hepatitis B, HIV, and chronic pain.

Haitao Guo, associate professor in the Department of Microbiology and Immunology at the IU School of Medicine, conducts research on the molecular biology of the hepatitis B virus, an incurable infection affecting approximately 2 billion people worldwide, resulting in approximately 1 million deaths annually. Guo's research on the hepatitis B virus is providing further understanding of the molecular mechanism behind this chronic virus infection.

Andy Yu, associate professor in the Department of Microbiology and Immunology at the IU School of Medicine, focuses on the origin and development of HIV. More than 35 million people have died during the HIV pandemic, and more than 36 million people worldwide are currently infected. Yu is developing therapeutic approaches to eliminate groups of HIV-infected cells that do not actively produce the virus, known as reservoirs. Currently, the only effective treatment for HIV-infected patients is antiretroviral therapy. Interrupting this treatment leads to a resurgence of HIV levels because of the reservoirs. Developing approaches to purge these reservoirs may move researchers closer to a cure.

Chris Harle, associate professor in the Department of Health Policy and Management at the Richard M. Fairbanks School of Public Health and affiliated scientist at the Center for Biomedical Informatics at the Regenstrief Institute, and his team have conducted almost 100 interviews to better understand how clinicians take care of patients with chronic pain. A tool for electronic health records is in the works to help primary-care providers more safely prescribe opioids when necessary and use non-opioid pain treatments when possible.

Research Frontiers Trailblazer Awards recognize outstanding work at IUPUI that is drawing national and international attention. The award is given to associate professors within the first three years of being appointed or promoted to that title.

James Farmer, center, meets with students and others at the IU Campus Farm.

In the face of environmental change and persistent public health issues, how do we develop more resilient, sustainable food systems? In the era of big data and massive cybersecurity breaches, how can we use quantum mechanics to design new materials and super-sensitive sensors?

These questions are at the heart of the two research programs that received 2018 Emerging Areas of Research awards from IU Bloomington. The program harnesses existing campus strengths to explore significant issues affecting people and communities in Indiana and around the world. Awardees receive up to $3 million to further their work.

Led by James Farmer, a faculty member in the School of Public Health in Bloomington, researchers in the Sustainable Food Systems Science program are analyzing what it takes to create environmentally sustainable, socially just, and resilient systems for food, from production to procurement. Farmer is also co-director of the newly established IU Campus Farm.

Since receiving its award, the SFSS team has added research scholars and developed relationships with community stakeholders around Indiana. Team members are also studying food security among rural families with children, farmer decision-making in the face of tariffs and industry consolidation, and linking producers in southwest central Indiana to large institutions such as hospitals, schools, and institutions of higher education.

The Quantum Science and Engineering initiative is focused on harnessing the power of quantum entanglement, a phenomenon that Einstein called "spooky action at a distance" in which particles that interact continue to act on one another, even when separated. The team aims to use entanglement to speedily simulate new and exotic materials and to develop quantum sensors, devices that use quantum interference effects to achieve greatly enhanced measurement sensitivity.

The Quantum Science and Engineering initiative, led by Gerardo Ortiz, a professor of physics in the College of Arts and Sciences' Department of Physics, has also been hiring new scholars as well as building the laboratory and equipment needed for quantum sensing and entangled neutron scattering experiments.

Created as part of the Bicentennial Strategic Plan for IU Bloomington and launched in 2016, the Emerging Areas of Research program is co-sponsored by the Office of the Provost and the Office of the Vice Provost for Research. The inaugural award provided $3 million to apply research on toddler learning to improve machine learning and artificial intelligence.

From aiding refugees to preventing malaria to providing disaster relief, the world relies on philanthropy to address its most urgent needs. But how can such efforts be successful unless we know what factors advance or hinder them, or how much assistance they provide? The Global Philanthropy Indices, a project of the IU Lilly Family School of Philanthropy at IUPUI, provides an answer.

Mina Ogbanga, center, a fellow at IUPUI, leads a session on sustainable development goals with a high school club in Nigeria.

The Global Philanthropy Environment Index is the most comprehensive effort to document the state of global philanthropy and the factors that enhance or inhibit philanthropy's success. Drawing on the research of more than 100 experts around the world, the GPEI evaluates 79 countries and economies on key factors, measuring the ease with which philanthropic organizations can operate within countries and across borders.

> *"At a time of significant challenges worldwide, with billions of dollars in philanthropic aid at stake, our ability to achieve development goals and respond to crises through philanthropy demands insight to assist global leaders who can help channel resources to meet the world's most pressing problems."*
>
> — **Una Osili**
> associate dean for research and international programs at the IU Lilly Family School of Philanthropy

According to GPEI results released in spring 2018:

- The political environment and political uncertainty now constitute the greatest challenge to philanthropy across the world, undermining the work of philanthropic organizations and endangering billions of dollars in much-needed help.
- The philanthropic environment globally is improving, but nearly two in five countries restrict philanthropic activity, and barriers, especially to philanthropic funding across borders, are increasing.
- Countries with favorable philanthropic environments are positively correlated with higher economic indicators, such as per capita GDP.
- Giving is widely represented in all cultures studied.
- Partnerships among philanthropic organizations, governments, and businesses are expanding worldwide, aided by technology.

Predecessor indices created at the Hudson Institute were transferred to the Lilly Family School of Philanthropy, which is taking them forward with the Global Philanthropy Indices project. A second index, the Global Philanthropy Resource Flows Index, captures the scope of formal international development aid, philanthropic giving, and private investments. It is the first research of its kind to offer a holistic view of the magnitude of aid to the developing world. The first report produced by IU is scheduled for release in 2020.

These two landmark studies—the Global Philanthropy Environment Index and the Global Philanthropy Resource Flows Index—unveil vital markers of philanthropy and equip policy makers, philanthropy and nonprofit leaders, business leaders, news media, and the public with clearer understanding of the global philanthropic landscape. The indices also expand IU's international partnerships and engagement, introduce opportunities for students and faculty, and unite a worldwide community of scholars.

IU President McRobbie addresses the U.S. Air Force Science and Technology 2030 Forum in spring 2018.

Advancing America's defense through IU research

In today's complex world, research partnerships are crucial to developing and advancing America's defense systems. IU continues to build such partnerships, including those with the U.S. Navy and the U.S. Air Force, both divisions of the Department of Defense.

In fall 2017, IU and the Naval Surface Warfare Center, Crane Division, located in Southern Indiana, again signed a Partnership Intermediary Agreement to extend a growing strategic relationship that is harnessing IU research to help NSWC Crane move innovative technology through the commercialization pipeline.

NSWC Crane provides technological systems and solutions for modern-day warfare. IU's strengths in information technology, informatics, and cybersecurity will assist in areas such as high-performance computing, big data, and artificial intelligence.

In spring 2018, IU hosted a forum associated with the U.S. Air Force Science and Technology 2030 initiative. IU was one of only six universities nationwide invited by the Air Force to host such a forum. More than 300 professionals in higher education, government, and industry convened at the IU Bloomington campus to discuss basic and applied technologies that could lead to discoveries to support the U.S. Air Force through 2030 and beyond.

Participants focused on artificial intelligence for mission planning and execution, cyber assurance and trusted microelectronics, human performance and human-computer interface, next-generation propulsion and advanced manufacturing, and novel sensing and data fusion. The conference expanded the potential for IU-USAF connections, with new ideas submitted to Air Force Research Laboratory officials.

> *"As enticing as websites and other online communications might be, they don't replace human interactions … My hope is that these events [are] the initiation of a more enduring relationship that we can leverage to tap into innovations being developed."*
>
> — **Maj. Gen. William Cooley**
> Air Force Research Laboratory Commander

Orange County, Indiana

Building partnerships to serve rural Indiana communities

Founded with support from Lilly Endowment Inc., IU's Center for Rural Engagement was formed in spring 2018 to reimagine the relationship between the Bloomington campus and nearby rural communities. Calling on the research, expertise, teaching, and service of faculty, staff, and students, the center focuses on community-identified challenges and solutions.

IU Professor John Keesler talks with community colleagues in Lawrence County.

The center's work dovetails with research directions in IU's Grand Challenges program. For example, collaborative teams affiliated with the center are addressing addiction. John Keesler, an assistant professor in the School of Social Work at IU Bloomington, has worked with colleagues and students to survey community attitudes and awareness about mental health and addiction issues and identify integrated treatment models that fit rural communities. In Lawrence County, Keesler is currently working to develop recommendations and programming that respond to the community's needs.

With leadership from Lee Florea, assistant director for research at the Indiana Geological and Water Survey at IU Bloomington, IGWS is working with the Center for Rural Engagement to investigate karst aquifers and the geology of groundwater. Engaging with community residents and students, the IGWS team is creating natural resource inventories and pursuing research to more fully trace groundwater flows in southwest central Indiana. This more complete mapping will help individuals, state and federal agencies, and towns better understand the impact of groundwater flows on development projects, water policies, agriculture, and the southern Indiana landscape in general. For example, one outcome of the project will be increased understanding of how the karst landscape responds to rainfalls, which have caused considerable flooding in recent years.

Bringing IU discoveries, innovations to market

The IU Innovation and Commercialization Office, now part of the Office of the Vice President for Research, continues to protect and advance technology derived from IU researchers. Recently launched startup companies that licensed intellectual property from the IU ICO offer advances in areas ranging from nanoparticles to algebra education.

A force-sensing instrument for use during manual therapy

- **Health Smart Technologies**, a medical device startup, is developing an instrument system called Quantifiable Soft Tissue Manipulation that can quantify the forces applied during manual therapy. Inconsistent pressure during soft-tissue manipulation is a problem, because results and benefits of such manipulation depend on pressure to treat conditions such as low back pain. Terry Loghmani, an associate professor in the School of Health and Rehabilitation Sciences at IUPUI; Sohel Anwar, associate professor of engineering in the Purdue School of Engineering and Technology at IUPUI; and Stanley Chien, a professor of electrical and computer engineering in the School of Engineering and Technology, co-founded the company.

- IU School of Medicine researchers Nathan Alves and Jeffrey Kline founded **Indiana Lysis Technologies** to use nanoparticles to administer agents that digest blood clots in the lungs. Current treatments can cause internal bleeding; using nanoparticles allows more control over clot digestion. In spring 2018, their startup was named the best biotech invention at the 2018 McCloskey New Venture Competition. Alves is assistant professor of emergency medicine; Kline is vice chair of research in emergency medicine and a professor of physiology.

- **Vascugen Inc.**, founded by Mervin C. Yoder, Distinguished Professor Emeritus at the IU School of Medicine, is using a licensed IU discovery to advance treatment of clogged arteries. The Yoder lab discovered rare cells responsible for the formation of new blood vessels in the body and then developed methods for manufacturing those cells. Many older Americans have "hardening of the arteries," a chronic condition that develops when extra cholesterol in the bloodstream collects along the walls of arteries. This buildup reduces or blocks blood flow and is the leading cause of limb amputations. Vascugen's product is capable of restoring blood flow to oxygen-starved tissues.

- To help develop more efficient regulatory risk assessments of chemicals in food, pharmaceuticals, pesticides, and other products, Kan Shao, assistant professor of environmental and occupational health in IU's School of Public Health-Bloomington, launched **Dream Tech LLC**. The startup's online dose-response modeling system sets it apart from other companies.

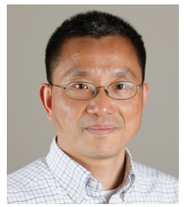
- **Graspable Inc.**'s algebra education technology was recently integrated into Google Classroom, a free service that is part of Google's G Suite for Education. Graspable Inc. offers interactive tools for students to learn to solve algebraic equations; students can move or drag terms using a touchscreen. The technology also provides tools for teachers to better track students' progress. The company was founded by entrepreneur Erik Weitnauer; David Landy, a professor of psychological and brain sciences in the College of Arts and Sciences at IU Bloomington; and Erin Ottmar, a professor at Worcester Polytechnic Institute.

American Association for the Advancement of Science Fellows

L. Jean Camp
Camp is a professor of informatics in the School of Informatics, Computing, and Engineering at IU Bloomington.

Matthew W. Hahn
Hahn is a professor of biology and of computer science and director of the Center for Genomics and Bioinformatics at IU Bloomington.

Andrea S. Wiley
Wiley is a professor of anthropology in the College of Arts and Sciences at IU Bloomington. She is also director of the Human Biology Program at IU Bloomington.



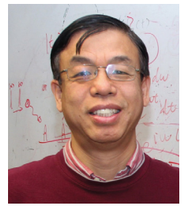
Chen Zhu
Zhu is a professor of hydrogeology and geochemistry in the Department of Earth and Atmospheric Sciences, College of Arts and Sciences, at IU Bloomington.

Adam Zlotnick
Zlotnick is a professor of molecular and cellular biochemistry in the Department of Biology, College of Arts and Sciences, at IU Bloomington.

American Physical Society Fellows

James Musser
Musser is a professor of high energy astrophysics and neutrino physics in the Department of Physics, College of Arts and Sciences, IU Bloomington. He is also associate executive dean in the College of Arts and Sciences.

Gerardo Ortiz
Ortiz is a professor of condensed matter physics (theoretical) in the Department of Physics, College of Arts and Sciences, at IU Bloomington.



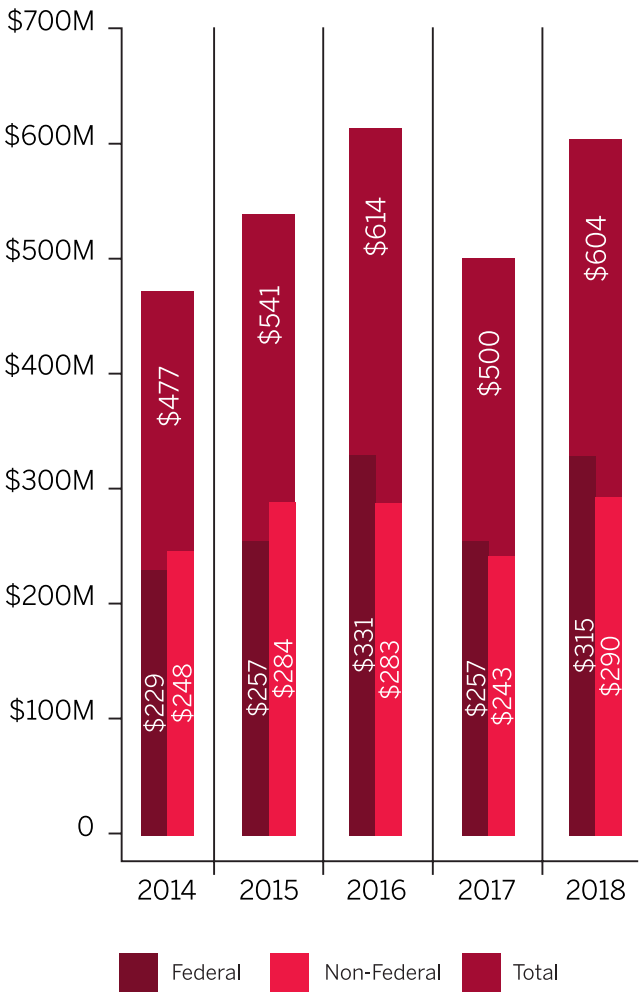
Zhe-Yu Jeff Ou
Ou is a professor of physics in the School of Science at IUPUI.

National Academy of Medicine

Robin Newhouse
Newhouse is dean of the IU School of Nursing and an IU Distinguished Professor. She is also principal investigator for Responding to the Addictions Crisis, an initiative of IU's Grand Challenges Program.

Sponsored Program Awards

Dollar figures given are in millions



Summary of Sponsored Program Activity

TOTAL AMOUNT OF PROPOSALS
$2,344,462,595

TOTAL AMOUNT OF AWARDS
$604,436,832

PROPOSALS SUBMITTED
4,048

AWARDS RECEIVED
2,879

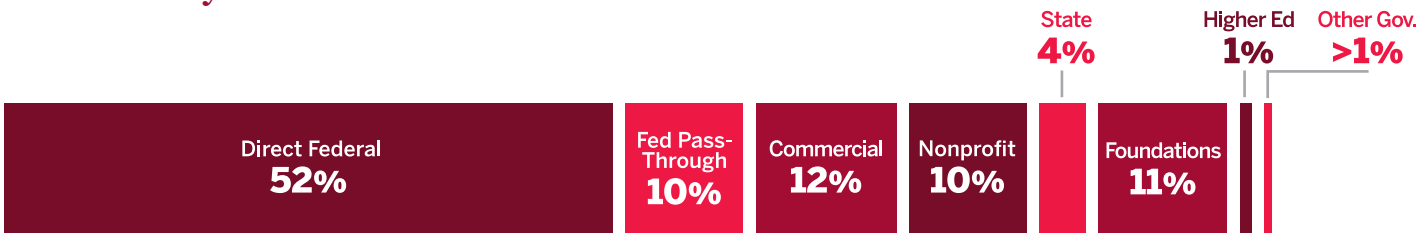
NEW AND COMPETING CONTINUATION AWARDS RECEIVED
1,781

NONCOMPETING RENEWALS AND SUPPLEMENTAL AWARDS
1,098

PRINCIPAL INVESTIGATORS RECEIVING AWARDS
1,238

SPONSORS
868

IU Awards by Source for FY 2018



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