New classes of antiviral drugs for diseases are being developed by Assembly Biosciences, a biotechnology company established by IU Bloomington Professor of Biochemistry Adam Zlotnick with the assistance of the IU Research and Technology Corp. Here, a protein shell of hepatitis B virus (red, blue, yellow, green) pictured with an experimental drug (magenta).
The 2016-17 year marked the announcement of the second in Indiana University’s signature Grand Challenges program—Prepared for Environmental Change. As you’ll read in this report, together with Cummins Inc., Citizens Energy Group, the Nature Conservancy, mayors, and state government officials, IU’s $55 million investment in this ambitious initiative is designed to help Indiana businesses, farmers, communities, and individual Hoosiers develop actionable solutions to prepare for the effects of ongoing environmental change.

Over the past year we have also significantly expanded the research office to better serve IU researchers and more effectively—and efficiently—engage with corporations and foundations. The Technology Transfer Office, long a part of Indiana University Research and Technology Corp., or IURTC, has been brought inside the university and made part of the research office. The group has been renamed the Innovation and Commercialization Office, or ICO, and significantly expanded with new staff on the Bloomington and Indianapolis campuses.

In addition, the team dedicated to corporate and foundation relations, formerly at the IU Foundation, also has become part of the Office of the Vice President for Research, as well as restructured and expanded. It has been a pleasure to welcome these colleagues into the research office and to work with them to ensure that we strengthen the connection between research and the communities we serve.

You’ll learn about other new initiatives in this report, including the new President’s International Research Fund. In keeping with IU’s deep commitment to global engagement, the fund helps to launch research projects that make use of IU’s Global Gateways in China, Europe, India, Mexico, and Thailand.

As I conclude my second full year as IU’s Vice President for Research, I can say without hesitation that I have found the job both challenging and rewarding. The people of Indiana, not to mention throughout the country and around the world, need the benefits of academic research now more than ever. This report provides ample evidence that IU is working hard to meet that need, thanks to the skill and dedication of the university’s faculty, students, and research staff. Working together, there is much we can accomplish in the future.

Thank you for your support.

Fred H. Cate
Vice President for Research
Distinguished Professor
C. Ben Dutton Professor of Law
Protecting Hoosiers’ health and livelihoods

DEVASTATING DROUGHTS

CONTAMINATED DRINKING WATER

DISEASE-CARRYING INSECTS

WIDESPREAD FLOODS
Indiana’s environmental changes pose profound challenges. In 2017, IU took action to help Hoosiers grapple with these challenges as it announced the second funded initiative in the IU Grand Challenges program. Led by IU Bloomington Distinguished Professor of Biology Ellen Ketterson, the Prepared for Environmental Change initiative is focused on giving Hoosiers the tools and resources they need to adapt and act.

For example, to better gauge and predict the impact of environmental threats, Ketterson and her extensive team of IU colleagues and external partners are establishing an Environmental Resilience Institute. IU researchers affiliated with the institute will build Indiana-specific projections of environmental change that can equip governments, businesses, and community groups to respond with the right investments in the right areas. The Prepared for Environmental Change initiative also will look for new strategies to communicate its findings and recommendations in ways that are clear and accessible, such as a Hoosier Resiliency Index to help Indiana communities track and respond to immediate and long-term challenges caused by environmental change. Cummins Inc. has agreed to partner on this effort, believing that the data will be useful in Indiana and possibly replicable in other areas where Cummins employees work and live.

The team is collaborating with the Indianapolis Office of Sustainability, Keep Indianapolis Beautiful, and Citizens Energy Group to pioneer a new model for water re-use in Pleasant Run Creek, a 27 square-mile watershed on the east side of Indianapolis whose water quality has substantially degraded over the years. This work will help to restore resiliency to the water supply. The Prepared for Environmental Change team is poised to pursue other urban green infrastructure projects as well, including working with Keep Indianapolis Beautiful on its Project Greenspace program, which partners with neighborhoods to revitalize public spaces.

The team is also delving into studies of animal movements and migration, developing survey instruments, and pursuing the strategic hiring of specialists in key areas, including green economic development and spatial modeling of risk and disaster. One particular hire, a specialist in invasive species ecology, will study ticks and tick-borne pathogens with Distinguished Professor of Biology Keith Clay, who has spent many years studying ticks and rapidly spreading tick-borne illnesses such as Lyme disease and Rocky Mountain spotted fever. Clay and his “tick team” will be conducting studies to further describe, explain, and predict the patterns of the widening spread of disease-carrying ticks and mosquitoes.

“Making ourselves more resilient in the face of environmental change isn’t just about rising sea levels or droughts in some faraway country,” says Ketterson. “It’s about protecting Hoosier farmers from invasive species, stopping the spread of diseases with broad-reaching impacts for our children, conserving the plants and animals that sustain us, defending ourselves from serious weather disasters, and creating more livable towns and cities.

“We are facing very real threats to Hoosier livelihoods. If we’re going to be a ‘state that works,’ we need to be a state that’s prepared for what’s to come.”

Distinguished Professor of Biology Ellen Ketterson
Precision health: The future of medicine is personal

What's the cure for what ails you? Today, the answer to that question is getting ever more specific -- your doctor can potentially customize an approach to your ailment or disease based on factors such as your genetics, lifestyle, and environment to create treatments and prevention methods that will work just for you.

The trick is getting new technologies and data, as well as the experts who can use them, to work across academic disciplines and health systems, alongside industry and community members.
Leaders of the Indiana University Precision Health Initiative—IU’s first Grand Challenge initiative now in its second year—are well on their way to creating a collaborative environment of scientists and clinicians armed with innovative tools and facilities to improve health in Indiana.

The five-year Precision Health Initiative was announced in June 2016. It aims to curing at least one cancer and one childhood disease, as well as find ways to prevent one chronic illness and one neurodegenerative disease – all by 2020.

The Precision Health Initiative is made up of interdisciplinary teams of researchers in genomic medicine; cell, gene and immunotherapy; chemical biology and biotherapeutics; data and informatics; and psychosocial, behavioral and ethics. Key hires have been made to lead these research clusters including Peter Embi, an internationally recognized expert in biomedical informatics, and Kun Huang, a scientific leader in bioinformatics and computing. They are helping to lead the informatics team, which is creating tools and technologies researchers will need to harness the combined power of genomic, phenotypic, and environmental data.

Michael Weiss, a top biochemistry investigator and physician-scientist, will lead the initiative’s new Center for Chemical Biology and Biotherapeutics, which recently launched a facility where scientists will be able to produce cell and gene therapies in accordance with the U.S. Food and Drug Administration’s crucial good manufacturing practices requirements.

The Precision Health Initiative team has also made major strides to expand personalized medicine across Indiana. Take Gwen Brack, for example. Diagnosed with Stave IV metastatic rectal cancer at 21, Brack endured chemotherapy, radiation, surgery, and multiple cancer recurrences. Thanks to testing through the IU Health’s Precision Genomics Program, though, Brack learned that her cancer had a genetic mutation that makes it responsive to treatment with a simple daily aspirin tablet. “Research gives me life,” Brack says, “and it gives me a chance at having a full life.”

In collaboration with the Precision Genomics Program, cancer patients can now access genomic medicine backed by IU research at new locations in Muncie, West Lafayette, and Bloomington. As part of this personalized approach to health care, a multidisciplinary committee of IU School of Medicine faculty reviews the genomic results of individual patients to discuss potential treatments.

Precision health team members also went to the 2017 Indiana State Fair, along with partners at the Indiana Clinical and Translational Sciences Institute, to launch a statewide research campaign called All IN for Health. Researchers asked Indiana residents what they think about science, provided information about different health indicators, and invited them to participate in the future of health research with IU.
Outstanding humanities, enlivening arts

The 2016-17 year saw the launch of arts and humanities initiatives at IU Bloomington that created new campus-community partnerships, connecting renowned artists and scholars with the people of south-central Indiana.

IU Bloomington’s recently formed Arts and Humanities Council organized the campus’s first Global Arts and Humanities Festival, a three-month event focused on the country of China. The annual festival supports global learning and international exchange as well as advances the arts and humanities as critical components of global community.

During the spring 2017 festival, for example, dozens of IU students in contemporary dance collaborated with students from Taipei National University of the Arts in a sold-out dance performance that drew a crowd from across the community. Grammy-winning pipa player Wu Man also performed to a sold-out crowd as well as in outreach programs at six area elementary schools and with IU students and faculty in the Jacobs School of Music’s New Music Ensemble and Vera Quartet. The festival’s weekly lecture series attracted up to 170 guests each week; other festival events included public appearances by graphic novelist and MacArthur Fellow Gene Yang and National Book Award winner Ha Jin.

The Arts and Humanities Council’s overall goal is to more strongly connect students and the community with the myriad archives, museums, performance spaces, and programs the Bloomington campus offers. Toward that end, the council has launched several new internal funding programs dedicated to supporting public arts projects, digital humanities projects, and public humanities research projects by IU Bloomington faculty that are expressly designed to foster projects that benefit the community. The
new funding programs are supported by various university, campus, and community partners, including the offices of the Vice President for Research and Vice Provost for Research at IU Bloomington, the Office of the Provost at IU Bloomington, the IU Libraries, and the City of Bloomington.

In a unique example of a humanities project with broad public impact, School of Informatics and Computing faculty at IUPUI are developing “Virtual Bethel.” In the mid-1800s, the Bethel AME Church in Indianapolis was 100 members strong and active in aiding fugitive slaves. Known as the “mother church” of the African Methodist faith in Indiana, the church building burned to the ground in 1864. A new building was constructed in 1869 and stood on West Vermont Street for nearly 150 years. In November 2016, however, the historic church was sold to a developer. That’s when IUPUI faculty and students stepped in to preserve the church’s trove of archival documents and objects, including baptismal records, tithing records, letters, and varied memorabilia from the church’s time as a stop on the Underground Railroad. With funding from IU’s New Frontiers in the Arts and Humanities program, among others, Andrea Copeland, Albert William, Zebulun Wood, Ayoung Yoon, and their students created a 3D walk-through of the church built from more than 3,000 photographs. The team replicated the church’s sanctuary in a virtual-reality environment to allow for continuing interaction with the church’s physical space and historic past. Not only is the Virtual Bethel project a prime example of preserving the cultural past with the digital tools of the present, it also is helping to prepare students for careers through service- and project-based learning. As Ayoung Yoon puts it, “Much like a building can be a vessel for diverse human activity, Virtual Bethel will be a vessel for diverse learning experiences.”
Connecting child, machine learning to advance education and recovery

With a unique combination of expertise in developmental psychology, human learning, neuroscience, and artificial intelligence, the first team to receive funding through IU Bloomington’s Emerging Areas of Research program will bring together the study of learning in human children and the study of machine learning. The first Emerging Areas of Research initiative, announced in early 2017, is “Learning: Brains, Machines, and Children”, led by Linda Smith, Distinguished Professor and Chancellor’s Professor of Psychological and Brain Sciences in the IU Bloomington College of Arts and Sciences. Although human infants and toddlers “are the best learning devices on the face of the earth,” according to Smith, there are still big gaps in our knowledge of how human learning works. The team’s multidisciplinary research on learning has the potential to yield big breakthroughs that may apply in a wide range of areas including helping children with school learning and helping people re-learn after illness or injury, such as a stroke.
Indiana University is engaged in numerous initiatives to promote and develop the science, technology, engineering and math (STEM) disciplines. Here, a student works in an IU biology laboratory.

Reforming STEM teaching, learning

The STEM Education Innovation and Research Institute (SEIRI), based at IUPUI, is making great strides in funding IUPUI researchers to address complex challenges in STEM teaching and expand the skill sets of science, technology, engineering and math students. SEIRI partnered on 13 externally funded grants totaling over $8 million, and an inaugural SEIRI seed grant competition yielded seven awardees who each received seed funding of approximately $30,000. One funded project will increase undergraduate students’ participation in research projects closely related to faculty research interests, rather than rote experiments, with the goals of increasing retention and encouraging students to pursue graduate education or careers in science. Another project will help physics students think beyond the theoretical by using computer models of real-life applications to help deepen students understanding of the connections between physics and the real world. SEIRI was created to bring together expert educational researchers with faculty from many other disciplines to inform and reform pre-college, undergraduate, and graduate education. Under the direction of Pratibha Varma-Nelson, a professor of chemistry in the School of Science at IUPUI, the institute is supported by IUPUI’s Office of the Vice Chancellor of Research and the School of Science, Engineering and Technology; School of Informatics and Computing; and School of Education.
Indiana University’s ever-expanding Global Gateway Network is increasingly creating new opportunities for IU’s community of scholars to conduct top-flight research in the most politically, culturally, and economically dynamic regions of the world.

—President Michael A. McRobbie
With locations around the globe, IU’s Global Gateway Network marks a milestone in the IU’s efforts to expand and grow international engagement. Gateways provide space and personnel to help faculty, staff, students, alumni, and others advance academic and professional interests in a country or region. IU has Global Gateways in China, Europe, India, Mexico, and Thailand. To facilitate international engagement, IU President Michael A. McRobbie established the President’s International Research Fund. Recipients of grants in the 2017 inaugural round of this university-wide funding program plan to use the grants for a case study of inorganic arsenic in rice in China (a serious problem in China because rice is the most important staple food and soil and water have been contaminated); an exploration of national and regional language education policies and how these are reflected in the preparation of in-service English language teachers; a study of integrating refugees from Syria, aimed at providing a basis for recommendations to policymakers, educators, and agencies; and the development of new teaching strategies in two schools for the blind, one in India and one in Indiana, to enhance classroom learning.

To improve the health, education, and economic vitality of the communities surrounding IU’s regional campuses, IU launched its Regional Campus Grand Challenges Initiative in spring 2017. Chosen for their potential to engage in promising approaches to complex challenges, the two selected projects are “Feeding Minds, Building Community and Eating Our Vegetables” and “Health Studies Consortium.” The first project will engage students from four regional campuses -- East, Kokomo, South Bend and Southeast -- and Indiana University-Purdue University Fort Wayne in fighting food insecurity. The students will collaborate with New Roots, a nonprofit that develops “pop-up” farm-fresh food markets in food-insecure neighborhoods to create access to affordable local and organic produce purchased from Indiana farmers. The second project is being developed by IU Northwest, IU South Bend, and IU Kokomo to provide new avenues for health-related study that will improve credentialing and training of health-care workers and enhance health-care delivery across Northwest Indiana.

Two faculty members at IUPUI had a vision of making greater connections between faculty and staff, policy leaders, and community organizations interested in the well-being of Latina and Latino populations across Indiana. That vision resulted in the formation of the Latinx Community-University Research Coalition of Indiana to advance community-engaged research collaborations that respect the needs, cultural identity, and interests of the Latinx population. (Latinx is a gender-neutral term encompassing Latina and Latino.) The coalition held its first conference in April 2017, with community leaders in attendance as well as researchers from universities around the state. The expectation is that Latinx will not only facilitate and increase research, but also help attract new Latinx faculty and students to IU. The coalition’s next conference is scheduled for March 2018.
Jerome R. Busemeyer
Busemeyer is a Provost Professor of Psychological and Brain Sciences in the IU Bloomington College of Arts and Sciences. Elected to the academy for lifelong contributions in psychology and cognitive science, Busemeyer is one of the world’s leading researchers in the theory of human decision-making. In recent years, he has nearly single-handedly launched a new field of scientific inquiry called quantum cognition, an approach to decision-making that views human cognition as governed not by “rational” principles of standard probability theory but by a probability system borrowed from physics’ quantum theory.

Sumit Ganguly
Ganguly is professor of political science, Rabindranath Tagore Chair in Indian Cultures and Civilizations, and director of the Center on American and Global Security in the School of Global and International Studies at IU Bloomington. He is author, co-author, editor, or co-editor of 20 books on the contemporary domestic and international politics of South Asia and also is a member of the Council on Foreign Relations and a senior fellow at the Foreign Policy Research Institute in Philadelphia. He has been a fellow and a guest scholar at the Woodrow Wilson International Center for Scholars in Washington D.C., and a visiting fellow at the Center on International Security and Cooperation and the Center on Democracy, Development and the Rule of Law at Stanford University. In 2017-18, Ganguly is a visiting fellow at the Strategic Studies Institute of the U.S. Army War College.

Andre Watts
Watts is the Jack I. and Dora B. Hamlin Endowed Chair and a Distinguished Professor in the Department of Piano in the IU Jacobs School of Music. He won a Grammy Award in 1964 for most promising new classical recording artist and was the youngest person to receive an honorary doctorate from Yale University, at age 26. One of the world’s most celebrated pianists, Watts received the 1988 Avery Fisher Prize, one of the top individual honors for an American classical musician. In 2011, he received the National Medal of Arts from President Barack Obama. Watts was inducted into the American Classical Music Hall of Fame in 2014.

Volker Brendel
Brendel is a professor in the IU Bloomington College of Arts and Sciences’ Department of Biology and professor and director of bioinformatics in the School of Informatics, Computing, and Engineering. His work bridges the fields of biology, statistics, and computer science. Brendel’s research has shed new light on molecular and cellular processes.
genetics mechanisms in plants, with a particular focus on the organization of plant RNA, the expression of genes in plants, and the genetic relationship between different plant species. He has also advanced the development of new computational tools to manage and understand the massive amount of genetic data produced by modern genomic sequencing methods, an effort that employs IU’s high-performance computing resources.

Kenneth Mackie
A professor in the IU Bloomington College of Arts and Sciences’ Department of Psychological and Brain Sciences, Mackie is a neuroscientist whose work focuses on endocannabinoids, compounds produced by the body that mimic effects of THC, the primary psychoactive component of marijuana. Mackie is especially interested in the therapeutic applications of these compounds, which have been shown to play a role in memory, anxiety, schizophrenia, and obesity. Scientists are also exploring these compounds for their potential as alternatives to opioid-based pain medications, whose overuse and abuse have contributed to an addiction crisis in the United States. Mackie is director of the Linda and Jack Gill Center for Biomolecular Science at IU and an affiliate faculty in the IU Bloomington College of Arts and Sciences’ Program in Neuroscience.

Bernice Pescosolido
Pescosolido is Distinguished Professor of Sociology in the College of Arts and Sciences at IU Bloomington. A leading expert on social issues in health, illness, and healing, addressing how social networks connect individuals to their communities and to institutional structures. In addition to stigma, her work has focused on health-care services and suicide research, and she has been instrumental in developing new models to understand issues related to all three areas. Pescosolido also serves on the board of directors and chairs a scientific advisory council for Bring Change 2 Mind, a national nonprofit organization established by actress Glenn Close, a six-time Academy Award nominee and three-time Golden Globe award recipient, to reduce the stigma associated with mental illness.

Craig S. Pikaard
Professor of Plant Growth and Development in the College of Arts and Sciences’ Department of Biology and Department of Molecular and Cellular Biochemistry. Pikaard uses his discoveries in plants to advance research on the underlying genetic mechanisms involved in diseases such as cancer. He has made numerous discoveries about how plants silence the expression of their genes, with a particular interest in plant epigenetics, inherited changes in gene activity without changes in the DNA sequence. This work sheds light on how changes in gene expression -- such as the silencing of tumor suppressor genes in some cancer cells -- can advance disease in people. In addition to his position at IU, Pikaard is an investigator of the Howard Hughes Medical Institute, which recently extended his appointment through 2024 and provided an additional $9 million in research funds.
Located in the heart of Beijing, the IU China Gateway allows IU faculty and others to immerse themselves in academic activities and partnerships throughout China.
Research Data

SPONSORED PROGRAM AWARDS
INDIANA UNIVERSITY FY 2013–17

Dollar figures given are in millions.

SUMMARY OF SPONSORED PROGRAM ACTIVITY

TOTAL AMOUNT OF PROPOSALS
$2,181,316,475

TOTAL AMOUNT OF AWARDS
$500,037,586

PROPOSALS SUBMITTED
3,962

AWARDS RECEIVED
2,698

NEW AND COMPETING CONTINUATION AWARDS RECEIVED
1,554

NONCOMPETING RENEWALS AND SUPPLEMENTAL AWARDS
1,144

PRINCIPAL INVESTIGATORS RECEIVING AWARDS
1,205

SPONSORS
858

Annual Report Indiana University Vice President for Research
**INDIANA UNIVERSITY AWARDS BY SOURCE: FY 2017**

![Pie chart showing the distribution of awards by source.]

**TOP TEN SOURCES OF FEDERAL AND FEDERAL PASS-THRU AWARDS FY 2017**

<table>
<thead>
<tr>
<th>Federal Agency†</th>
<th>Direct Awards</th>
<th>Pass-thru Awards</th>
<th>Total</th>
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<tr>
<td>NIH</td>
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<td>AHRQ</td>
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† Awards are directly from the entity listed and do not include funding from subsidiary agencies, where applicable.

* Federal pass-thru funding consists of federal funding received by a non-federal entity (e.g., another university, state government, etc.) and subawarded to IU.
Eduardo Zattara, Armin Moczek and Jim Powers of the IU Bloomington College of Arts and Sciences’ Department of Biology were among the winners of the Federation of American Societies for Experimental Biology’s 2016 BioArt competition for this stunning image of a beetle’s brain and nerve cord. The image was also displayed at the National Institutes of Health.
Students, faculty, and community members enjoy the arts together during a First Thursdays arts and humanities celebration on the IU Bloomington Fine Arts Plaza.