2014 was an outstanding year for Indiana University research and creative activity. Our faculty’s excellence was recognized by the receipt of exceptional funding awards to support initiatives such as the three-year, $30 million Concussion Assessment, Research and Education Consortium (CARE), funded by the Department of Defense and the NCAA. CARE, unveiled at a news briefing by President Barack Obama, is a consortium of numerous universities led by the IU School of Medicine, the University of Michigan, and the Medical College of Wisconsin. Researchers at the IU School of Medicine will guide the administrative and operations areas of this long-term project, which seeks a deeper understanding of concussion injuries: how they impact the brain, how the brain recovers, and how treatment and prevention can be improved. More broadly, School of Medicine researchers brought in more than $109 million in grants from the National Institutes of Health in FY 2014, an increase of nearly $12 million over FY 2013. The single largest source of research funding for biomedical research scientists, NIH research grants are viewed as a proxy for the quality of a school of medicine’s research enterprise. IUSM’s robust NIH funding reflects the excellence of our program.

Within the other excellent schools of Indiana University, researchers in IU’s School of Informatics and Computing, along with colleagues in University Information Technology Services’ Pervasive Technology Institute, won more than $20 million in highly competitive federal IT research grants in 2014, awards that are leading to advanced IT tools needed by researchers for medical and scientific breakthroughs.

In the humanities area, four IU faculty—three from IU Bloomington and one from Indiana University–Purdue University Indianapolis—were awarded a total of nearly $1 million from the National Endowment for the Humanities for projects focusing on the writings of European figures of the thirteenth and fourteenth centuries and studies of American Plains Indians and Muslim American identities.

Our visual artists were similarly honored. For example, Herron School of Art and Design Professor Anila Quayyum Agha won the two top prizes at the international art competition ArtPrize 2014 for her work “Intersections,” which graces the cover of this report. Initially funded by IU’s unique New Frontiers in the Arts and Humanities program, “Intersections” is the first entry ever to have won both the Public Vote and the Juried Grand Prize.

IU faculty achievements were further recognized by prestigious national and international academic societies, including the election of Distinguished Professor Emerita Susan Gubar and Distinguished Professor Ellen Ketterson to the American Academy of Arts and Sciences. Five IU faculty members were named fellows of the American Association for the Advancement of Science in FY 2014: Dr. Bernardino Ghetti from the IU School of Medicine; Provost Professor Olaf Sporns, a professor of Psychological and Brain Sciences at IU Bloomington; and three members of the IU Bloomington College of Arts and Sciences Department of Biology—Emeritus Professor Peter Cherbas, Professor Elizabeth Raff, and Professor Malcolm Winkler.

I take special pride in all of these achievements, and those of so many other faculty, especially as I near the end of my five-year term as IU’s Vice President for Research. On July 31, 2015, I will step down from the position to continue exploring other avenues, starting with a sabbatical year to pursue my own research in neuroscience as a member of IU Bloomington’s Department of Physics and the IU School of Medicine’s Department of Cellular and Integrative Physiology. Over the last five years, it has been my privilege and honor to work with the many highly talented faculty members and administrators across Indiana University. I believe we have built a strong foundation for the future of research and creative activities at IU, and I look forward to remaining part of that endeavor.

Sincerely,

Jorge V. José
Indiana University Vice President for Research
www.indiana.edu/~vpr/
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CARE-ing about concussions

“We know some things about concussion,” says Thomas McAllister, chair of the Indiana University School of Medicine Department of Psychiatry and a national expert on the effects of impacts on the brain. “But most of what we know has come from football players and men, and from small studies at individual institutions.”

Those limited sources of data have started to grow with the implementation of the three-year, $23 million Concussion Assessment, Research and Education (CARE) research initiative funded by the National Collegiate Athletic Association and the Department of Defense.

Researchers from the IU School of Medicine, the University of Michigan, and the Medical School of Wisconsin are collaborating to create a massive database of college athletes—27,000 eventually—that will provide the foundation for two major studies.

McAllister describes the first study as “the natural history of concussions.” Overseen by the University of Michigan, this study will draw on all 27,000 participants. Those among them who have a concussion will be assessed a half dozen times over six months, providing new insights on what happens to the brain in a concussion, how quickly people recover, and what factors affect who gets better quickly and who does not. It’s expected that this study will provide concussion data on about 400 athletes.

“Importantly, these athletes will not just be football players,” McAllister says. “So we will learn a lot about concussions in female athletes, and how they may differ from men, as well as about concussions sustained in non-helmet sports.”

The second project, the neurobiology of concussion, will target high-risk sports: football, lacrosse, soccer, and ice hockey. All players in those sports at UCLA, Virginia Tech, Wisconsin, and the University of North Carolina will wear impact sensors that quantify how often and how hard they are hit. The neurobiology study is being overseen by the Medical College of Wisconsin.

In this research, 100 athletes with concussions will be compared with 100 athletes in contact sports who are not diagnosed with concussions and 100 in non-contact sports who are not concussed.

The athletes in the second study will undergo neuroimaging and provide blood samples, reaping data it’s hoped will illuminate how genetic factors influence recovery, and what biomarkers might help diagnose concussions or improve the ability to tell if someone has recovered.

The IU School of Medicine is the administrative and operations core for the project and will be the home for the data and specimens collected. Tatiana Foroud, the P. Michael Conneally Professor of Medical and Molecular genetics and scientific director of the Indiana Biobank, oversees the team in charge of collecting biospecimens. Barry Katz, chair of the Department of Biostatistics, is head of the data analysis and biostatistics team. Andrew Saykin Jr., director of the Center for Neuroimaging, and Yu-Chien Wu, assistant professor of radiology and imaging sciences, have played important roles in setting up the protocols to be used for neuroimaging.

Despite navigating institutional review boards at participating universities and the Department of Defense, creating and signing contacts, and getting organized, the consortium started collecting data just a few months after the grant announcement in May 2014. During fall 2014, they gathered baseline information on more than 3,000 athletes at 11 universities.

In addition, by the end of the year, the IU School of Medicine had already implemented an online database that allows participating schools to enter the athlete data.

For many such complicated projects, getting started on data collection can take a year or more, McAllister says.

“We’ve had enormous cooperation from IU, Michigan, and the Medical College of Wisconsin, from the NCAA and the DOD, and from the other participating schools,” McAllister says.

“It’s very encouraging—I’ve never seen a study like this move so quickly.”
Protocols for imaging work to be done in the CARE research initiative are being developed at the IU School of Medicine, where data generated for the project also will be stored and analyzed.
Dionne Cross Francis researches the factors which contribute to learning environments that promote mathematics learning and understanding.
Broadening STEM education

Broadening STEM education is a national priority and Dionne Cross Francis and Crystal Hill Morton are two IU faculty members working to see that effort is successful.

Raised in Jamaica by parents who didn’t attend college but nevertheless knew what education meant for their daughter, Dionne Cross Francis attended the best schools her parents could afford. “They were my advocates in education and in life,” she said when accepting an award at the 2014 Women of Color STEM Conference in Detroit. “In a similar way, I try to be an advocate for those society seems to have forgotten—many of whom look like me, like us.”

Cross Francis, an associate professor in the Indiana University School of Education in Bloomington, received the K–12 Promotion of Education award, for “a teacher or educator with a demonstrated commitment to enhancing STEM career opportunities for women and minorities through promotion of STEM education programs and exemplary teaching and outreach activities.”

Cross Francis began her career as a high school mathematics teacher in Jamaica and continued high school teaching after coming to the United States. Today, her research focuses on identifying factors that contribute to the quality of learning environments that promote mathematics understanding, and enhancing those factors to maximize learning opportunities.

Currently, Cross Francis is heading an initiative in partnership with IU Northwest, the Gary Community School Corporation, and the School City of East Chicago aimed at increasing engagement with science and math among African American students by focusing on teachers. The goal is to teach teachers to integrate math and science content into inquiry-based instruction.

Cross Francis is also director of the Center for P–16 Research and Collaboration at the IU School of Education. The center is designed to improve college access and success, especially for students from groups traditionally underrepresented in higher education. One of the center’s initiatives is the Balfour Scholars Program, supported by a grant from the Lloyd G. Balfour Foundation (and operated in collaboration with the IU Office of Enrollment Management, the Career Development Center, and the Office of Vice President for Diversity, Equity, and Multicultural Affairs). The free Balfour Scholars Program has brought hundreds of high school students to the IU Bloomington campus over the last two years to focus on college readiness.

Developing greater interest in STEM disciplines and careers is also the intent of Crystal Hill Morton’s work. Morton, an assistant professor of mathematics education at the IU School of Education on the Indiana University–Purdue University Indianapolis campus, studies mathematics learning among African American students, particularly females. She’s interested in what kinds of factors affect their mathematics learning and developing interventions to improve that learning.

As part of that effort, Morton has co-designed and implemented “The STEM in You” summer camp program aimed at girls and young women ages 9 to 18. The camp, which completed its second year in 2014, is organized to develop girls’ understanding of mathematics and science through focusing on health and wellness topics, as well as financial literacy. The local Marion County, Indiana, organization Guidance Lifeskills and Mentoring—or GLAM—partnered with Morton to provide a curriculum focused on math and science situated in broader life contexts.

Morton, who has conducted other summer enrichment experiences and also mentors college students, is certain that with the right resources, the right support, and the right mindset, the number of African American females in STEM-related fields will increase.

“It’s my life’s passion to serve the ladies I am mentoring—the young ladies in the camp and any young lady that walks into my life who needs my support,” Morton says. “It truly is my life’s passion.”
The National Science Foundation’s CAREER Award is among the most prestigious awards a young scientist can earn. A highly competitive award that provides support over five years, new CAREER Awards at Indiana University this past year totaled $2.6 million for five junior faculty members: an environmental scientist, a mathematician, a chemist, and two physicists.

Specifically, the five are conducting inquiries into some of the most timely and complex scientific issues of our time: Haibo Ge, assistant professor of chemistry, answering fundamental questions about the nuclear matter that existed after the Big Bang; Jinfen Liao, assistant professor of physics, air pollution chemistry; Jonathan Raff, assistant professor of public and environmental affairs, determining the intricacies of the complex dynamical systems at the core of nearly all scientific fields; Roland Roeder, assistant professor of mathematics, and electronic states for next generation technologies (Babak Seradjeh, assistant professor of physics).

Haibo Ge
Ge’s research will focus on development of efficient, environmentally friendly methods for preparing organic molecules that could have an important impact on organic, medicinal, and agricultural chemistries. An expert in the field of chemical synthesis, Ge is a faculty member in the School of Science at IUPUI. He will use his CAREER award to develop a wide variety of chemical compounds useful in those fields and that have minimal metal waste.

The award also allows for training undergraduate and graduate students for entry into the workforce through a new course and a new undergraduate laboratory experiment, and a summer undergraduate research program designed to improve retention and engagement among chemistry and biochemistry students at IUPUI.

Jinfeng Liao
To most it’s the stuff of science fiction movies, but to theoretical nuclear physicist Liao, understanding the extreme conditions microseconds after the Big Bang is a very real undertaking. Through examination of the hottest temperatures ever created in a laboratory, about 250,000 times hotter than the Sun, Liao is working toward understanding quark-gluon plasma, the primordial soup that briefly occupied the universe. By deconfining the quarks and gluons that make up ordinary nuclear matter through 4 trillion degree heavy ion collisions, Liao can create a time machine looking back to the very early moments of the universe. Called “Little Bangs,” the re-creations suggest that quark-gluon matter strongly interacts both before and after reaching thermal equilibrium in these collisions, and Liao wants to know how such phenomena arise.

Study of these interactions between the smallest known components of the atomic nucleus will help unravel some of the deepest mysteries of the nuclear force, such as quark confinement. It could also have profound impacts on other areas of physics including cosmology, supernova, compact stars, supersymmetric theories, string theories, and condensed matter physics.

Liao is a faculty member in the College of Arts at Sciences at IU Bloomington. His project also has an outreach component to develop educational software for computer desktops and mobile devices that utilizes visualization and simulations to demonstrate concepts related to the “Physics of Extreme Matter” in an interactive, engaging, and child-friendly manner.
Jonathan Raff

Raff’s work investigates the chemical reactions that occur on different surfaces—from airborne aerosols to asphalt—with a specific focus on nitrous acid production and its role in the atmosphere. Nitrous acid is an important compound in atmospheric chemistry for its ability to act as a precursor to hydroxyl radical formation, which directly influences the oxidizing capacity of the atmosphere.

Raff is a faculty member in the School of Public and Environmental Affairs at IU Bloomington. He is interested in obtaining a molecular-level understanding of where this important trace gas comes from and where it goes in the atmosphere. This fundamental knowledge is crucial for improving the computer models that help us predict unhealthy air pollution events and climate change.

In addition, Raff will be integrating his research into an outreach program designed to monitor air pollution in local high schools.

Roland Roeder

It’s difficult to imagine an area of scientific endeavor that doesn’t involve dynamic, complex variables—chemistry, biology, physics, even the social sciences all reflect past, present, and future states of complex systems.

But is predicting the future state of such a system possible? How do the variables and parameters of the existing systems influence the evolution of the state of the system?

Most dynamical systems are too complex for individual rigorous study. For Roeder, on the faculty of the School of Science at IUPUI, the challenge is to develop simpler models that can both be rigorously studied and can indicate the types of behaviors that could be expected experimentally. He hopes that in developing a deeper understanding of the fundamental properties of these systems, his work can lead to connections beyond mathematics to other areas of scientific inquiry.

Roeder’s CAREER award will also allow him to help run and improve the IUPUI High School Math Contest and lead local high school students in specially tailored research projects.

Babak Seradjeh

Seradjeh’s work is focused on topological states, which are characterized by physical properties that remain unchanged while a range of small changes occur in the material being studied. Scientists need to know more about topological states, as that knowledge could contribute to the foundations of various new technologies such as quantum computing, energy conversion, and low power electronic devices.

To uncover potential applications for topological states in next generation electronics, Seradjeh will focus on the role of non-equilibrium dynamics, correlations, and disorder in topological states of matter, especially in topological insulators and superconductors. A member of the College of Arts and Sciences at IU Bloomington, Seradjeh will conduct research that is considered critical for a better understanding of the behavior of superconducting electrons for technological applications, including looking at the realization, detection, and manipulation of topological bound states and delving into the effects of disorder and fluctuations in dynamic and static topological states.

An outreach component of Seradjeh’s CAREER research includes development of short, inquiry-based modules that bring recent advances to high school physics classrooms, as well as a summer research experience for underrepresented students.
In a banner year for discoveries in biology at Indiana University, no single one may have been more recognized than Distinguished Professor of Biology Jeff Palmer’s leadership in discovering what is believed to be the largest example of horizontal gene transfer—the acquisition of foreign genes from other species—in any organism.

It’s known that microorganisms lacking a nucleus to envelope their DNA (prokaryotes) swap genetic material, and there are many cases of viruses moving genes in animal genomes. But recently, Palmer and other scientists have recognized that eukaryotes—animals, plants, and fungi with cellular nuclei—have also been exchanging genetic material.

In Palmer’s work, funded in part by the Indiana University METACyt Initiative, genes from a number of plant species were identified in the South Pacific shrub *Amborella trichopoda*. The species is considered to be the sole survivor of one of the two lineages that resulted from the earliest split in flowering plant evolution, more than 200 million years ago.

The DNA that the *Amborella* mitochondrial genome absorbed and retained through horizontal gene transfer amounted to more than 1 million base pairs, giving it a bloated 3.9 million base pairs. A typical plant mitochondrial genome’s size is around 500,000 base pairs.

The study, published as a research article in *Science*, also provided important insight into the evolution of mitochondrial fusion—a process that works to maintain functional mitochondria during periods of stress—with the first evidence that mitochondria of flowering plants and green algae, whose last common ancestor existed more than a billion years ago, undergo fusion by the same mechanism.

“This genome is like the old lady in the song who swallows a fly, then a spider, a bird, a cat, and so on, all the way to a horse, at which point, finally, ‘she’s dead of course,’” Palmer says. “Likewise, *Amborella* has swallowed whole mitochondrial genomes from a broad range of land plants and green algae, but instead of bursting from all this extra, mostly useless DNA, or purging it, it’s held on to it for tens of millions of years, and in remarkably intact form.”

The findings were considered compelling evidence that mitochondrial fusion is the driving force for mitochondrial gene transfer and that incompatibility in the mechanism of mitochondrial fusion between different phyla—plants versus animals or fungi—provides the major barrier to unconstrained mitochondrial “sex” across the evolutionary tree of life.

Research on the mitochondrial genome of the plant, which grows only in New Caledonia, a small nation 750 miles off the eastern coast of Australia, took eight years.

Palmer, who has been named one of the top 15 plant and animal scientists in the world, is a member of the National Academy of Sciences and a fellow of the American Academy of Arts and Sciences.
The parasitic flowering plant *Amyema scandens*, shown here growing along the branch of a host tree, belongs to the group of plants from which the South Pacific shrub *Amborella trichopoda* has captured many of its foreign genes.
Shahzeen Attari’s research demonstrates that simple actions can substantially reduce household water use in the United States. Outdoor water use could be curtailed significantly by actions such as using a rain barrel or other rain-harvesting system.
Record drought conditions last summer, especially in the Western United States, caused many Americans to think seriously about whether they were wasting water. But even if they wanted to cut back, it wasn’t always easy to find out what conservation methods were effective.

At just the right time, Shahzeen Z. Attari provided some answers. The assistant professor in the School of Public and Environmental Affairs at Indiana University Bloomington, along with lead author Benjamin D. Inskeep of North Carolina State University, produced a how-to guide based on detailed research.

“The Water Short List: The Most Effective Actions U.S. Households Can Take to Curb Water Use,” was the cover article in a special water issue of the journal *Environment*. It explained how simple actions like installing efficient appliances and fixtures and changing daily habits can save water and lower bills.

The good news: Consumer decisions really can make a difference.

“As water availability is expected to become an increasingly urgent issue in the coming decades,” Attari and Inskeep wrote, “it is heartening to find that substantial reductions in household water use are readily available to U.S. households.”

The article was modeled on “The Short List,” an influential 2009 *Environment* article in which Gerald Gardner and Paul Stern analyzed how households could reduce energy consumption and help mitigate climate change. Like Gardner and Stern, the authors analyzed the benefits of efficiency measures, such as one-time technology upgrades, and of curtailing actions that involve changing habits.

“Both categories of conservation actions have unique challenges,” they wrote. “Efficiency actions require incurring a potentially large upfront cost, and curtailing actions require that the action be continuously repeated.”

But both actions can pay off. Drawing on data from the American Water Works Association and the U.S. Geological Survey, the researchers estimated indoor water consumption could be reduced by 45 percent through actions such as installing efficient toilets, washing machines, dishwashers, showerheads, and faucets. For example, replacing a standard toilet with a WaterSense-labeled toilet could reduce household water use by 18 percent.

Curtailment actions, such as reducing toilet flushes by a quarter, washing only full loads of clothes, and taking shorter showers, could reduce indoor water consumption by 30 percent.

Outdoor water use could be nearly eliminated by watering turf grass less often, using a rain barrel or other rain-harvesting system, watering all plants in the morning, replacing cool-season grass with warm-season grass that requires less watering, and installing drip irrigation systems.

Some of the information may seem like common sense. But in fact, there’s a lot of misleading information being tossed around in the name of conservation. One campaign, for example, suggests “washing your face or brushing your teeth while in the shower,” an approach that would waste water because a typical sink faucet uses far less water than a showerhead.

Attari documented the challenge in a paper published in March in the *Proceedings of the National Academies of Sciences*, which found that Americans had little idea how much water is used by various activities. She surveyed more than 1,000 people and found that most weren’t aware that installing more efficient fixtures and appliances is the best way to save water.
When the Twitter hashtag #womenleadingphilanthropy trended in April 2014, during the #WomenLeadingPhilanthropy Symposium in Chicago, it was a sure sign of the event’s impact, backed up by Chicago Mayor Rahm Emanuel proclaiming it Women’s Philanthropy Week in the city while the symposium took place.

The trend-setting symposium was organized by the Women’s Philanthropy Institute at the Indiana University Lilly Family School of Philanthropy. The WPI is directed by Debra Mesch, who is also a professor of public and nonprofit management in the School of Public and Environmental Affairs at Indiana University–Purdue University Indianapolis.

A trending hashtag is only one indication of the impact the WPI and the Lilly Family School of Philanthropy are having on the field of philanthropy research, especially on the study of women’s philanthropy. The WPI is the only such institute located in a research institution dedicated to further understanding women’s philanthropy through research, education, and knowledge dissemination.

In addition to the popular symposium, now in its fourth year, the WPI generates notable research studies such as the annual Women Give report. The 2013 report was conducted and released in partnership with the United Nations Foundation. It focused on charitable giving by girls and boys, and the impact of parents on children’s charitable behavior. According to the study’s findings, children are certainly philanthropic. Nearly 90% of children ages 8 to 19 give to charity, and they learn their charitable behavior not from role-modeling alone, but also from parents talking to them about the importance of giving. Children whose parents talk about giving are 20 percent more likely to give than children whose parents don’t, the study found.

The report issued in fall 2014 focused on the role of religion in women’s giving. In a notable shift from previous research in this area, Women Give 2014 researchers found that young single women who are religiously unaffiliated give roughly two times larger amounts to charitable organizations than women who are affiliated but infrequently attend religious services. The researchers suggest that their study points to a need for nonprofits, both religiously identified and not, to build different relationships with constituents according to gender and age.

Women Give 2013 and 2014 were co-authored by a Lilly Family School of Philanthropy team including Debra Mesch and Mark Ottoni-Wilhelm, who has served as a visiting professor in the nation’s first endowed chair in women’s philanthropy at the school, the Eileen Lamb O’Gara Chair in Women’s Philanthropy. Mesch becomes the full-time chair-holder in 2015. The school now has a total of 10 endowed chairs in philanthropy devoted to expanding philanthropy research and education, the most at any university in the world.

The Lilly Family School of Philanthropy features not only leading research on women’s giving, but also a number of leading researchers who are women. In FY2014, the school hired Catherine Herrold and Sara Konrath, both assistant professors of philanthropic studies, and Lehn Benjamin, an associate professor of philanthropic studies.

Herrold, who joined the school in January 2014, specializes in studying philanthropy in the Middle East, especially Egypt, examining the role of philanthropy in building democracy. Her research on the intersection of philanthropy, democracy, and society during the Arab Spring uprisings in Egypt earned her the Gabriel Rudney Memorial Award from the Association for Research on Nonprofit Organizations and Voluntary Action.

Benjamin also joined the school in January 2014. She brings a decade of research on nonprofit performance, including an award for this work from the Nonprofit and Voluntary Sector Quarterly journal. Her recent research examines nonprofit performance “from the ground up,” studying the day-to-day work of frontline staff in a variety of human service organizations and the experiences of the people they are trying to help. In one set of findings, Benjamin has shown that performance models used to assess nonprofits are program-centric; they assume that clients are passive recipients of program activities and that staff simply deliver these activities. Consequently, Benjamin observes, such performance models miss a good portion of the relationship-building and support work done by staff members, work that has a direct positive influence on outcomes for the nonprofit’s clients.
Konrath, who was appointed to the Lilly Family School of Philanthropy in May 2014, arrived with her research laboratory, the Interdisciplinary Program for Empathy and Altruism Research, in tow. A social psychologist, Konrath is interested in the consequences of low empathy in society and what can be done to strengthen it. In her current work, she’s examining whether mobile phones can be a tool for increasing empathy. In a recent study, she found that it is possible to increase people’s empathy using text messages—with effects lasting up to six months. With funding from the John Templeton Foundation, Konrath and her colleagues are currently developing an interactive empathy-building smartphone application.

In his welcome to the #WomenLeadingPhilanthropy symposium, Gene Tempel, founding dean of the Lilly Family School of Philanthropy, noted that the WPI and its symposium aim to “recalibrate the national conversation by highlighting the impact of women as leaders in philanthropy.” Clearly, through its research and its new faculty, the Lilly Family School of Philanthropy is doing just that.
During 2014, composer P. Q. Phan, above left, debuted his opera The Tale of Lady ThOUCHought to KHin at the IU Jacobs School of Music, while composer and musician Erich Stem debuted orchestral pieces written for his America By project around the country.
When he was a boy, musician Erich Stem was inspired by Mozart to start composing. Today, he’s on a mission to transform a classical music repertoire that is, as he puts it, “still dominated by dead people.”

Now an associate professor of music at Indiana University Southeast, Stem is at work on America By, an ambitious effort to create an opus comprising original symphonies that represent communities across the United States. Supported in part by funding from IU’s New Frontiers in the Arts and Humanities grants program, America By is intended to create a musical montage of the musical heritages that make up the nation. Orchestras are participating by commissioning and performing pieces written by Stem. So far, five orchestras have joined the project—the Bainbridge Symphony Orchestra (Bainbridge Island, Washington), the West Virginia Symphony, the University of Portland (Oregon) Orchestra, the New Chicago Chamber Orchestra, and the Southern Illinois Symphony Orchestra.

In each case, Stem’s goal is to create a piece that incorporates unique aspects of the community in which the orchestra performs. For the Bainbridge ensemble, he wrote a piece that echoes the rugged beauty of the locale as well as includes Japanese-American influences, reflecting the island’s history as the first site from which Japanese-Americans were sent away to internment in the 1940s. Bainbridge premiered in February 2014.

For the University of Portland Orchestra, Stem is incorporating influences that reflect the area’s diverse ethnicities, ranging from current Vietnamese immigrants to the Upper Chinook Native Americans who previously inhabited the area.

The America By performances are accompanied by a website (www.americaby.com) featuring video interviews with orchestra conductors and performers talking about Stem’s musical creations.

When he’s not working on a “soundtrack” for the nation, Stem keeps busy with teaching at IU Southeast as well as serving as director of the record label New Dynamic Records. New Dynamic Records is housed at IU Southeast for the purpose of discovering, recording, and distributing works by current national and international composers.

Composer P. Q. Phan, associate professor of composition in the IU Jacobs School of Music in Bloomington, created something new out of the very old with the world premiere of his two-act opera The Tale of Lady Thi Kinh in February 2014.

Born in Vietnam, Phan emigrated to the United States in 1982. The Tale of Lady Thi Kinh is his version of a traditional tenth-century Vietnamese musical theater piece. It tells a transcendent story, Phan says, of “a young lady whose love, compassion, and selflessness shine like the aura of Gautama Buddha.” The story is a tale of the sacrifices Thi Kinh makes as she becomes a female Buddha. The music in the production becomes more complex, Phan says, “as the life of Thi Kinh progresses from a simple earthly life to her ultimate stage of entering Nirvana.”

Called “touching” and “creative” by reviewers, Phan’s opera accomplished what Phan saw as one of his biggest challenges: preserving the essence of the traditional story while creating a new experience for twenty-first-century American audiences.

A prolific composer, Phan’s body of work has been performed in countries throughout the world including Austria, China, Israel, Russia, Spain, and South Korea. Phan says he never tires of the work of composing: “Writing the piece itself is pure joy. There is no agony at all. [And when] something makes you feel good about yourself, makes you feel enlightened, of course when you feel like that, the music is like that as well.”

Phan spent several years writing, composing, and refining The Tale of Lady Thi Kinh, which was commissioned by the IU Jacobs School of Music and supported in part by funding from the IU New Frontiers in the Arts and Humanities program.

Now in its tenth year, IU’s New Frontiers in the Arts and Humanities program has supported more than 700 faculty projects across IU’s campuses.

These intriguing projects by Indiana University humanities faculty caught the attention of the National Endowment for the Humanities in 2014. The NEH awarded nearly $1 million to four IU scholars: Douglas Parks, H. Wayne Storey, Rega Wood, and Edward Curtis IV of the IU Bloomington College of Arts and Sciences, and Edward Curtis IV of the School of Liberal Arts at Indiana University–Purdue University Indianapolis. The IU awards are among $34 million in grants for 177 humanities projects announced in July 2014 by the endowment.

According to Edward Curtis IV, Millennium Chair of the Liberal Arts and professor of religious studies at IUPUI, the primary goal of his project is to nurture an environment in which teachers can answer a key question: What does it mean to be both Muslim and American? Curtis was awarded $114,438 for “Muslim American Identities, Past and Present,” a three-week seminar for teachers on the history and cultures of Muslims in the United States. The seminar will take place at IUPUI in summer 2015. Participants will study primary source documents, hear from visiting experts, make field trips to local mosques, and use the resources of the IUPUI University Library to complete individual research projects.

Douglas Parks, professor of anthropology and associate director of the American Indian Studies Research Institute at IU Bloomington, is a scholar of linguistics whose research focuses on the documentation of American Indian languages of the Great Plains. He was awarded $275,000 for his three-year project “Historical Voices of the Plains Earth Lodge Peoples II,” encompassing four tribes—Pawnee, Arikara, Mandan, and Hidatsa. Parks will prepare, for print and digital publication, 15 volumes of previously unpublished collections of linguistic texts and ethnographic descriptions. The material was compiled in the late nineteenth and early twentieth centuries by tribal scholars in collaboration with anthropologists.

H. Wayne Storey, professor of Italian, was awarded $275,000 over three years for “The Petrarchive Project: An Online Edition of 366 Poems by Petrarch.” Storey is collaborating with John A. Walsh, associate professor of library and information science in the School of Informatics and Computing at IU Bloomington. Known as the inventor of poetic forms such as the sonnet and the sestina, Petrarch also spent long years studying and annotating classical works, which gave him unique views on the preparation and material construction of books. Storey’s NEH project, initially funded by an IU New Frontiers in the Arts and Humanities grant, focuses on the publication of a digital “rich text” edition of Petrarch’s Rerum vulgarium fragmenta, also known as the Canzoniere. The digital edition will incorporate complex visual poetics and book design that were integral to the poet’s techniques and the meaning of his poems. The edition will include an apparatus of variants, manuscript facsimiles, commentary, and supporting material in English and Italian.

Rega Wood, professor of philosophy at IU Bloomington, was awarded $310,060 for “The Richard Rufus Project,” an edition of the works by the influential but self-effacing thirteenth-century philosopher. The three-year grant will support the ongoing preparation for online and print publication of Rufus’s works. Rufus introduced the teaching of Aristotle’s metaphysics and natural philosophy in the thirteenth century, not only outlining, but also challenging, Aristotle’s arguments. In so doing, Rufus influenced great philosophers who followed him, including Roger Bacon and Thomas Aquinas.

This is not Wood’s first NEH award for her project. In 2011, the NEH awarded a $315,000 grant to Wood to prepare Rufus’s lectures on Aristotle’s Metaphysics for publication. As far as is known, Rufus was the first to teach Metaphysics. An edition of Rufus’s approximately 1,500 pages of lectures on metaphysics delivered before 1238 is due to be complete by 2017.
“Somewhere inside me, a gray barn is rising.”
Poet for Indiana

Once a week during 2014, George Kalamaras settled into the corner of his couch next to his beagle-hound, Bootsie, to share a cup of tea and some poetry with you and me. Kalamaras, a professor of English at Indiana University–Purdue University Fort Wayne, is the current Poet Laureate of the state of Indiana. Appointed by the Indiana Arts Commission, Kalamaras began his two-year term in January 2014.

Kalamaras’s cozy couch readings on video make up A Gray Barn Rising, a weekly video-blog series designed to “broaden the conversation,” Kalamaras says, about “the work of poets who ought to be more widely read.” The series is just one of the many ways Kalamaras is fulfilling his Poet Laureate responsibilities as an ambassador for poetry throughout the state. Throughout 2014, he organized and participated in numerous poetry readings across Indiana, delivered weekly writing prompts via his Poet Laureate Facebook page, and created the website The Wabash Watershed: Where the Rivers of Tradition Meet the Rivers of Innovation (www.wabashwatershed.com) to offer poetry features, conversation, and news. The Gray Barn Rising video series is available through Kalamaras’s Facebook page and his website.

Kalamaras considers the Wabash River a metaphor for the tradition of Indiana poetry. “The Wabash is fed by many tributaries,” writes Kalamaras. “So it is with poetry and poets. It is the small, seemingly invisible, currents that form something larger.”

Kalamaras, who has been at IPFW since 1990, has published 14 volumes of poetry, including seven full-length books and seven chapbooks. He has also published a scholarly study of the “rhetoric of silence”; numerous articles in scholarly journals; and hundreds of poems in anthologies and magazines including The Best American Poetry, Hopewell Review, The Iowa Review, Kenyon Review, New Work by Indiana’s Best Writers, North American Review, Southern Humanities Review, and TriQuarterly.

In an interview with Fort Wayne-based radio station WBOI shortly after his appointment as Poet Laureate, Kalamaras reflected on a single line from his large body of work that captures his relationship to the state of Indiana. “The line is ‘Somewhere inside me, a gray barn is rising,’” Kalamaras said. “The barn has always represented for me an image of psychological and emotional wholeness. It’s decorated by the things of the earth and the things of Indiana. That gray barn is always going to be inside me.”
To say that 2014 was a memorable year for poet Adrian Matejka is definitely an understatement. In 2014, Matejka's most recent book, *The Big Smoke*, received the Anisfield-Wolf Book award, presented by the Cleveland Foundation to honor works that address racism and diversity. *The Big Smoke* was also a finalist for the 2014 Pulitzer Prize in Poetry, which followed on the book’s selection as a finalist for the 2013 National Book Award. Matejka also received a John Simon Guggenheim Fellowship and a Lannan Literary Fellowship in 2014.

*The Big Smoke*, Matejka’s third work of poetry, takes the legendary African American heavyweight boxing world champion Jack Johnson (1878–1946) as its unusual poetic subject. In a collection of 52 poems, many of them sonnets, the book follows the fighter’s journey from poverty to the most coveted title in sports through the multilayered voices of Johnson and the white women he boldly loved.

In an interview with the National Book Foundation, Matejka described his fascination with Johnson this way: “For me, there’s something epic about Jack Johnson. He’s a mythic kind of figure—literally larger than life because he was bigger, faster, and a far more accomplished boxer than anyone of his time. [His] rise and fall naturally lends itself to the oral tradition of poetry. I think Johnson was already a poetic figure; I just organized part of his story for a contemporary audience.”

Born in Nuremberg, Germany, Matejka grew up in California and Indiana. He earned his B.A. from Indiana University and an M.F.A. from Southern Illinois University Carbondale. He is currently an assistant professor of English at IU Bloomington. Matejka’s earlier work includes *The Devil’s Garden*, winner of the 2002 New York/New England Award from Alice James Books, and *Mixology*, which won the 2008 National Poetry Series and was nominated for an NAACP Image Award.

All three of Matejka’s poetry collections touch on questions of race, masculinity, and family, each in different ways. *The Devil’s Garden* juxtaposes history and autobiography through Matejka’s own mixed racial identity, while *Mixology* explores “otherness” through hip hop-style sampling.

A love of rap music led Matejka to poetry. In junior high school, he and a friend would gather after basketball practice every week to write and record their own rhymes. In college, he decided to write some poetry to impress a girl he liked. Around the same time, he heard a reading by Pulitzer Prize-winning poet Yusef Komunyakaa, then a professor at IU Bloomington.

“It was one of the most extraordinary experiences I’ve ever had,” Matejka recalls. “He just killed it—I had never heard anything like that in my life. I thought, ‘If that’s what poetry is, I’m all over it. I want to be like this guy.’”

With the recognition Matejka achieved in 2014, it’s fair to say he’s fast closing in on that goal. Reflecting on the considerable attention *The Big Smoke* has received, Matejka says, “In many ways, each of these accolades points back to Johnson, as it should, since I wrote the book trying to bring his story into the contemporary dialogue of race and politics. It’s humbling and extraordinary at the same time. I imagine Johnson is some place right now laughing about it all.”

Matejka is now at work on a second volume about the latter part of the boxer’s life, as well as a new collection of poems about astronomy.
A love of rap music led award-winning poet Adrian Matejka to poetry. He now teaches a course on the poetics of rap, among other subjects.
Breakthroughs in diabetes treatments

The numbers are staggering when it comes to the incidence of diabetes: 29 million Americans have already been diagnosed; 387 million people worldwide, with nearly half undiagnosed; a prediction of nearly 600 million 20 years from now. So it’s no surprise that hundreds of scientists, medical doctors, graduate students, and faculty members at Indiana University are working on research tied to the disease. In 2014, the work of six Indiana University faculty members garnered attention.

Of particular note were advances announced by a team led by IU Distinguished Professor of Chemistry Richard DiMarchi, also IU’s Linda and Jack Gill Chair in Biomolecular Sciences, that a new treatment for adult-onset diabetes and obesity had essentially cured lab animals of obesity, diabetes, and associated lipid abnormalities.

The treatment centered on the design of a new peptide that was the molecular integration of three gastrointestinal hormones. It improved glucose sensitivity, reduced appetite, and enhanced calorie burning.

The new triple hormone specifically and equally targeted three receptors of the three hormones, in turn enhancing insulin action, reducing blood glucose, curbing appetite, increasing the long-term rate calories are burned, and improving liver function. Using the combined hormones, called “triple agonists,” the new research found that rodents’ body weight was reduced by about 30 percent.

Following success of the lab animal trials, Roche Pharmaceuticals is managing human clinical trials.
The National Institutes of Health recognized the work of epidemiologist Juhua Luo, an assistant professor at the IU School of Public Health-Bloomington, by funding new research that will allow her to examine the relationship between type 2 diabetes and breast cancer. Past studies have found that women who have type 2 diabetes and breast cancer have a worse cancer prognosis compared to women who do not have diabetes as a pre-existing condition. Luo’s research is unique in that it examines which factors could contribute to the poor prognosis, such as biological effects, cardiovascular disease, and variations in treatment. It is also the first study of its kind to analyze data from a large and well-established group of women, the NIH’s Women’s Health Initiative, a 15-year study that examined the most common causes of death, disability, and impaired quality of life in postmenopausal women. Luo is also examining the influence of the diabetes drug metformin on breast cancer prognosis, since the drug is attracting interest for its potential anticancer effects.

At the IU School of Medicine, Raghu Mirmira, a Lilly Foundation Professor in Pediatric Diabetes, was named the first director of the new Indiana Diabetes Research Center in Indianapolis. Mirmira is also co-leading, along with IUSM Assistant Professor Carmella Evans-Molina, a three-year biomarker development project funded by NIH. The grant is designed to provide early prediction and diagnosis tools for type 1 diabetes.

Type 1 diabetes occurs when the insulin-producing cells of the pancreas, beta cells, die off to the extent that the body is unable to produce enough insulin, which is needed to convert sugar and other foods into energy.

The School of Medicine professors are hoping to develop new biomarkers to support early detection because currently, most patients with diabetes have already had most of their beta cells destroyed by their own immune systems by the time they are diagnosed. Biomarkers are proteins—bits of genetic material or other molecules found in blood or other tissues—that can be used as indicators of disease, response to drugs, or other bodily activities. By developing the equivalent of a picture of how the disease progresses, the researchers hope to identify a protein or other molecule uniquely produced by stressed beta cells. If uncovered, that marker could be detected in the blood long before a patient appears at a hospital with symptoms.

At the IU Bloomington School of Optometry, where researchers are also working to develop tools to identify early warning signs for diabetes-related complications, the challenge is the loss of sight from diabetic retinopathy, where irreplaceable damage occurs to the retina, that network of nerve cells that captures light and gives the first signals in the process of seeing.

Optometry Professors Ann Elsner and Stephen Burns reported striking changes across the retina, including to blood vessels, in patients not thought to have very advanced diabetes. The team used an adaptive optics technique developed by Burns that used small mirrors with tiny movable segments to reflect light into the eye to overcome optical imperfections that are present in every human eye. Tiny capillaries in the eye appeared quite large on a computer screen, and the video format allowed for refined focus and observation of blood cells as they moved through blood vessels.

The team uncovered insufficient blood circulation in the retina, causing variable ranges of damage in different patients. Patients with diabetes had significantly thicker blood vessel walls, even for relatively small diameter blood vessels, and the capillaries varied in width in the diabetic patients, with some capillaries closed so that they no longer transported blood within the retina. On average, the capillaries that still had flowing blood were broader for the patients with diabetes, even though they were thought to have had fairly mild symptoms.

With the expertise of these faculty, and many more, IU researchers are making significant strides in combating the disease of diabetes.
Improving patient care through better drug interaction alerts

Doctors in the United States see millions of computer-generated drug-with-drug interaction alerts every day, and the vast majority of them—over 95 percent—go ignored. Knowing that, the National Science Foundation saw the importance of supporting Indiana University research to study how alerts can elicit better compliance from physicians.

Two IUPUI human-computer interaction specialists, Davide Bolchini and Jon Duke, are leading an effort to rethink the role those alerts play in how doctors prescribe drugs, with their goal being to see alerts evolve from oft-ignored warnings to trusted tools. They envision, for example, alerts that can engender more trust in physicians by being endorsed by an attending physician, by employing more collaborative and inclusive language, or by capturing important decisions and patient notes that are recorded during in-patient meetings.

Desensitized by a bombardment of warnings, doctors suffer from a computerized “alert” fatigue, Bolchini and Duke believe. Recognizing that, and with evidence that physicians doing daily clinical work have more trust in advice from their peers, the two researchers are looking to recraft how alerts can better reflect those peer-to-peer principles doctors prefer to use for decision making.

Through a series of studies in clinical settings, the team will investigate those principles that accompany trusted physician-to-physician advice regarding appropriate medication prescribing. From there they hope to conceive and demonstrate novel designs for computerized drug safety guidance that elicit physician trust and a sense of collaboration. Then, through a series of comparative evaluation studies, they will evaluate the impact of the proposed strategies on physician compliance and experience.

Duke is a research scientist, the drug safety informatics lab director and chief innovation officer at the Regenstrief Institute, an assistant professor of medicine at the IU School of Medicine, and an adjunct professor at IUPUI’s School of Informatics and Computing. His primary research focus is on applying big data and human-computer interaction to identifying adverse drug event risk and effectively communicating this information through clinical decision support and advanced product labeling. His other area of research is in electronic health records design and innovation, including the integration of an area of computer science called natural language processing into clinical workflows to improve the quality and efficiency of health care.

Bolchini is an associate professor and department chair of the IUPUI School of Informatics and Computing’s Department of Human-Centered Computing. His work investigates novel methodologies and conceptual tools to understand and structure design reasoning for the user experience with the web, hypermedia, and content-intensive interactive applications. Specifically, he is interested in user experience requirements, conceptual design, navigation patterns, and navigation architecture modeling; and interactive accessibility, especially aural navigation interfaces for the blind.
Duke and Bolchini are working to rethink the role drug interaction alerts play in how doctors prescribe drugs and to see them evolve from oft-ignored warnings to trusted tools.
This flavor network captures the flavor compounds shared by culinary ingredients. Each node denotes an ingredient, the node color indicates a food category, and the node size reflects the ingredient prevalence in recipes.
Pushing the boundaries of network science

There may only be one place in the world where you can find a connection between culinary ingredients, human migration over millennia, Flickr, the economy of Côte d’Ivoire, and protein interactions in the plant *Arabidopsis thaliana*. That would be Informatics East 316, the office of Indiana University Bloomington School of Informatics and Computing assistant professor Yong-Yeol Ahn.

In 2014 Ahn, a physicist by training, was named a Microsoft Faculty Fellow—an honor bestowed upon young academics with the potential to transform, take risks, and push the boundaries within their unique areas of computer science. Ahn joined peers from MIT, Cornell, and Columbia universities as one of five researchers in North America to receive the honor.

Since arriving at IU in 2011, Ahn’s work has been published in elite journals such as *Nature*, *Science*, and the *Proceedings of the National Academy of Sciences*, referenced in *The New York Times*, *MIT Technology Review*, and *Scientific American*, and cited by other academics nearly 3,000 times. Ahn is a network detective. He hunts for hidden patterns within massive datasets and examines the structure and dynamics of complex systems—computational, biological, cultural—to glean new insights into areas as diverse as neuronal network organization and user-generated video systems like YouTube.

“You can find networks in so many systems—biological, political, social—and then translate and apply methodologies developed for one domain to others,” Ahn says. “They may often share universal characteristics and evolutionary mechanisms even though they are totally different.”

In a single paper, Ahn and co-authors were able to cogently analyze biological, consumer, political, psychological, and social systems, exposing the fundamental interdisciplinary nature of his field.

Last year Ahn received an IU Faculty Research Support Program award from IU Bloomington’s Office of the Vice Provost for Research to support innovative research, and in 2012 he was one of two scientists to receive the Outstanding Young Research Award from the Association of Korean Physicists in America. He received his Ph.D. from the Korea Advanced Institute of Science and Technology, was a visiting researcher and fellow at Jacobs University in Bremen, Germany, and spent three years as a visiting researcher at Harvard’s Dana-Farber Cancer Institute while doing postdoctoral research at Northeastern University from 2008 to 2011.

Also an adjunct professor in IU Bloomington College of Arts and Sciences’ Department of Statistics, Ahn has compared network science to statistics as a way of bridging disciplines and providing knowledge tools to other scientists. As proof, some of his future subjects of analysis include applying computational and mathematical methods to online social media and cultural datasets, and understanding creative processes across science, music, and other domains.
In a third-grade classroom, the child of a middle class family is struggling with a math assignment. She raises her hand, then asks her teacher several questions to clarify how she should approach the problem. Next to this student, the child of a working class family also struggles. She does not raise her hand, however, and when the teacher passes by to offer help, the student asks a single question, then returns to chewing the end of her pencil, still confused.

Why do the problem-solving approaches of these students differ? Put simply, says social scientist Jessica Calarco, it starts with lessons learned at home. In a study published in *American Sociological Review*, Calarco, an assistant professor of sociology in the College of Arts and Sciences at IU Bloomington, found that social class shapes how parents coach their children to manage classroom challenges.

“Parents have different beliefs on how to deal with challenges in the classroom,” says Calarco. “Middle class parents tell their children to reach out to the teacher and ask questions. Working class parents see asking for help as disrespectful to teachers, so they teach their children to work out problems themselves.”

In short, children are doing what they’re told. Calarco notes that the differences in how parents teach their children to deal with problems in school stem primarily from parents’ own educational experiences and their level of involvement in their children’s schooling. While middle class parents expect teachers will be responsive to their children’s needs, working-class parents worry that teachers may punish students for asking.

Calarco’s study followed four public elementary classrooms for three years. In the study, Calarco writes that “the transfer of class-based culture from parents to children helped reproduce social inequalities” in the classroom, in part because teachers respond differently to children’s differing strategies.
“Teachers need to be aware of social class differences that students are bringing with them into the classroom and be more active in seeking out struggling students. If we leave it up to the kids, they may not seek help themselves.”
When it comes to studying youth violence in the United States, sociologist Tamara Leech takes an unexpected approach—she looks at where the violence isn’t. In Leech’s words, she studies “cold spots” (as opposed to “hot spots”) of urban youth violence—areas where, regardless of the risk for it, youth violence is not occurring.

Leech is an associate professor in the Department of Social and Behavioral Sciences at Indiana University’s Richard M. Fairbanks School of Public Health. With a $350,000 grant from the William T. Grant Foundation, which invests in research related to children and youth in the United States, Leech is pursuing a project she calls “Pockets of Peace: Investigating Urban Neighborhoods Resilient to Adolescent Violence.”

“Myriad information exists about the association between neighborhood disadvantage and juvenile violence,” Leech notes. But the available information comes from a deficit orientation, she notes, focusing on things missing from neighborhoods that are already under-resourced. Instead, Leech is using a “resilience paradigm” to study what is present in urban neighborhoods that have low rates of juvenile violence despite high-risk factors such as poverty and unemployment.

“We need research on the unique aspects of disadvantaged neighborhood environments where youth—regardless of their propensity toward violence—are unlikely to act violently,” she says.

Working in the Indianapolis area, Leech has created maps of “pockets of peace,” analyzing their economic and social characteristics. She’s also partnered with “rovers,” local residents who gather stories and social observations about assets in their neighborhood areas. Next, she’ll begin collecting data from adolescents aged 14 to 19 who will use their cell phones to report on everyday experiences in their communities. The goal is to identify what spatial factors and social processes in neighborhood settings protect against high rates of problem behavior among young people.

Leech is currently translating the results of her research into briefs about community resilience for policy makers. So far, her findings have been shared with the Indiana Disproportionality Committee and the Newark, New Jersey, city government. She is also working on a book aimed at supporting public health practitioners’ efforts to control teen violence.

Leech says her study “has significant potential to refocus academic attention on positive change in urban adolescents’ neighborhood environments.”

“Violence is a priority health risk behavior,” says Leech. “What can we do outside the justice system to contribute to primary prevention and positively affect adolescent well-being?”

“We need research on the unique aspects of disadvantaged neighborhood environments where youth, regardless of their propensity toward violence, are unlikely to act violently.”
The tiny grasshopper mouse can feed on bark scorpions without feeling its stings, an adaptation that researchers think may hold clues to pain relief for millions.
Get stung by a bark scorpion, and you’ll know it. “It feels like you’ve gotten a burn that someone then drives a nail through,” says Theodore Cummins, professor and interim chair of pharmacology and toxicology, and a pain researcher at the IU School of Medicine.

So the fact that the little grasshopper mouse can munch on scorpions like candy without feeling the stings is a fascinating oddity of life in the southwestern United States.

But for Cummins and a team of fellow researchers, that oddity (or more precisely, that evolutionary adaptation) suggests something much more: the mouse might offer clues to pain relief for millions of people.

Their question was, how does the mouse do that? The answer is in the mouse’s sodium channels.

Sodium channels are specialized proteins that play important signaling roles in cells. Sodium channels Nav1.7 and Nav1.8 are known to be involved in the transmission of pain sensations from the peripheral nerves—such as those in the hand—to the central nervous system.

After considerable work, the research team—which included Ashlee and Matthew Rowe, now of Michigan State University; Yucheng Xiao of the IU School of Medicine and the Stark Neurosciences Research Institute, and Harold Zakon of the University of Texas—found a few simple genetic alterations in the Nav1.8 channels that blocked the pain sensations in the mice. Specifically, the mutations caused scorpion venom molecules to latch on to the Nav1.8 channels, blocking their pain signal transmissions.

These discoveries were reported in the journal *Science* in October 2013. But the work was only beginning.

Ashlee Rowe continues to travel to the Southwest, collecting mice, scorpions, and certain venomous centipedes as well.

Meanwhile, the researchers are breaking down the venom into tiny components using a process called fractionation to try to isolate the component of the venom that targets the Nav1.8 channel. So far, they have identified some promising candidates for further testing.

“We’re trying to figure out how the mice have made this venom into a drug that works like morphine. We’re trying to learn what toxin the mouse is using as an analgesic, and we’re trying to look at where it interacts with the Nav1.8 sodium channel in this mouse,” Cummins says.

Having learned that, the next step would be to figure out how to use that information to block pain in humans, knowing that humans don’t have the sodium channel mutations that have evolved in the mice.

Nonetheless, those sites in the sodium channels would become potential targets, potential druggable sites.

“If we can figure out how nature is shutting down this activity, then if we can make a drug that works similarly to the venom in grasshopper mice but targets the human channel, we can hopefully shut down problematic pain sensations,” Cummins says.

The grasshopper mice research is part of a broader effort to find new ways to control pain.

It appears, Cummins says, that the two channels, Nav1.7 and Nav1.8, work together to produce pain sensations. There are people who don’t feel any pain—a dangerous condition—who have mutations in Nav1.7.

“We think there are at least two good targets there. Right now, morphine and morphine-like drugs are used a lot for treating pain, but they are the number one addiction now in America.

“So if we can find something to target other than the opioid receptors that morphine and similar drugs use, then maybe we can make a drug that’s not addictive but will target the pain that’s hard to hit otherwise,” Cummins says.
Add “combat gum” to the list of products associated with the Indiana University School of Dentistry’s Oral Health Research Institute at Indiana University–Purdue University Indianapolis.

The school’s research facility has been engaged in a year-long, $1.2 million study for the U.S. Army of the first use of pharmaceutical-grade antiplaque chewing gum in humans. The gum is intended for soldiers in the field.

Carrying gum isn’t anything new for soldiers. America’s fighting men made their way across Europe during World War II carrying Wrigley’s Spearmint, Doublemint, and Juicy Fruit gum. In fact, because Wrigley could not make enough top-quality gum for everyone during the war, the company took those brands off the civilian market and dedicated the entire output of these brands to the U.S. Armed Forces.

But the new gum the military will carry into the field will be a lot better for their teeth. Given that about 40 percent of Army recruits enter the service with more than three cavities, that’s good news. Necessary dental work is done before the troops deploy, but if a problem crops up in the field, a soldier must be removed from duty and taken to the nearest dentist.

Soldiers in the field don’t spend a lot of time brushing their teeth, says Domenick T. Zero, director of the Oral Health Research Institute, professor of preventive and community dentistry, and principal investigator of the study. “The hope is that the gum will reduce the amount of plaque buildup that occurs when soldiers aren’t brushing their teeth, reducing the risk of periodontal disease and dental decay.”

A compound developed by the army is incorporated into the new chewing gum. Known as KSL-W, the compound is a novel antimicrobial peptide that kills bacteria. It was designed to help prevent the development of dental plaque and reduce periodontal disease and cavities.

One challenge in developing the gum was the adequate release of the pharmaceutical active peptide within 20 minutes of chewing, says Dr. Kai Leung, the Army scientist behind the idea. “Ideally we would like to see more than 70 percent of the active ingredient to be released within that time period.

“We modeled the naturally occurring antimicrobial peptides such as defensins and developed several synthetic peptides that exhibited similar or more potent antimicrobial activity,” Leung says. “The pharmaceutical active, KSL-W peptide, is one of the more potent molecules showing stability in the oral cavity.”

The Oral Health Research Institute administered the gum to 137 people between the ages of 18 and 64, focusing on the safety and tolerability of single and multiple doses of the compound. It also tested the feasibility of delivering a drug through chewing gum, Zero says. Further studies will be required to determine the extent to which the gum reduces periodontal disease and cavities.

Leung says the IU Oral Health Research Institute was selected to conduct the clinical study because it is one of the largest and most experienced clinical research units in dentistry in the world.
“The hope is that the gum will reduce the amount of plaque buildup that occurs when soldiers aren’t brushing their teeth, reducing the risk of periodontal disease and dental decay.”
Two National Humanities Center Fellows at IU Bloomington

Indiana University Bloomington faculty members Shannon Gayk and William Newman were appointed fellows at the National Humanities Center for 2014–15. The 14 NHC Fellows for 2014–15 were chosen from among 362 applicants. The center is an independent institute for advanced study in the humanities located in North Carolina’s Research Triangle Park. Gayk, an associate professor of English in the College of Arts and Sciences and a scholar of late medieval religious writing and culture, received a Walter Hines Page Fellowship for her book project *Instruments of Christ: The Arma Christi in Early England*. The work explores how medieval people understood the uses, power, and meanings of passion relics. Newman is Distinguished Professor and Ruth N. Halls Professor of history and philosophy of science in the College of Arts and Sciences. He was awarded a Birkelund Fellowship for “The Alchemy of Isaac Newton—A New Appraisal.” Newman’s recent research has focused on early modern “chymistry” as exemplified by Isaac Newton and others. His “Chymistry of Isaac Newton” project combines a digital edition of the scientist’s alchemical works with tools derived from computational linguistics and replication of Newton’s experiments.

Operations management and humanitarian aid

Alfonso Pedraza-Martinez understands the business of disaster. An assistant professor of operations and decision technologies at the Indiana University Kelley School of Business in Bloomington, Pedraza-Martinez’s research focuses on humanitarian operations management—in particular, the vehicle supply chain for the distribution of aid. In 2014, he and two co-authors from France and Germany received the best paper award from the Production and Operations Management Society for their paper, “Vehicle Supply Chains in Humanitarian Operations: Decentralization, Operational Mix, and Earmarked Funding.” In the paper, Pedraza-Martinez and his colleagues use data from the International Red Cross and other agencies to examine how different organizations operate their fleets of the four-wheel drive vehicles that provide transportation to humanitarian operations. Among other things, they paid particular attention to the effect that earmarked funding—funds a donor assigns to a specific use—may have on operational performance. They conclude that earmarked funding constrains operational performance and may lead to deterioration in performance in some settings. In view of the tendency toward greater earmarked funding, the co-authors say the study “offers a timely reminder that this may have a counterproductive outcome.”

Kennedy Center honors

Born in New York in 1937, Martina Arroyo studied to be a teacher, graduating from Hunter College in 1946. Studying voice was a hobby. By 1958, though, Arroyo was winning Metropolitan Opera auditions and making her debut in Carnegie Hall. In 1965, she was called as a last-minute replacement for an ailing Birgit Nilsson in the opera *Aida*, and her career skyrocketed. *The New York Times* once heralded her voice as “among the most glorious in the world.” In December 2013, Arroyo, renowned soprano and IU Distinguished Professor Emerita, took the stage to receive Kennedy Center Honors along with Herbie Hancock, Billy Joel, Shirley MacLaine, and Carlos Santana. The annual award honors lifetime contributions to American culture in dance, television, music, theatre, or opera. Arroyo joined the IU Jacobs School of Music faculty in 1993, retiring in 2007. While teaching at IU, she created a course in role preparation that became the basis of a program she offered to young opera singers. The success of that program led to the establishment of the Martina Arroyo Foundation, through which Arroyo prepares young singers in the interpretation of complete operatic roles for public performance.
A garden’s history

These days, community gardens enjoy widespread popularity as part of a contemporary movement toward local food and sustainability practices. Micheline Nilsen shows us the deep history and origins of such gardens in her 2014 book *The Working Man’s Green Space: Allotment Gardens in England, France, and Germany, 1870–1919*. In the book, Nilsen examines the role allotment gardens played in the social safety net of the time period, their impact on land-use planning, and finally, the significance of the allotment gardens for the working-class men who cultivated them. The Foundation for Landscape Studies awarded the book the David R. Coffin Publication Grant for advancing scholarship in the field of garden history and landscape studies. A native of Belgium, Nilsen is currently an urban historian teaching art history at the Ernestine M. Raclin School of the Arts at Indiana University South Bend. *The Working Man’s Green Space* helped Nilsen earn a residential fellowship at the Dumbarton Oaks Research Library to work on her next book, *From Turnips to Lawn Chairs: Allotment Gardens in Europe, 1920 to 1975*.

Looking back at U.S. taxes

In fall 2013, the U.S. income tax turned 100 years old, having been enshrined in the 16th Amendment in October 1913. In *Making the Modern American Fiscal State: Law, Politics, and the Rise of Progressive Taxation, 1877–1929*, Ajay K. Mehrotra, professor of law and history at the IU Maurer School of Law in Bloomington, offers a comprehensive history of the transformation in American public finance that has given us our current U.S. tax system. The book was named the winner of the 2014 Society for U.S. Intellectual History annual book award. Calling the book “important and ambitious” and “a history of ideas in action,” the society cited Mehrotra’s analysis of the shift from the nineteenth-century “regime of indirect, hidden, partisan, and regressive taxes” to today’s “direct, transparent, professionally administered, and progressive tax system.” A book on taxation may seem a curious choice for an intellectual history prize, the society’s editors noted, “but we were struck by how successfully Mehrotra weaves together the intellectual, legal, and administrative threads of his argument. (He) takes ideas seriously.”
Cardiovascular health and middle age

A nutritional epidemiologist, Ka He, who is chair and professor of epidemiology and biostatistics at the Indiana University School of Public Health-Bloomington, co-authored a paper selected by the American Heart Association as one of the 10 most important papers in 2013. Published in *Annals of Neurology*, the paper, “Cardiovascular Health through Young Adulthood and Cognitive Functioning in Midlife,” examined the association between overall cardiovascular health in young adulthood to cognitive function in midlife. He and his colleagues analyzed data on more than 2,900 individuals, ages 18 to 30, according to seven metrics of ideal cardiovascular health including the avoidance of overweight or obesity, a healthful diet, no smoking, physical activity, total cholesterol, blood pressure, and fasting glucose. Looking at a 25-year period beginning in young adulthood, the researchers found a strong association between a greater number of cardiovascular health metrics and better visual motor speed, executive function, and verbal memory in midlife. As research makes it clearer that dementia in adults can develop over a long period of time, the co-authors note the relevance of their evidence that cardiovascular behaviors at a younger age influence cognitive function at older ages. Ka He, who specializes in the study of diet and nutrients in relation to the development of chronic diseases, also was named a fellow in the American College of Epidemiology in 2013.

Better batteries for electric cars

Electric vehicles are driving change toward a cleaner, more sustainable energy environment. With current funding from the National Science Foundation, Likun Zhu, an assistant professor in the School of Engineering and Technology at Indiana University–Purdue University Indianapolis, is advancing research on lithium ion batteries, the battery technology often relied upon for electric vehicle ground transportation. In his laboratory, Zhu and his colleagues are developing new approaches to studying the microstructure of the electrode and its impact on a lithium ion battery’s physical and electrochemical performance. Zhu’s research findings may directly facilitate improvement of lithium ion battery capability, allowing for more widespread use of environmentally sustainable energy sources, especially in ground transportation.
What common ancestor?

The search for a common ancestor linking modern humans with the Neanderthals who lived in Europe thousands of years ago has long been a robust area for research. But a new study co-authored by David Polly, professor in the Department of Geological Sciences, College of Arts and Sciences at IU Bloomington, suggests the quest isn’t nearly complete. The study, published in the Proceedings of the National Academy of Sciences, was carried out by an international team of scholars who focused on the shape of dental fossils. They found that none of the usual suspects fits the expected profile of an ancestor of Neanderthals and modern humans. They also found evidence that the lines that led to Neanderthals and modern humans diverged nearly 1 million years ago, much earlier than studies based on molecular evidence have suggested. The article, “No Known Hominin Species Matches the Expected Dental Morphology of the Last Common Ancestor of Neanderthals and Modern Humans,” relies on fossils of approximately 1,200 molars and premolars from 13 species or types of humans and human relatives and ancestors. The researchers concluded with high statistical confidence that none of the hominins usually proposed as a common ancestor, such as Homo erectus, is a satisfactory match. They argue that quantitative and statistical methods provide a better way to settle debates about human origins than the descriptive analyses that have been used in the past. “Our primary aim,” they write, “is to put questions about human evolution into a testable, quantitative framework and to offer an objective means to sort out apparently unsolvable debates about hominin phylogeny.”

Investigating pregnancy discrimination

Through her research and writing on pregnancy discrimination in the workplace, Deborah A. Widiss, associate professor at the Indiana University Maurer School of Law in Bloomington, has changed the way courts and administrative agencies treat pregnant employees. Her 2013 article “Gilbert Redux: The Interaction of the Pregnancy Discrimination Act and the Amended Americans with Disabilities Act,” published in the University of California Davis Law Review, was the first in-depth treatment of how the 1978 Pregnancy Discrimination Act interacts with the Americans with Disabilities Act (ADA). Her analysis of cases and of the Pregnancy Discrimination Act shows why multiple courts have incorrectly limited the act’s reach as well as argues for an approach that would require employers to accommodate pregnant employees in many contexts. In July 2014, the Equal Employment Opportunity Commission (EEOC), the federal agency charged with interpreting both the Pregnancy Discrimination Act and the ADA, released new guidance largely endorsing Wildiss’s interpretation of the Pregnancy Discrimination Act. Her article was cited and commended in a public written statement by EEOC Commissioner Chai Feldblum. Widiss also drew on her work for an op-ed she published in the Huffington Post about Walmart’s policy on accommodating pregnant workers.
Awards and expenditures

Awards by Direct Source

FY 2014

1. Federal, 48%  $228,589,111
2. Commercial/For profit, 17%  $79,604,987
3. Non-Profit, 15%  $70,803,909
4. State of Indiana, 7%  $34,780,456
5. Higher Education, 7%  $32,453,131
6. Foundations, 6%  $27,497,110
7. Other Governmental, 1%  $3,099,568

TOTAL  $476,828,272

Technology Commercialization
FY 2010–14

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To find out more, visit: iurtc.iu.edu

Research Expenditures
Department of Health and Human Services* and National Science Foundation

Dollar figures given are in millions.

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*The Department of Health and Human Services comprises 11 operating divisions, including the National Institutes of Health. The NIH is made up of 27 institutes and centers, each with a specific research agenda. Over the past five years, NIH funding made up 89% of all DHHS funding to Indiana University.
Research Expenditures

Research Expenditures by Unit*

FY 2014

1. Medicine & Health Sciences $270,921,017
2. Arts & Sciences $101,396,441
3. VP Research $22,080,274
4. Informatics & Computing $19,758,038
5. Science $13,425,159
6. VP IT $12,532,100
7. Education $10,881,051
8. Engineering & Technology $9,299,532
9. Public Health $8,975,309
10. Public & Environmental Affairs $8,526,201

* Includes University Internal funding. University Internal consists of direct costs on internally funded accounts as well as calculated indirect costs. It also includes cost share and unrecovered indirect costs on sponsored projects.

Research Expenditures by Source

FY 2014

1. Federal, 43% $228,604,416
2. University Internal*, 43% $231,243,053
3. Foundations, 4% $23,886,949
4. Commercial, 4% $19,681,142
5. Nonprofit, 4% $23,493,251
6. State of Indiana, 0.8% $4,107,828
7. Higher Education, 0.5% $2,819,693
8. Other governmental, 0.1% $536,237

TOTAL $534,374,583

* University Internal consists of direct costs on internally funded accounts as well as calculated indirect costs. It also includes cost share and unrecovered indirect costs on sponsored projects.

Research Expenditures by Federal Agency

FY 2014

1. U.S. Department of Health and Human Services $159,812,040
2. National Science Foundation $35,640,815
3. U.S. Department of Defense $12,516,017
5. NASA $2,509,833
7. Environmental Protection Agency $1,297,730
8. DHS $580,851
9. USDA $552,167
10. All other federal agencies $3,020,242

TOTAL $228,604,416