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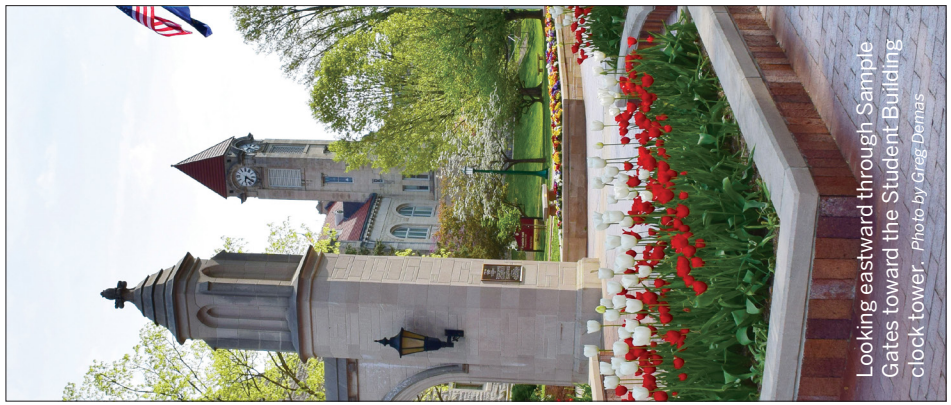

Looking eastward through Sample Gates toward the Student Building clock tower. *Photo by Greg Dimas*

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INDIANA UNIVERSITY College of Arts + Sciences

BioNews

Keeping you updated on what's happening in the **Department of Biology**

Spring 2020

Editor's note: We share with you news from the past months as we forge ahead during this uncertain time. Be safe and well.

In just six weeks, freshmen in ASURE program develop a novel research question, draft a professional proposal, and pass it through peer review. *Photo by Mike Manzella* 5

A sheet of glass was removed from the Jordan Hall greenhouse roof to allow the *Agave americana*'s 30-foot flower stalk to pass through. *Photo by James Brosher* 10

Distinguished Professor Emeritus Jeff Palmer smiles after receiving the IU President's Medal for Excellence. *Photo courtesy of Mimi Zolan* 16

Your blood type may influence your vulnerability to norovirus, the winter vomiting virus

by Patricia L. Foster

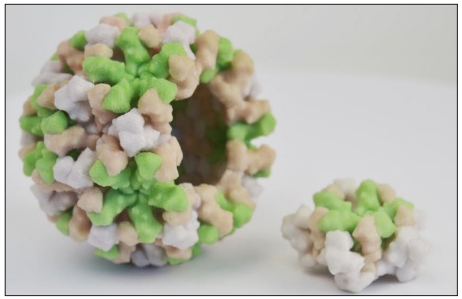
In the last few [winter] months, schools all over the country have closed because of outbreaks of norovirus. Also known as stomach flu, norovirus infections cause watery diarrhea, low-grade fever and, most alarming of all, projectile vomiting, which is an extremely effective way of spreading the virus.

Norovirus is very infectious and spreads rapidly through a confined population, such as at a school or on a cruise ship. Although most sufferers recover in 24 to 48 hours, norovirus is a leading cause of childhood illness and, in developing countries, results in about 50,000 child deaths each year.

Interestingly, not everyone is equally vulnerable to the virus, and whether you get sick or not may depend on your blood type.

Norovirus is hard to get rid of

I am a microbiologist, and I got interested in norovirus because, while norovirus symptoms are distressing under any circumstances, my encounter with the virus was particularly inconvenient. During a seven-day rafting trip down the Grand Canyon, the illness passed through the rafters and crew, one by one. Obviously, the wilderness sanitary facilities were not the best to cope with this outbreak. Luckily, everyone, including me, recovered quickly. It turns out that norovirus outbreaks on Colorado River rafting trips are common.



▲ 3D print of Norwalk virus, a type of norovirus. Noroviruses are the most common cause of acute gastroenteritis (infection of the stomach and intestines) in the United States. *Image by NIH*

As debilitating as the illness it causes can be, the norovirus particle is visually beautiful. It is a type of virus known as "non-enveloped" or "naked," which means that it never acquires the membrane coating typical of other viruses, such as the flu virus. The norovirus surface is a protein coat, called the "capsid." The capsid protects the norovirus' genetic material.

The naked capsid coat is one factor that makes norovirus so difficult to control. Viruses with membrane coatings are susceptible to alcohol and detergents, but not so norovirus. Norovirus can survive temperatures from freezing to 145 degrees Fahrenheit (about the maximum

educational mission, including employing modern pedagogical techniques. He retired as Professor Emeritus in 1998. He was involved in numerous departmental science outreach programs, and Togasaki regularly volunteered as a teacher at Harmony School and the WonderLab Science Museum.

Togasaki and Girl Scout Brownies at a 2004 outreach program. *Photo by IU Biology* ▶

Keep in touch

We'd like to hear from you! **Share your recent accomplishments** to be added to "class notes" in the next *BioNews* issue: http://go.iu.edu/bioshare.

Visit https://biology.indiana.edu/news-events/newsletters to **access the current issue with class notes** and a few extras as well as past issues of IU Biology newsletters.

Contact information changed? Notify Kathy Wyss at kwyss@indiana.edu or 812-855-6195.

Update your record with the IU Alumni Association at https://myiu.org/my-profile/alumni-directory.

BioNews is published by the IU Department of Biology—with support from the IU College of Arts and Sciences—for alumni and friends to encourage their interest in and support for Indiana University, the College of Arts and Sciences, and our department.

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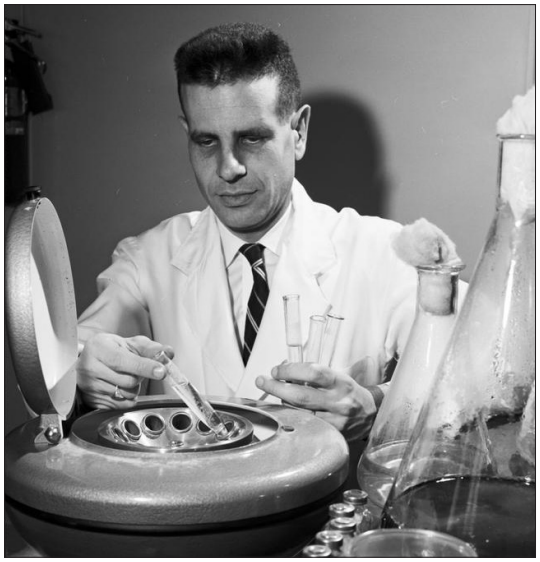
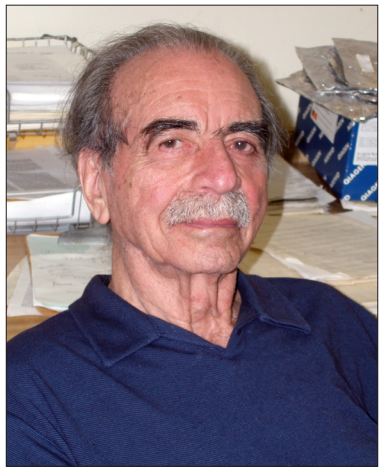


▲ Weinberg directs chelation (metal grabbing) by antibiotics research, 1959. *Photo courtesy of IU Archives #P0047493*

Eugene "Gene" Weinberg (Mar. 4, 1922–Mar. 8, 2019) had been an IU Biology faculty member since 1950 (with a joint appointment in Medical Sciences), starting as an assistant professor of the then Department of Microbiology and rising quickly through the ranks to Professor of Biology in 1961. Weinberg was among the first to advance the concept that humans and animals protect themselves from invasion by microbes and cancer cells by withholding iron from the invaders. His research on the roles of iron and other minerals in health and infectious diseases, cancer, and other chronic conditions was nationally and internationally recognized. He retired as Professor Emeritus in 1992.

Drew Schwartz (Nov. 15, 1919–Aug. 10, 2019) was a faculty member from 1964 until his retirement as Professor Emeritus in 1990. He made several fundamental contributions to maize genetics during his time at IU, including developing methods to screen for negative mutants and developing a "competition model" for the regulation of gene action. He also made important contributions to the area of transposable elements ("jumping genes") in maize. Schwartz was named a Guggenheim Fellow in 1972. Shortly before his retirement, Schwartz established a graduate fellowship for students whose research involves fundamental genetic phenomena.



▲ Schwartz, 2006. *Photo by IU Biology*

Robert K. "Bob" Togasaki (Jul. 24, 1932–Nov. 19, 2019) was recruited in 1968 to the then Department of Botany to provide research strength in biochemistry of photosynthesis. He made important discoveries in genetics using the unicellular green algae *Chlamydomonas*. He developed the Bio Nebulizer, one of "100 Discoveries of the Year" by *Research and Development Magazine* in 1993. Togasaki also made critical contributions to IU Biology's

water temperature in a home dishwasher), soap and mild solutions of bleach. Norovirus can persist on human hands for hours and on solid surfaces and food for days and is also resistant to alcohol-based hand sanitizers.

To make things worse, only a tiny dose of the virus—as few as 10 viral particles—is needed to cause disease. Given that an infected person can excrete many billions of viral particles, it's very difficult to prevent the virus from spreading.

Susceptibility to norovirus depends on blood type

When norovirus is ingested, it initially infects the cells that line the small intestine. Researchers don't know exactly how this infection then causes the symptoms of the disease. But a fascinating aspect of norovirus is that, after exposure, blood type determines, in a large part, whether a person gets sick.

Your blood type—A, B, AB, or O—is dictated by genes that determine which kinds of molecules, called oligosaccharides, are found on the surface of your red blood cells. Oligosaccharides are made from different types of sugars linked together in complex ways.

The same oligosaccharides on red blood cells also appear on the surface of cells that line the small intestine. Norovirus and a few other viruses use these oligosaccharides to grab onto and infect the intestinal cells. It's the specific structure of these oligosaccharides that determines whether a given strain of virus can attach and invade.

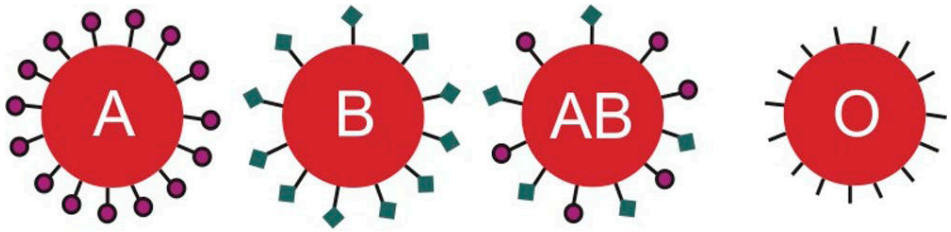
The presence of one oligosaccharide, called the H1-antigen, is required for attachment by many norovirus strains.

People who do not make H1-antigen in their intestinal cells make up 20% of the European-derived population and are resistant to many strains of norovirus.

More sugars can be attached to the H1-antigen to give the A, B or AB blood types. People who can't make the A and B modifications have the O blood type.

Different strains of norovirus infect different people

Norovirus evolves rapidly. There are 29 different strains currently known to infect humans, and each strain has different variants. Each one has different abilities to bind to the variously shaped sugar molecules

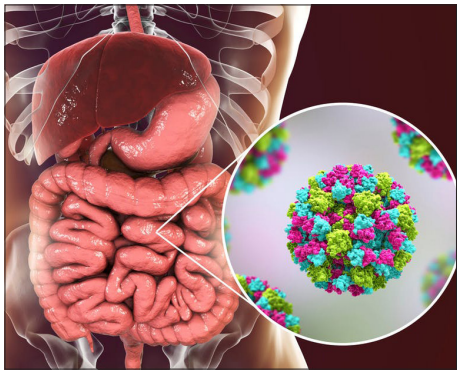


▲ Each blood type is distinguished by a different sugar marker on the red blood cell. Cells lining the intestine also have these sugar markers. *Image by Fernando Jose V. Soares/Shutterstock.com*

on the intestinal cell surface. These sugars are determined by blood type.

If a group of people is exposed to a strain of norovirus, who gets sick will depend on each person's blood type. But, if the same group of people is exposed to a different strain of norovirus, different people may be resistant or susceptible. In general, those who do not make the H1-antigen and people with B blood type will tend to be resistant, whereas people with A, AB, or O blood types will tend get sick, but the pattern will depend on the specific strain of norovirus.

This difference in susceptibility has an interesting consequence. When an outbreak occurs, for example, on a cruise ship, roughly a third of the people may escape infection.



▲ Norovirus, also called winter vomiting bug, infects cells in the human intestine causing diarrhea, vomiting, and stomach pain. *Image by Kateryna Kon/Shutterstock.com*

Because they do not know the underlying reason for their resistance, I think spared people engage in magical thinking—for example, "I didn't get sick because I drank a lot of grape juice." Of course, these mythical evasive techniques will not work if the next outbreak is a strain to which the individual is susceptible.

Immunity to norovirus is short-lived

A norovirus infection provokes a robust immune response that eliminates the virus in a few days. However, the response appears to be short-lived. Most studies have found that immunity guarding against reinfection with the same norovirus strain lasts less than six months. Also, infection with one strain of norovirus offers little protection against infection from another. Thus, you can have repeated bouts with norovirus.

The diversity of norovirus strains and the impermanence of the immune response complicates development of an effective vaccine. Currently, clinical trials are testing the effects of vaccines made from the capsid proteins of the two most prevalent norovirus strains.

In general, these experimental vaccines produce good immune responses; the longevity of the immune response is now under study. The next phase of clinical trials will test if the vaccines actually prevent or reduce the symptoms of norovirus infection.

Patricia L. Foster is a professor emerita at IU Biology.

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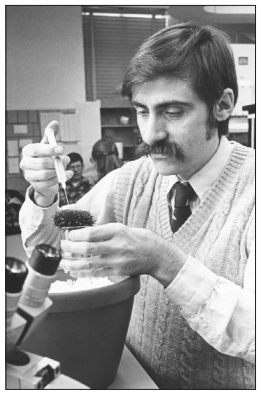
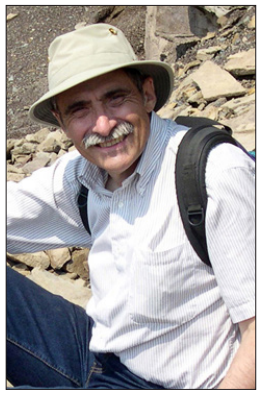
▲ Tulips bloom near Beck Chapel on the IU Bloomington campus. *Photo by Chaz Mottinger*

In memoriam

We lost four valued and cherished members of the faculty last year.





Left: Raff works with a sea urchin in 1980. *Photo courtesy of IU Archives #P0035222*

Right: Raff on vacation at the fossil cliffs of Joggins ca. 2006. *Photo courtesy of Elizabeth Raff*

Rudolf "Rudy" Raff

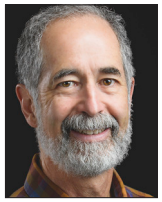
Nov. 10, 1941–Jan. 5, 2019

Raff was a faculty member in IU Biology since 1971, starting as an assistant professor and rising quickly through the ranks to a James H. Rudy Professor of Biology in 2000 and a Distinguished Professor in 2002, until his retirement as Distinguished Professor Emeritus in 2018. Raff was a pioneer of the field now known as evo-devo (evolutionary developmental biology) and his work received numerous awards and honors, including the pioneer award of the PanAmerican Society of Evolutionary Developmental Biology, a Guggenheim Fellowship, and election to the American Association for the Advancement of Science and the American Academy of Arts and Sciences. Perhaps more important than his scientific and scholarly accomplishments (and there were indeed many), Raff was a wonderful colleague, friend, and mentor to many, and he was vital to the growth and success of the department over the last half century.

Professor **Armin Moczek leads an evolutionary research effort under nearly $2 million grant** to study how organisms play an active role in directing their own development and evolution.

Roger Innes has been appointed Distinguished Professor for his many contributions to the field of biology, the department, and the university.


Moczek


Innes

Palmer awarded IU president's highest honor

Jeffrey Palmer, Distinguished Professor Emeritus and Class of 1955 Professor of Biology, was awarded the President's Medal for Excellence during the Academic Excellence Dinner at IUPUI last October.

"Professor Palmer is a world-renowned expert on plant molecular evolution and phylogeny," IU President Michael A. McRobbie said. "A member of the IU faculty since 1989, Professor Palmer has made landmark discoveries spanning topics as diverse as plant phylogeny and the evolution of introns, segments of genes that are removed as part of the gene expression process."

While serving at IU, Palmer was instrumental in the development of Simon Hall (the multidisciplinary science building dedicated and opened in Bloomington in 2007) and has trained 40 postdoctoral fellows and 20 graduate students.

Palmer has been identified as one of the top 15 researchers in the world in the field of plant and animal science by the Institute for Scientific Information. He is a Guggenheim Fellow, a Fellow of the National Academy of Sciences, a fellow of the American Academy of Arts and Sciences, and of the American Association for the Advancement of Science. He has been awarded the McClintock Prize for Plant Genetics and Genome Studies by the Maize Genetics Executive Committee, a professional organization for scientists and researchers working in the field of maize genetics.

The President's Medal for Excellence is awarded for outstanding academic, artistic, or professional accomplishments or for exceptional service to IU. The silver medal is a replica of the jewel of office IU's president wears during ceremonies.


▲ Distinguished Professor of Biology Roger Hangarter congratulates Palmer (right). *Photo courtesy of Mimi Zolan*

Freshmen "deliver" in IU's new ASURE program by Michael Manzella

When the first cohort of ASURE students arrived in 2018, they weren't quite sure what they were getting into. With interactive professors and students conducting novel research of their own design, the new Arts and Sciences Undergraduate Research Experience (ASURE) at IU isn't your typical freshman experience.


▲ On February 4, Mike Manzella tweeted: My 2020 #ASURE #VIBNAUTS setting up their first MuGENT reactions. Science happened, math struggled, but they're all set up before 10 am. 8 groups today . . . gonna be madhouse when it comes to plating. *Photo by Mike Manzella*

The ASURE program aims to avoid the "when will I ever have to know X" and instead pushes the students to ask, "Why is X happening and how can I find out more?" While the full ASURE cohort registered over 100 students, a majority of those took part in humanities research. Just under 40 students were selected to enter one of the two science tracks.

One track, opened in 2018 and led by Dr. Megan Murphy (lecturer, biology), focused on the evolution of katydid behavior in response to a parasitoid fly. Murphy's students prepared next-generation sequencing libraries, analyzed genetic diversity, and developed novel research questions using a dataset that Murphy collected specifically for her ASURE track. This year Murphy has switched her lab's focus to immune function in crickets and within a week of starting her lab course had students initiating an immune response in crickets and measuring resulting behavioral changes.

The other science track, also opened in 2018 and led by Dr. Mike Manzella (lecturer, biology), focused on something already established at Indiana University—engineering the genomes of *Vibrio* bacteria. Multiple laboratories

in the IU Biology program direct their focus at *Vibrio* species (Rowe-Magnus, Dalia, and van Kessel to name a few), but it wasn't until Manzella arrived in 2018 that a full batch of freshmen could take a bite out of this research. Nicknamed "Vibnauts" (in homage to University of Puget Sound Associate Professor of Biology Mark O. Martin's amazing community of Micronauts), these students use tools developed by Dr. Ankur Dalia (assistant professor, biology) and others to alter the genome of the world's fastest growing bacterium (*Vibrio natriegens*).

Starting from scratch, the students enter Manzella's "Lab Boot Camp" and within weeks are up to speed and set free in the newly-renovated ASURE Genome Engineering lab. Following boot camp, the Vibnauts complete their one and only "cookie cutter" lab—replicating a published experiment from the Dalia lab. During this time, the students learn some advanced techniques but also have time to devote to their own research proposal. Yup, you heard me—six weeks into their first lab experience and these freshmen have not only combed through primary literature but developed a novel research question, drafted a professional proposal, and had it pass through peer review. From there until the end of the semester (when a poster and manuscript are due), it's "off to the races."

In collaboration with the Dalia, van Kessel, and McKinlay labs in IU Biology, Manzella's Vibnauts have created and analyzed strains of *Vibrio* where copies of the "protein making" apparatus (ribosomes), regulators of stress response (RpoS), and cell-cell communication (quorum sensing) components have been removed. They have even pushed toward engineering a novel co-culture between *Vibrio natriegens* and another bacterium (*Rhodopseudomonas palustris*). Several of these projects have been picked up by the labs for further study. While this is an obvious benefit of working with IU Bloomington faculty, these students aren't the only ones pursuing novel ideas with publishing potential. Two ASURE alumni of Manzella's program are aiming to have their research published. One student attempted to temporarily eliminate a cell-division protein (FtsZ) to induce the industrially relevant phenotype of filamentation while the other was inspired to identify and optimize a growth assay more sensitive than simple growth rates. Throughout the ASURE program the instructors stress that scientific progress is not done in leaps in bounds, but with small steps—and these first-year ASURE students are already taking those steps.

Regardless of the topic, the ASURE research labs are proving that if you give freshmen the support, space, and opportunity—they can deliver. The ASURE program has (as of the 2019-2020 year) expanded from two science labs to six and now gives students opportunities to participate in research in biology, chemistry, biotechnology, and earth and atmospheric sciences.

Michael Manzella is a lecturer with the IU Department of Biology. Learn more about the ASURE program at go.iu.edu/2IzT.

Faculty awards, grants, and honors


Calvi


Kumar

Professors **Brian Calvi and Justin Kumar were named fellows of the American Association for the Advancement of Science**, an honor that recognizes their outstanding contributions to the progress of science and research.


Winkler


Rosvall

Professor **Malcolm Winkler received a Maximizing Investigators' Research Award** (MIRA) to investigate cell wall synthesis in the bacterial "superbug" *Streptococcus pneumoniae* to find new vulnerabilities of bacterial pathogens.

Assistant Professor **Kim Rosvall** is a 2020 recipient of the **Indiana University Outstanding Junior Faculty Award**. The award identifies promising tenure-track faculty and provides resources to further develop their research programs.


Zelhof


Berndtson

Two NSF grants totalling $1.47 million to Andrew Zelhof, associate professor, will support the use of arthropods to advance research on basic biological mechanisms, including vision.

Amy Berndtson, senior lecturer of biology, **was awarded the annual David and Cheryl Morley Career Distinguished Teaching Award** in 2019. The award recognizes a career of distinguished service in the classroom and related pedagogical endeavors.


Newton

A $1.8 million NIH grant is funding Irene Newton's research on how a bacterium stops mosquitoes from spreading disease. Newton investigates how Wolbachia colonizes insects to prevent the spread of diseases such as West Nile virus and Zika.

◀ Newton and colleagues use fruit flies as a model species to investigate the use of Wolbachia to inhibit mosquito-borne diseases. *Photo by Eric Rudd*

Last fall these efforts reached a new level. For years Moczek had been collaborating with Dr. Kirstin Milks, a science teacher at the local Bloomington High School South. Her expertise and lessons learned while piloting the *Human evolution* module in her classroom had helped tremendously in the development and fine tuning of this effort. Then, in 2019, Milks and Moczek were invited to present this module at the annual meeting of the National Association of Biology Teachers conference in Chicago. They made their presentation in a workshop attended by approximately fifty teachers from around the country, receiving overwhelmingly positive feedback and requests to share all this with a broader audience through publication. The corresponding manuscript is now in its initial stages, as are efforts to utilize existing 3D printing files to create classroom-ready, affordable skull replicas for any educator anywhere willing to put them to use.

▲ Moczek presents the "skulls" module during a teachers workshop at WonderLab in 2017. Karen Jepson-Innes watches. *Photo by Terri Greene*

What is next? Moczek, Jepson-Innes, and Milks just submitted a new proposal to expand on the most recent successful modules and to develop and launch a new one on *Biodiversity in the Anthropocene*. It will start where the module on *Human evolution* ends, the ice ages, and expand into the very near future that will shape the living conditions current students will encounter during their own adult lives. In conversations with both teachers and students, the team quickly realized that students are deeply interested in this content, while existing teaching resources fall way short to meet this demand. Moczek, Jepson-Innes, and Milks have given themselves two years to develop and pilot the new module. In the process they also hope to further intensify the involvement of graduate students and postdocs. Members of the Moczek lab have been contributing to these outreach efforts in diverse ways for a long time, often creating their own initiatives in the process. The resulting training experiences in design and implementation of impactful science outreach is something Moczek, Jepson-Innes, and Milks hope to capitalize upon more systematically going forward—for example, through teacher/graduate student partnerships and the further inclusion of graduate students in workshops. In so doing, the team aims to not only bring science to life for K-12 students, but to train and engage the next generation of faculty and other scientists in the best practices of science outreach.

Instructors share teaching award

▲ Manzella (left) and Murphy. *Courtesy photos*

The first annual Morley ASURE (Arts & Sciences Undergraduate Research Experience) Teacher-of-the-Year Award was presented to Michael Manzella and Megan Murphy in 2019. Both are lecturers in the Department of Biology.

Diversity + Inclusion

We are, and will remain, one IU.
—Lauren Robel, IU Provost and Executive Vice President

IU Biology staff members Jeremy Bennett and Tracey Bradley are serving a two-year term on the College of Arts and Sciences Diversity and Inclusion Action and Advisory Committee.

The committee's mission is to assist in broadening efforts that impact diversity, equity, and inclusion; to strengthen lines of communication between College diversity and inclusion administration and faculty, staff, and students; to brainstorm innovative programming and initiatives; and to assist in transforming these ideas into action.

▲ Bradley (left) and Bennett. *Courtesy photos*

Bradley, graduate student recruitment coordinator, participates with the graduate student-centric subcommittee in gathering qualitative and quantitative data from current graduate students with an end goal of having a diversity audit by which attainable and affordable action items can be made. Bennett, HR business partner, is involved with the faculty-centric subcommittee with a goal of creating literature and/or guides for departments on the value of diversity statements as part of the application process and a rubric by which search committees may evaluate such statements.

Visit IU Biology's "Diversity + Inclusion" web page at https://biology.indiana.edu/about/diversity.html.

For those who follow us

A distinguished ornithologist reflects on her life, climate change, and her optimism for the future

from *The College Magazine*, Summer 2019

Ellen Ketterson thinks a lot about change. As an ornithologist and biologist, she's spent her career studying the evolution, ecology, and migratory habits of birds. She's one of the most preeminent scholars in her field, and indeed one of the foremost experts in the entire world when it comes to certain birds in specific, most notably the dark-eyed junco. Change is the only constant in life, and the study of change has been the basis of Ketterson's whole career.

But not all of the changes that Ketterson studies are naturally occurring. If you ask her, Ketterson can tell you in detail about a myriad of ecological and environmental changes that she's witnessed right here in Indiana.

▲ Ellen Ketterson, Distinguished Professor of Biology. *Photo by Sandee Milhouse*

Ketterson should know; she's lived in southern Indiana for more than 50 years. She earned all of three of her degrees from IU—a bachelor's and a master's degree in Plant Sciences, followed by a Ph.D. in Biology—and since 1977 she's been a faculty member in the College of Arts and Science's Department of Biology.

Ketterson also serves as the founding director of the College's Environmental Resilience Institute (ERI), which itself is an outgrowth of the university's Grand Challenges Program. The ERI's mission is to provide the people of Indiana with

casts of fossil hominids. And each module puts students in the driver's seat as they confront scientific evidence, probe its explanatory value, and reconcile conflicting observations. In the process, the **learning** of science, *what we know*, is connected to the **practice** of science, *how come we know this, what are the limitations of our knowledge*—dimensions that normally get lost in the classroom.

Where modules differ is in the increasing diversity of content areas they attack. Insects still play a big role, as in a module on insect life cycles and metamorphosis that fits particularly well with teaching standards for second grade. But other organisms have been added: one particularly successful module on the *Evolutionary ecology of skulls and teeth* utilizes 40+ mostly real skulls of diverse mammals to teach students how to distinguish basic feeding types, before introducing more complex concepts such as convergence (using marsupial skulls) and artificial selection (using diverse dog breeds). Another titled *Reconstructing 6 million years of human evolution using diverse data sets* uses high-end casts of modern human skulls and fossil hominids, alongside hands, feet, artefacts, and climate data to allow students to piece together an increasingly complex and nuanced understanding of their own evolutionary origins. Combined both modules have so far been taught over 400 times.

▲ To observe trail-following behavior in termites during Moczek's *Introducing the scientific method* module, a student releases a termite onto the paper on which she's drawn a circle. *Photo by Terri Greene*

In all of this Moczek and Jepson-Innes try to make it easy for teachers to participate in workshops and adopt modules. Workshop participation is free and often comes with a stipend. Other funds cover expenses for substitute teachers. Moczek and his lab members assist teachers interested in trying out a module through school visits and by modelling module implementation in the classroom. All materials necessary to teach a module are provided for free. For some modules this is easy: Moczek cultivates termite colonies in his backyard for teachers to use. For others, it's harder. Yet with help from funders such as the National Science Foundation and IU's Ostrom Grants Program, Moczek and Jepson-Innes were able to duplicate all materials needed for the *Mammal skulls* and *Human evolution* modules, which now makes them loanable from both Moczek or WonderLab by request. Moczek also trained WonderLab staff in both modules so, if teachers prefer, students can experience the modules during a visit to WonderLab, with WonderLab staff running the show.

▲ Professor Armin Moczek presenting the successful teaching module *Human evolution* at the National Association of Biology Teachers conference in Chicago in November 2019. *Courtesy photo*

Connecting the learning of science to the practice of science—from Bloomington to the national stage

In 2005 Karen Jepson-Innes (now executive director of WonderLab*) and Armin Moczek (professor of biology) got together for the first time to brainstorm about developing a teacher-training workshop. The goal was to develop and present teaching modules that bring to life biology—and to do so in ways that support *Indiana's Academic Standards for Science*. The first workshop was held in 2006; about 20 teachers participated, and all modules focused on insects, a group of organisms for which both Jepson-Innes and Moczek have great affection. And one module in particular, using trail-following behavior in termites, created immediate excitement among teachers because of the eye-catching opportunity it provided to model the scientific method. Fifteen years later the termite module is now widely used in local and regional schools, averaging approximately 50 classes every year.

This brings us to the present. Twenty workshops and over 400 participants later, Moczek has developed a dozen modules and expanded into content areas well beyond insects. What all modules share is utilizing eye-catching or otherwise captivating materials, from live insects to real mammal skulls to

*WonderLab Museum of Science, Health, and Technology is an award-winning and very popular science museum in Bloomington, Indiana. WonderLab provides opportunities to experience the wonder and excitement of science through interactive exhibits and programs that stimulate curiosity, encourage exploration, connect to the arts and everyday life, and foster lifelong learning.

predictions about the nature of environmental change, how it will affect our state, and how communities can address those coming changes with anticipatory solutions.

In a world of rising sea levels and shrinking resources, the ERI's work is crucially important. Its work that affects lives not only in the here and now, but in the future, as well. Change may be the only constant in life, but not every change is inevitable. Just ask Ellen Ketterson.

▲ Ketterson holds a Gray Catbird (*Dumetella carolinensis*). *This image and the heading image of the two photographs were captured from the video that accompanied the article in* The College Magazine.

View the video at https://youtu.be/nXmzri1p5Uk

IU and coronavirus COVID-19

On March 10, 2020, IU President Michael A. McRobbie announced: "Indiana University has been actively monitoring the rapidly evolving novel coronavirus (COVID-19) situation and providing regular updates to the IU community as the situation changes. The health and safety of our IU community is our primary concern in this fluid situation, and we are taking decisions as warranted following guidance from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO), along with state and county health departments. These decisions are being taken to help mitigate and slow the spread of COVID-19 and to help protect the IU community."

Visit IU's "Coronavirus COVID-19: Working to protect the IU community" website for the latest information: https://coronavirus.iu.edu.

Agave americana "swan song"

▲ Although the typical age is 30 years, our *Agave americana* shown in this 2016 photo was over 50 years old when it produced its flower stalk in 2019. *Photo by Terri Greene*

Our large century plant (*Agave americana*) in the Jordan Hall greenhouse has bloomed and died. A species that blooms once and then dies is referred to as monocarpic. Our plant was estimated to have been over 50 years old and had been the focal point in the cactus/succulent room for many years. Although it's nicknamed the century plant, the longevity of *A. americana* is typically 30 years as opposed to 100 years as the name suggests.

In March 2019 the plant began sending up its impressive flower stalk—which looked like a giant spear of asparagus. *A. americana* is a member of the Asparagaceae family.

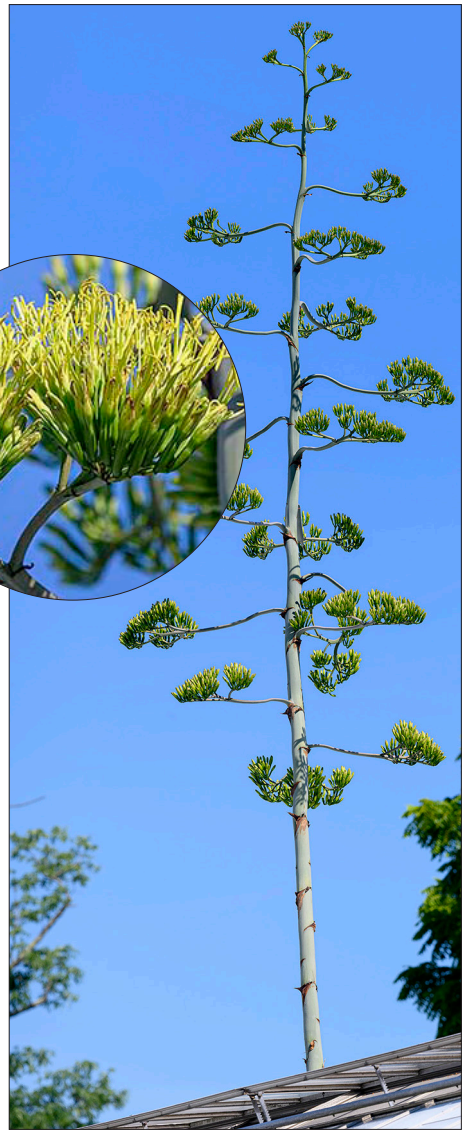
The stalk grew to a height of at least 30 feet (which required removing a section of glass to let the stalk pass through the roof), producing horizontal branching near its top. Greenish-yellow flowers 3 to 4 inches in length bloomed in panicles (loosely branched clusters of flowers) at the branch ends. After pollination occurs in the wild, the plant begins to produce seeds and forms plant shoots at its base. After flowering, the main plant will die, leaving the plants that formed around its base to replace it until they mature and the process repeats itself.

▲ The flower stalk of our *Agave americana* extends up through the greenhouse roof in this photo taken on June 6, 2019. Memorial Hall is in the background. *Photo by James Brosher*

Our plant's flower stalk was discovered bent over onto the greenhouse roof on July 22, 2019—most likely due to the previous night's storm and the stalk weakening as the plant died. Greenhouse staff left the stalk on the roof to see whether some of the flowers would set seed.

The stalk and plant were removed on November 11, 2019. Greenhouse staff replaced the old plant with one of its shoots that had been divided from the parent plant and placed in a separate pot more than 16 years ago.

Some of the seeds were planted. *A. americana* is a chiropterophilous plant. Chiropterophilous means "bat loving" (derived from Chiroptera, the name of the scientific order to which bats belong). In its native habitat of Mexico and the southwestern U.S., the *A. americana*'s blooms are mainly pollinated by bats. Because only insectivorous bats live in Indiana, we were unsure whether the seeds would be fertile. Several of the seeds, however, sprouted; it appeared that insects seen around the blooms were able to pollinate them.



▲ The flowers had begun to open by June 26, 2019. *Photo by Roger Hangarter*

A. americana seedling, November 25, 2019. ▼
Photo by Terri Greene