

DEPARTMENT OF BIOLOGY

INDIANA UNIVERSITY
College of Arts and Sciences
Bloomington

1001 East Third Street
Bloomington, IN 47405
<https://biology.indiana.edu>

 Printed on recycled paper

Nonprofit Org.
Postage
PAID
Indiana University



Save trees! Have *BioNews* sent to your inbox rather than your mailbox.
Submit your email address through our form at <http://go.iu.edu/bioshare>.

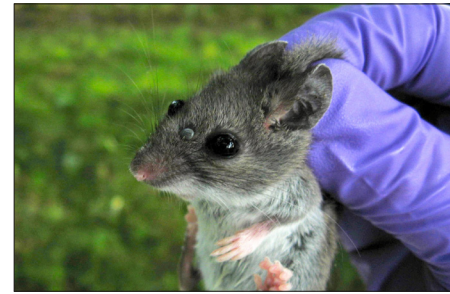
INDIANA UNIVERSITY College of Arts + Sciences

BioNews

Keeping you updated on
what's happening in the
Department of Biology
Fall 2018



Ankur Dalia (left) and Courtney Ellison point to *The New York Times* article (June 19, 2018) about their research that made worldwide headlines. *Photo by Yves Brun, IU Biology* 2



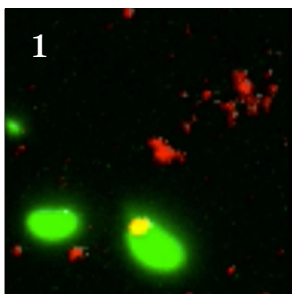
A tick is embedded between the mouse's eyes. A new environmental monitoring project has found tick numbers increasing in southern Indiana. *Photo courtesy of Clay lab, IU Biology* 7



IU Biology is no longer requiring the Graduate Record Examination (GRE) as part of the application process to its M.S. and Ph.D. programs. *Photo by Terri Greene, IU Biology* 9

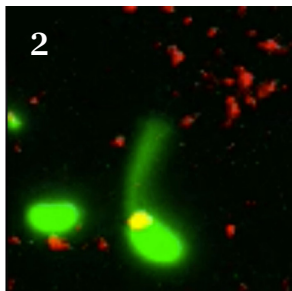
- 2 **IU biologists first to see bacteria reel in DNA**
Expertly delivered fluorescence dyes allow them to observe DNA uptake under the microscope
- 3 **Nematode hitchhikers found to be beneficial**
Beetle's genital worms benefit the beetle and its young
- 4 **Student profile**
Ph.D. student Courtney Ellison shines a light into the secrets of bacteria
- 6 **Student news in brief**
Summer visitors, AFRISNET online, graduation numbers
- 7 **Tick numbers rising in southern Indiana**
- 9 **GRE no longer required**
GRE no longer required as part of the application process to IU Biology M.S. and Ph.D. programs
- 10 **Alum profiles**
IU Biology salutes Norm Pace, Paul Hardin, and C. David Allis
- 13 **In memoriam**
IU Biology remembers Don Whitehead and Kathy Matthews
- 14 **World-class fruit fly genetics center**

IU Biology researchers first to witness bacteria's DNA uptake process



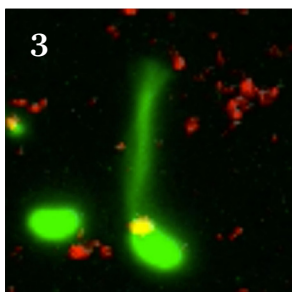
"You need to follow me right now!" Courtney Ellison blurted out as she dashed into Ankur Dalia's lab. Ellison had become the first person to witness a bacterium hooking and then reeling in DNA with its pilus—an extremely thin, hair-like appendage.

Bacterial cells can shape their own evolution through natural transformation by capturing free DNA and incorporating its genetic information. This mechanism for DNA uptake—or horizontal gene transfer—is a way that antibiotic resistance moves between bacterial species.



"It's important to understand this process, since the more we understand about how bacteria share DNA, the better our chances are of thwarting it," said Dalia, assistant professor of biology.

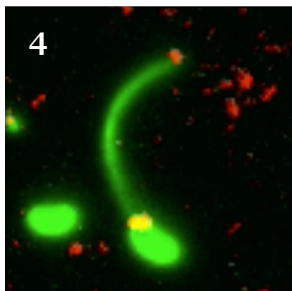
Because the structures involved are so incredibly small (over 10,000 times thinner than human hair), the process had never been observed—until recently.



Distinguished Professor Yves Brun and Ellison, a Ph.D. student in his lab, led the team who developed the method to "paint" the pili and DNA fragments with special glowing dyes. This allowed Ellison and Dalia to subsequently lead a team to observe DNA uptake under the microscope.

"These are really versatile appendages," Dalia said. "This method invented at IU is really opening up our basic understanding about a whole range of bacterial functions."

The bacterium used in the study was *Vibrio cholerae*, the microbe that causes cholera. The work was reported in *Nature Microbiology*.



Top to bottom: The series of four still images above shows a pilus reach out from a bacterium (in green) to grab a piece of DNA (in red) in the environment. This is the first step of natural transformation. Photos by Ankur Dalia, IU Biology

Watch the video at https://www.youtube.com/watch?time_continue=1&v=tFv1A0mwhTc

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.

Editor: Terri Greene

Editorial correspondence

Email: bionews@indiana.edu
Letters: 1001 East Third Street,
Bloomington, IN 47405-7005 USA

Department of Biology

<https://biology.indiana.edu>
Chair: Greg Demas
Associate Chair for Research and Facilities:
Scott Michaels
Associate Chair for Teaching: G. Troy Smith
Development Officer: Kathy Wyss

College of Arts and Sciences

<https://college.indiana.edu>
Executive Dean: Larry D. Singell
Director of Communications and
Marketing: Joanna Davis
Executive Director of Advancement:
Travis Paulin
Director of Alumni Relations: Vanessa Cloe

Follow IU Biology on:



<https://twitter.com/IUBiology>



<https://www.facebook.com/iubbiodept/>

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>.

Give back to IU Biology

Help us build an even stronger department. Support the Biology Enrichment Fund (our general fund) or give to a specific scholarship, fellowship, lecture series, or memorial fund.

To learn how, contact Kathy Wyss at kwyss@indiana.edu or at 812-855-6195 . . . or visit <https://biology.indiana.edu/alumni-giving>.

World-class fruit fly genetic center's grant renewed

Drosophila Genomics Resource Center was recently awarded a five-year, \$2.7 million grant by the National Institutes of Health as a continuation of the grant that established the center in 2003. The DGRC is one of three world-class, federally funded facilities on the IU Bloomington campus that support the use of fruit flies in research.

Fruit flies (*Drosophila*) and humans are genetically similar, sharing nearly 10,000 genes, thus making *Drosophila* a model organism for biomedical research. Much of what is known about the function of genes has been learned through *Drosophila* research.

The DGRC acquires, archives, curates, and distributes essential genetic tools to researchers. It also supports the development of improved techniques for *Drosophila* research and works to generate new resources to benefit fly researchers.



"We service not only the domestic research community but also the international research community," said Associate Professor Andrew Zelhof. "People across the whole spectrum of biology are using our resources, and this award will help us continue to do this for another five years."

 Andy Zelhof. Photo by Terri Greene, IU Biology

Zelhof became director of the DGRC in 2016.

"IU has been very supportive of *Drosophila* research for a really long time," he said. "As home to three centers, IU Bloomington is commonly referred to as the *Drosophila* capital of the world by biologists."

The other two centers are Bloomington Drosophila Stock Center and FlyBase. BDSC maintains a living stock collection with over 63,000 (the number continues to grow) genetically defined strains of *D. melanogaster*. The strains are shipped to researchers around the globe. FlyBase maintains the world's most comprehensive database of fruit fly DNA sequence information.

Zelhof noted that having all three centers on campus is helpful towards IU's undergraduate education mission. Around eight labs in IU Biology rely on tools and resources from all three centers. Opportunities for undergraduate students to participate in *Drosophila* research are possible because of the centers.

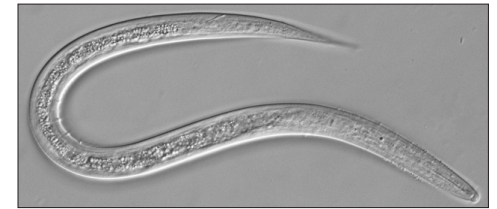
Beetle's genital worms found to benefit the beetle and its young

Cris Ledón-Rettig, an assistant research scientist in the IU Department of Biology, found that dung beetles (*Onthophagus taurus*) carry tiny worms—specifically, one particular species of nematode (*Diplogastrellus monhysteroides*)—in their genitalia.



Taurus scarab (dung beetle). Photo by Eduardo Zattara

Nematodes' associations with insects often have negative impacts on the insects. Assistant Professor Erik Ragsdale, who studies nematodes, suggested that the worms could also be harmless hitchhikers.



Diplogastrellus nematode. Photo by Erik Ragsdale



"I asked him if they could be beneficial," Ledón-Rettig says. "He said that it was certainly a possibility given how common insect-associated nematodes were. There just wasn't functional evidence for it."

 Cris Ledón-Rettig. Courtesy photo

So Ledón-Rettig found some evidence. Through her research, she discovered that when the nematodes (which are transgenerationally inherited and sexually transmitted by the dung beetles) are around, beetle larvae grow faster and eventually transform into bigger adults. The nematodes alter the bacterial and fungal communities in ways that benefit their beetle hosts.

Ledón-Rettig's work illustrates that nongenetic inheritance can include intermediately sized organisms that live and proliferate in close association with, and in certain cases enhance, the development of their hosts' offspring. Learning how the nematodes engineer the microbiome may provide insight into ways to influence human health.

.....
Listen as Cris Ledón-Rettig discusses her research on NPR's *Science Friday* at <https://www.sciencefriday.com/segments/some-dung-beetles-carry-parasites-on-their-genitals-and-its-not-a-bad-thing/>.

IU Ph.D. student shines a light into the secrets of bacteria

by Kevin Fryling

If there's anything Courtney Ellison has learned from studying microorganisms since the moment she first set foot on a college campus, it's this: Bacteria are not the enemy.

When the Indiana University Ph.D. student told friends and family five years ago that she was headed to IU to study bacteria after graduating from the University of Georgia, where she had joined a microbiology lab in her freshman year, she was surprised by the reaction from a relative who asked, "Aren't all bacteria bad?"

It's a misperception that persists despite the rise in headlines about the microbiome and probiotics in the supermarket aisle.

"It's getting a lot better, but people still don't think about how 99 percent of bacteria don't cause any disease," said Ellison, a member of the lab of Yves Brun, an IU distinguished professor who studies basic cellular functions in bacteria. "I like to try and help people, especially kids, understand that bacteria are actually really cool."

Of course, her family member's concern might not have been eased by the subject of her most recent scientific triumph: *Vibrio cholerae*, the microbe that causes the intestinal disease cholera. But Ellison wasn't interested in the disease the bacterium causes but rather the "limbs"—called pili—that it uses to interact with the world.

Ellison recently made worldwide headlines after her work with *Vibrio* resulted in her becoming the first person ever to witness a bacterium gobbling up DNA in real time using their surprisingly long and mobile pili to fish for genetic material. The discovery was accomplished by using "genetic tricks" to alter pili so they could be coated with fluorescent dyes that allowed them to show up under a microscope. [Read story on page 2.]

Stories about the "bacterial harpoon" appeared in *The New York Times*, *Scientific American*, and *BBC Radio*, which interviewed Ellison and her co-author from the WFIU studio on



IU Ph.D. student Courtney Ellison examines a sample in the lab. Photo by James Brosher, IU Communications

<https://biology.indiana.edu>

In memoriam

We lost two valued and cherished members of the faculty this year. We miss them.

Kathleen A. Matthews

Mar. 8, 1954–Mar. 17, 2018

Kathy Matthews was an accomplished geneticist and began her career at IU as a postdoc in Thom Kaufman's lab. It was at that time that Cal Tech sought a new home for its drosophila stock center. Kaufman proposed that the stock be moved to IU and that Matthews be the collection manager. Matthews directed and grew the Bloomington Drosophila Stock Center since 1986 and cofounded FlyBase, a catalog of *Drosophila* genetics, in 1992; both are critical repositories for fruit fly research.

"... it is fair to say that Kathy is as responsible for the success of the worldwide *Drosophila* research community as any other single person," said Greg Demas, professor and chair.

Donald R. Whitehead

Sep. 14, 1932–Feb. 6, 2018

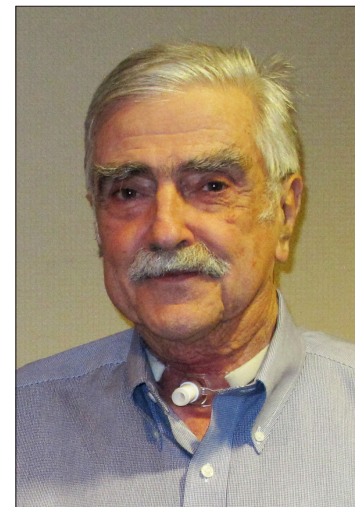
Don Whitehead joined IU in 1967 as a faculty member of the then Department of Botany, serving until his retirement from the current Department of Biology in 1997. His research interests throughout his career ranged from biogeography and paleoclimatology to the effects of forest fragmentation and management on migratory songbird populations.

Whitehead was an avid environmentalist; his passion was birds. His involvement with conservation groups, knowledge, and dedication to area birding events earned him a position of deep respect among the birding and conservation communities. The local Sycamore Land Trust named one of its preserve trails in Whitehead's honor. Whitehead's fantastic cooking skills were well known among family and friends who eagerly anticipated canned gifts of fabulous sauces he produced from vegetables grown in his extensive backyard garden. Whitehead was also an enthusiastic sports fan.

<https://biology.indiana.edu>



Kathy Matthews, Senior Scientist. Courtesy photo



Don Whitehead, Professor Emeritus. Photo courtesy of Susan Hengeveld

Paul Hardin received the 2018 Distinguished Alumni Award and presented the inaugural Distinguished Alumni Lecture on October 18.

About Paul Hardin

Paul Hardin is a distinguished professor within the Department of Biology at Texas A&M University.

For his graduate work, Hardin studied the development of the sea urchin embryo in the laboratory of William Klein and received his Ph.D. from Indiana University in 1987. He went on to do his postdoctoral fellowship with Michael Rosbash at Brandeis University where he worked on the circadian rhythms of the fruit fly, *Drosophila melanogaster*. Hardin's work with Michael Rosbash and Jeff Hall has been instrumental to our understanding of how circadian rhythms affect a myriad of animal behaviors, and his contributions to fly chronobiology was important to the awarding of the 2017 Nobel Prize in Physiology or Medicine to Professors Rosbash and Hall.



Paul Hardin. Courtesy photo

C. David Allis wins 2018 Lasker Award



C. David Allis is the Joy and Jack Fishman Professor and head of the Laboratory of Chromatin Biology and Epigenetics at The Rockefeller University. Photo by Zach Veilleux, The Rockefeller University

IU Biology alumnus C. David Allis received the Albert Lasker Basic Medical Research Award in recognition of his pioneering research in epigenetics, specifically on how histone proteins are modified and how this affects gene expression. The Lasker award is one of the highest honors in science.

Working in the laboratory of Anthony P. Mahowald, Allis earned his Ph.D. from IU Biology in 1978. "It was a terrific lab environment. The people were great, and for where I was at that stage of my career, the science was exactly what I wanted to do," Allis said in his 2006 National Academy of Sciences profile. IU awarded Allis an honorary Doctor of Science degree in 2015.

the IU Bloomington campus. Her co-author on the work was Ankur Dalia, an IU assistant professor of biology.

Ellison said the best part of the coverage was the chance to share the news with her grandfather, a retired professor of biochemistry at Virginia Tech and graduate research professor of microbiology and cell science at the University of Florida, who inspired her decision to pursue a career in science.

"He just instilled a sense of 'why' in me from a young age—a desire to know why things are the way they are," she said. All of her siblings and cousins also work in science- or health-related fields—but not her parents. "It skipped a generation," she said with a laugh.

The media reports also prompted calls to Brun and Dalia's labs from others in the U.S. and Europe who wanted to know how the team accomplished its discovery.

"There have actually been several labs that tried to label pili in other (bacteria), but no one could get it to work," Ellison said. "I think it was really a mixture of luck and persistence that I was able to do it. A lot of people couldn't get it to work after a few mutations and chalked it up to it being impossible. But now we know that's not true."

The work also benefited from Ellison's earlier research on pili. Last year, she was the first author on a paper in the journal *Science* that used the same genetic manipulation technique that binds fluorescent dyes to pili to understand how the

microscopic "limbs" play a role in surface sensing. The work illustrated for the first time how bacteria detect their contact with a surface and decide to attach to it permanently.

That research was conducted in *Caulobacter crescentus*—a bacterium that counts itself among the 99 percent that aren't harmful to humans. In fact, Ellison said she was attracted to IU by Brun's breakthrough work in other nonpathogenic organisms. A former postdoctoral researcher from his lab had visited the University of Georgia to talk about Brun's work using special dyes to label a molecule that forms cell walls called peptidoglycan.

Not that she minds working with *Vibrio* too, especially since it's so perfect for studying pili. Plus she said it's actually "really hard" to get sick from the cholera bacteria—unless you're crazy enough to drink it.

"It's important to be careful but, honestly, because I know that most bacteria are harmless—as well as scientific speculation that hyper-cleanliness may contribute to the rise we're seeing in some immune disorders, like allergies—I've probably become more unhygienic since I started this work," she said with a laugh. "I'm definitely not a germophobe."

.....
Kevin Fryling—news and media specialist for science at IU Communications—connects people to information about IU's latest discoveries in biology and other sciences. Among his many skills and responsibilities is translating science-speak to AP style.

Student news

Visitors from Nigeria and Puerto Rico participate in summer research

IU Biology's Kumar and Lacefield labs hosted two students from Nigeria for a month this summer as part of IU's program to provide African students opportunity to conduct research in order to improve their competitiveness for graduate school. Several African IU graduate students proposed the program, including IU Biology's Maureen Onyезiri and Gabriel Muhire Gihana.

The Demas lab hosted one of the undergrads from Puerto Rico participating in IU's Research Experience for Undergraduates program in animal behavior. Associate Professor Laura Hurley directs the program. The students were grateful for the opportunity and to learn Hoosiers were concerned about P.R.'s hurricane victims.



Organizers and participants in IU's inaugural summer research program for African students: front row from left, Ishola Peter Gbenga, Gabriel Muhire Gihana, Ahmed Oloruntoba, Soni Lacefield, Greg Demas, Maureen Onyезiri, and Nelson Chepkwony. Back row from left are Joey Wooley, Moustafah Saleh, and David Daleke. *Courtesy photo*



Gabriel Muhire Gihana, Ph.D. student in the Lacefield lab, is one of the founders of AFRISNET. *Photo by Chris Meyer, IU Communications*

AFRISNET is online

AFRISNET, or African STEM Network, is an international network of students, faculty, and professionals in STEM fields with the goal of exposing African students to modern research. Its website is one of the network's main tools.

Currently, three faculty members (Soni Lacefield and Armin Moczek at IU and Kwadwo Akuffo at Kwameh Nkurumah University of Science and Technology, Ghana) serve as advisers for AFRISNET. A team of IU graduate students and postdocs helps inform and teach African students about research.

"Many extremely talented people do not have access to careers in science, largely because of lack of communication, logistical challenges, and infrastructure limitation," said Professor Armin Moczek. "When I learned about AFRISNET, it struck me as an excellent opportunity to increase the accessibility of STEM careers for highly talented and motivated African students."

Visit AFRISNET at afrisnet.org.

enabled scientists to study, for the first time, the 99 percent of microbes that could not be grown in the laboratory and were thus considered inaccessible for study. This work "blew the door off the microbial world," ushering in the modern age of microbial ecology, including metagenomics and microbiome research. Without it, our understanding of the human microbiome would be years behind where it stands now.

Pace is also celebrated for his revolutionary co-discovery that RNA, like protein, can act in catalysis and thus serve as an enzyme.

Pace received his Ph.D. from the University of Illinois in 1967. He was an assistant, associate, and professor of biophysics and genetics at the University of Colorado Medical Center, Denver (1969-84); professor and distinguished professor of biology and chemistry at Indiana University (1984-96); professor of plant and microbial biology, University of California at Berkeley (1996-99); and professor and distinguished professor of molecular, cellular, and developmental biology at the University of Colorado, Boulder (1999-present).

Indiana University presented an honorary Doctor of Science degree to Pace during the May 4, 2018, IU graduate commencement ceremony.

Distinguished Alumni Award Lecture

This annual award and lecture series was established to honor former undergraduate and graduate students of the Department of Biology who have gone on to make exceptional contributions to fields within the broad umbrella of the biological sciences.

Pace is an elected member of the National Academy of Sciences and the American Academy of Arts and Sciences. He received the Waksman Award for Excellence in Microbiology, a MacArthur "Genius" award, and the 2017 Massry Prize in recognition of his outstanding contributions to the biomedical sciences and the advancement of health. He has received lifetime achievement awards from the American Society for Microbiology, the International Society for Microbial Ecology, and the RNA Society. He has been a key consultant of the National Research Council's Space Studies Board on a variety of issues since the 1980s.

A superb and inspiring teacher, both in the classroom and research laboratory, many of his numerous postdoctoral, graduate, and undergraduate trainees are leaders in academia and industry.

In keeping with his Hoosier heritage, Pace is also a renowned spelunker: He has explored more than 100 caves and was the 1987 recipient of the Lew Bicking Award, the highest honor that American cave explorers can achieve.

Alumni Profiles

We bring to your attention three esteemed alumni of IU Biology: Norman R. Pace [B.A. '64], C. David Allis [Ph.D. '78], and Paul Hardin [Ph.D. '87].

We also call to your attention IU Biology's two newest lecture series: the Norman R. Pace Lecture and the Distinguished Alumni Award Lecture. Inaugural presentations for each of the lecture series were made this year.

Norman R. Pace Lecture

The Pace lecture series honors IU alumnus and former Distinguished Professor of Biology Norman R. Pace, one of the world's most influential biologists. Pace is known for his groundbreaking research in biochemistry and in microbial ecology and evolution. He has been a pioneer and leader in two very different fields: he co-discovered catalytic RNAs, and he was a pioneer in developing the methods and philosophy of sequence-based studies of microbes in their natural environments, ushering in the age of metagenomics and microbiome research.

Pace himself presented the inaugural Norman R. Pace Lecture on May 7.

About Norm Pace

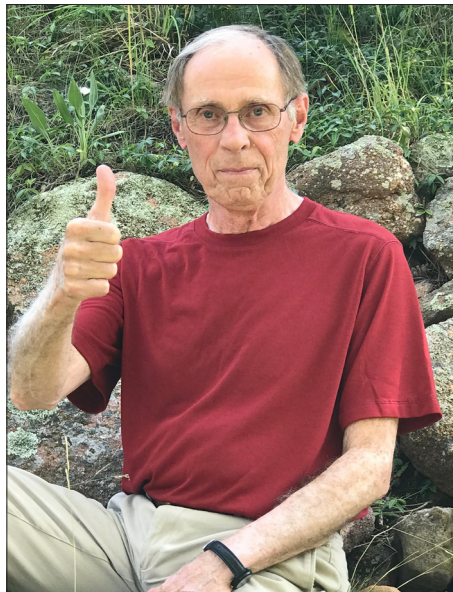
Norm Pace was born and raised in a small farming community in Indiana. While in high school, he spent a summer doing research in an Indiana University microbiology lab.

Pace confessed:

“Once I was exposed to the culture of being a lab rat, I was hooked!”

Pace graduated from Indiana University in 1964 with a B.A. (with honors) in bacteriology, which could be referred to as the precursor to IU Biology's microbiology degree.

From 1984 to 1996, Pace was professor and distinguished professor of biology at Indiana University, during which time he revolutionized microbial ecology



Norman R. Pace. Photo by Bernadette Pace

in ways that allowed the “unseen 99 percent” to be revealed. His ribosomal RNA gene sequencing



IU Biology graduates by the numbers

246

undergraduate degrees
May & Aug. 2018

38

graduate degrees
2017-18

Undergraduate degrees/majors:

- 8 graduated with B.A. with double majors
- 38 graduated with dual degrees (either two B.S. degrees or a B.S. degree and a B.A. degree)
- 1 graduated with triple majors

Graduate degrees:

- 14 Ph.D.'s in Evolution, Ecology, and Behavior
- 6 Ph.D.'s in Genome, Cell, and Developmental Biology
- 8 Ph.D.'s in Microbiology
- 9 M.S. degrees in Biotechnology
- 1 M.S. degree in Genome, Cell, and Developmental Biology

IU's new environmental monitoring project finds tick numbers on the rise

The IU Environmental Resilience Institute has launched Project Vector Shield to understand and guard against disease-carrying organisms in Indiana.

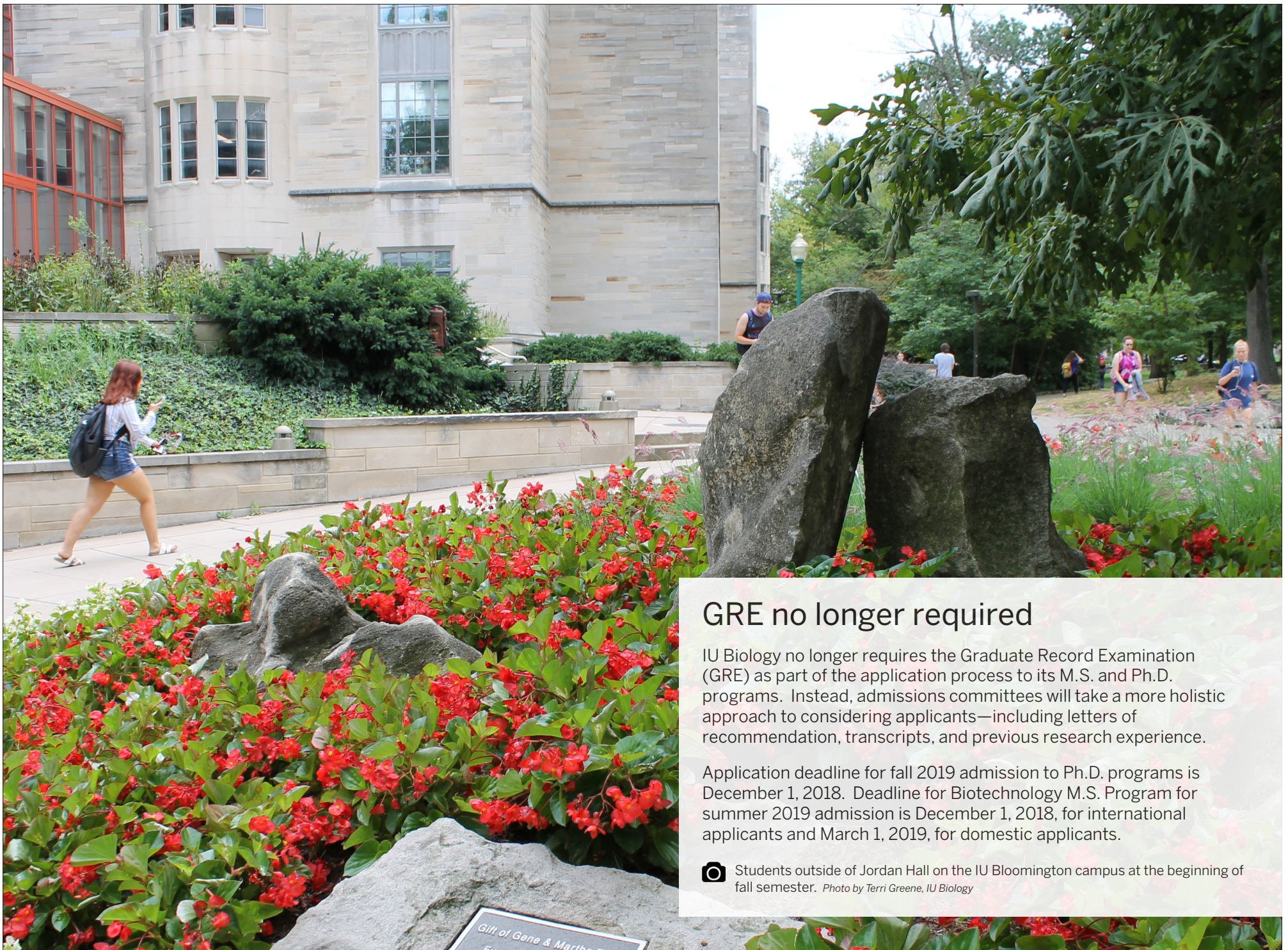
“Changes in climate, temperature, and weather conditions, as well as human activities such as international travel, all contribute to the movement of disease vectors into a new region,” said Distinguished Professor Emeritus of Biology Keith Clay, a leader on Project Vector Shield. “But the only way to quickly detect new species or diseases entering an area is regular, long-term data collection.”

Ticks and mosquitoes will be collected five to six times per year from spring through fall for four years. The effort will focus on southern Indiana since most new diseases enter the state from the south due to rising global temperatures. The vectors will be analyzed to see whether they carry disease.

The project has found increased numbers of deer ticks, which are known to carry Lyme disease, in southern Indiana. The ticks collected are not yet confirmed to carry the disease; however, IU researchers said the presence of a known disease vector—like a deer tick—is commonly followed by a rise in the illness caused by the bacteria it carries.



Deer ticks, also known as blacklegged ticks, are a common carrier for the bacteria that cause Lyme disease. Photo courtesy of USDA ARS



GRE no longer required

IU Biology no longer requires the Graduate Record Examination (GRE) as part of the application process to its M.S. and Ph.D. programs. Instead, admissions committees will take a more holistic approach to considering applicants—including letters of recommendation, transcripts, and previous research experience.

Application deadline for fall 2019 admission to Ph.D. programs is December 1, 2018. Deadline for Biotechnology M.S. Program for summer 2019 admission is December 1, 2018, for international applicants and March 1, 2019, for domestic applicants.



Students outside of Jordan Hall on the IU Bloomington campus at the beginning of fall semester. Photo by Terri Greene, IU Biology