



DEPARTMENT OF BIOLOGY

COLLEGE OF ARTS + SCIENCES
Bloomington

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The IU Bloomington campus was abuzz earlier this summer with the emergence of Brood X 17-year periodical cicadas.

Photo by Terri Greene



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BioNews

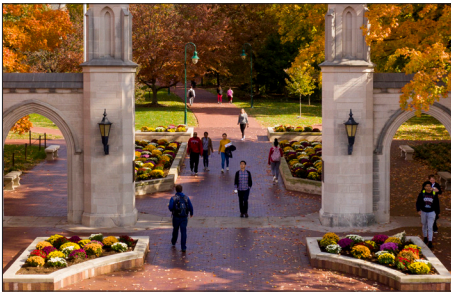
Keeping you updated on what's happening in the Department of Biology

Summer 2021



O'Neill Graduate Center on a summer evening on the IU Bloomington campus. Nighttime lighting in buildings poses a threat to birds.

Photo by James Brosher 4



Department of Biology faculty and staff are eager to welcome back students to in-person classes and activities this fall.

Photo by Indiana University 5



Newton lab finds addition of *Bombella apis* to hives could protect honey bees from fungal pathogens.

Photo from Adobe Stock 8

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Taking up the baton:

Michaels is new department chair



▲ Scott Michaels. *Photo by Sandee Milhouse*

Professor Scott Michaels assumed the role of IU Department of Biology chair on July 1, 2021, as Professor Greg Demas stepped down from his four-year term as head of the department.

Both Demas and Michaels share a commitment to maintaining a scientifically and culturally diverse department. Demas considers it one of his biggest accomplishments during his term. Michaels lists it as one of his priorities.

"I'm grateful to Greg for leaving Biology in such great shape and will continue his efforts to build a diverse and welcoming department," said Michaels. "I plan to take advantage of opportunities to maintain, and hopefully improve, our already stellar research, teaching, and outreach activities. Recruiting talented and diverse faculty, postdocs,

scientists, graduate students, and staff—along with improvements to infrastructure—are critical to Biology's success.

Michaels is quick to praise his predecessor.

"Greg has been a wonderful chair," said Michaels. "I've admired his calm demeanor and ability to keep his sense of humor under pressure—both of which were put to the test during the myriad of challenges that accompanied the pandemic."

The last nearly year and a half of his term found Demas navigating the challenging, stressful, and sometimes chaotic issues brought on by the COVID-19 pandemic. Demas was also quick to praise Michaels' leadership during the unprecedented time.

"We all spent countless hours dealing with pandemic-related issues and figuring out ways to manage them—or at least hold it together," Demas noted. "As the associate chair for research and facilities at the time, Scott did a truly outstanding job, including the handling of complicated space issues, with the utmost competence and professionalism. I have no doubt that he will bring a steady hand to the chair's seat."

Demas looks forward to his return to "civilian life." He plans to spend more time in his lab interacting with the students, sending (and receiving!) fewer emails, and refurbishing his endocrinology class which he will once again teach this year. As he

hopes for a more normal and less stressful academic year in 2021-22, he's confident things will be fine.

"Scott brings to the position a wealth of new ideas and thoughtful intellect," Demas said. "The department is in good hands under Scott's guidance."

Professor Leonie Moyle replaces Michaels as associate chair for research and facilities. Associate Professor Troy Smith continues as the associate chair for teaching.

About Michaels

Scott Michaels earned his Ph.D. from the University of Wisconsin-Madison where he also completed a postdoc.

He joined the Department of Biology at IU Bloomington as an assistant professor in 2003.

Now a professor of biology, Michaels has served as the department's associate chair for research and facilities (2017-2021) and as the director of the IU Center for Genomics and Bioinformatics (2013-2017).

He maintains a research laboratory, studying gene regulation. In particular, Michaels and his lab focus on two interrelated mechanisms: 1) the role that histone modifications play in controlling gene expression and 2) the role that negative transcription elongation factors play in repressing gene expression and preventing transcriptional interference between neighboring genes.

Being a member of the IU Biology faculty may have been destined by fate for Michaels. Michaels is a first-generation college student from a tiny coal-mining town (population of about 200) in western Pennsylvania. He completed his undergraduate degree in chemistry at the Indiana University of Pennsylvania. IUP is not connected with the Indiana University campuses in the state of Indiana, but instead derives its name from the town in which it is located: Indiana, PA. If not fate, maybe becoming an IU Bloomington faculty member was at least a subliminal suggestion.

In his spare time (when he can find some), Michaels has become serious about woodworking, particularly arts-and-crafts-style furniture.



▲ Michaels created this lovely sofa table from two massive Utile boards. Utile, also known as Sipo, is an African tree. Its wood is sold as an alternative to Mahogany. *Photo courtesy of Scott Michaels*

Making IU Bloomington safer for birds

"I took a brief walk out from the lab during an enzyme incubation and checked out the small wetland north of the music building on the IU campus," reported Steve Bell, professor of biology and expert birder, on a local birding Facebook page. "It was absolutely crawling with birds, Swainson's and Grey-cheeked Thrush and 10 warbler species including Wilson's and Mourning. Amazing to have this sort of habitat a 4-minute walk from my workplace."

According to ebird.org, an online database of bird observations managed by The Cornell Lab of Ornithology, 136 species of birds have been documented on the IU Bloomington campus since 2009.

Although the campus provides good habitat for birds, many dangers are also present—including bird-building collisions. Crashing into windows is a primary cause of bird mortality. It is estimated that window strikes kill as many as 1 billion birds per year in the U.S. and Canada. These deaths are



▲ Nighttime lighting as seen in this photo of the Global and International Studies Bldg. on the IUB campus can attract birds, leading to potentially fatal window strikes. *Photo by Indiana University*

nondiscriminatory; window strikes kill otherwise healthy birds. Nighttime lighting in buildings poses an additional threat. Artificial light at night can disorient birds, especially during migration. It can also attract them, leading to avian window strikes with often fatal results.



▲ Sarah Wanamaker. *Courtesy photo*

Sarah Wanamaker, research associate with IU's Environmental Resilience Institute and lab manager for Distinguished Professor of Biology Ellen Ketterson, is measuring the impact of campus buildings on bird populations.

Last fall and this spring, Wanamaker and her crew of volunteers monitored the area

See **BIRDS** | page 6

Class is back in session! Biology's return to in-person instruction

by Jeremy Bennett

A primary goal of Indiana University's Restart Committee and response to the pandemic was to make it safer to be part of the IU community than not. We are pleased that actions taken—including extensive mitigation testing, general virus and vaccination education through university communications and weekly "Keeping IU Healthy: Ask Aaron" webinars, paid COVID-related leaves available to all employees, and large percentages of IU constituents receiving the vaccination—have made a robust return to campus a possibility.

Because IU Bloomington remains a primarily residential campus, the Department of Biology is eager to increase the number of in-person courses and resume standard administrative operations for fall 2021. Despite overcoming the many obstacles and challenges from COVID-19—though in some cases innovative and exciting contributions were achieved—nothing compares to being able to instruct, mentor, and support our undergraduate and graduate students through face-to-face interactions in class, lab, and beyond. Further, having the physical presence of our staff, many of whom have been working remotely for the past 16 months, will be a welcomed change. Along with students, their presence will certainly help counteract the stillness of



▲ IU Bloomington projects a record-breaking class of incoming students in the fall. *Photo by James Brosher*

our hallways. We look forward to again being able to make personal connections and have impromptu conversations with students in person as these interactions are so crucial to their collegiate experience and potentially impact their futures.

We would be remiss not to acknowledge that the pandemic is ongoing and that risks still exist. The department supports those who choose to wear a mask for personal convictions and will monitor and follow other university guidance on prevention measures and protocols. Surveillance testing will also begin this fall, and if and when new developments arise, Biology will be prepared to respond to the challenges with resilience and the leadership that continually guides us through this unfathomable journey.

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Jeremy Bennett is a member of the *BioNews* committee and HR business partner for the Department of Biology.

BIRDS (continued from page 4)

around seven IU Bloomington campus buildings. During fall 2020 they found 56 carcasses; in spring 2021, they found 32 carcasses.

Most bird populations are in decline. With the data she's collecting, Wanamaker intends to do something about it.

"Ultimately, the data from our studies will be used to raise awareness on the issue of bird-building collisions," explained Wanamaker. "Working with our partners, such as the City of Bloomington, IU building managers, and our local Audubon chapter, our mission is to reduce bird deaths by promoting bird-safe buildings. Reducing nighttime lighting will save energy as well."

Wanamaker has recruited Bryce Himebaugh, IU clinical assistant professor of engineering, to customize sensors to detect and record window strikes and measure light output.

This spring Wanamaker was awarded a small grant from the Brabson Library and Educational Foundation. The additional funding is helping to expand her preliminary campus survey. Wanamaker's bird strikes project has recently received funding from the Amos Butler Audubon Society as well.

In addition to collecting and analyzing data, the team is creating and publicizing a "Lights Out" campaign to alert the campus community to the danger nighttime lighting presents for birds.

Wanamaker recognizes the urgency to develop strategies to make the university and beyond safer for birds.

"I know that groundskeepers, maintenance workers, and predators remove many of the birds before we find them," said Wanamaker. "You have to

| Species | Fall '20 | Spr '21 |
|---------------------------|-----------|-----------|
| Mourning Dove | 1 | |
| Ruby-throated Hummingbird | 1 | |
| American Woodcock | 2 | 1 |
| Yellow-bellied Sapsucker | 2 | 1 |
| Downy Woodpecker | | 2 |
| White-breasted Nuthatch | 2 | |
| Brown Creeper | | 1 |
| House Wren | 1 | |
| wren sp.* | 1 | |
| European Starling | | 1 |
| Gray Catbird | | 1 |
| Brown Thrasher | | 1 |
| Veery | 1 | |
| Swainson's Thrush | 2 | |
| Wood Thrush | 1 | |
| American Robin | 2 | 2 |
| thrush spp.* | 2 | |
| House Sparrow | | 1 |
| House Finch | 1 | 4 |
| White-crowned Sparrow | 1 | |
| Lincoln's Sparrow | 1 | |
| Eastern Towhee | 1 | |
| Brown-headed Cowbird | | 1 |
| Ovenbird | 3 | 2 |
| Northern Waterthrush | | 1 |
| Kentucky Warbler | | 1 |
| Yellow Warbler | 4 | |
| Pine Warbler | 2 | |
| Yellow-rumped Warbler | 1 | |
| warbler spp.* | 12 | |
| Rose-breasted Grosbeak | 2 | |
| Unable to be identified* | <u>10</u> | <u>12</u> |
| Total individuals | 56 | 32 |

**Bird carcass was heavily scavenged or decomposed, preventing species identification.*

▲ Avian fatalities due to window strikes on IU Bloomington campus recorded by Wanamaker and her team during fall (Sep. 13–Oct. 26, 2020) and spring migration (Mar. 16–Apr. 30, 2021). Carcasses were identified to species when possible, otherwise classified by genus or as unidentifiable.



▲ One of the three Yellow-bellied Sapsuckers (a species of woodpecker) found by the team monitoring for avian window-strike fatalities on the IU Bloomington campus during fall 2020 and spring 2021 migration.

These three warblers were window-strike victims at IU's Luddy Hall on the north side of the Bloomington campus in Sep. 2020. Warblers made up nearly 40 percent of the carcasses identifiable to species or genus found by Wanamaker and her crew. ►



consider all of the birds we're not finding. If you scale up our numbers to how many buildings are on campus, I'm astonished at the number of deaths that are most likely occurring. I'm surprised we still have birds left at this rate."

For more information or to submit data and photos about dead birds found near buildings on the IU Bloomington campus, email Wanamaker at sarawana@iu.edu. For those seeking ways to help birds in your area, visit Global Bird Rescue at <https://globalbirdrescue.org>.

Faculty and student accomplishments

Find details about the achievements below and more faculty and student accomplishments at <https://biology.indiana.edu/news-events/news/>.



▲ Tennesen



▲ Newton



▲ Wang



▲ Lennon

Scientist awarded \$2.2 million to study why cancer cells are addicted to sugar:

Associate Professor Jason Tennesen has been awarded a five-

year extension of his NIH MIRA to continue research that uses fruit flies as a model to understand why human cancer cells consume large amounts of sugar with an ultimate goal of developing new cancer therapies.

Researchers identify microbe that protects bees from fungal infections:

Associate Professor Irene Newton and her lab find addition of *Bombella apis* to hives could protect bees from fungal pathogens, helping maintain bee populations—thus, protecting the food supply.

NIH awards IU biologist \$1.66 million to study chromosome biology:

Assistant Professor Xindan Wang receives \$1.66 million from the National Institutes of Health's Research Project Grant Program (R01) to study chromosome organization and segregation.

Biologist honored for contributions to the understanding of microbial community ecology: Professor Jay Lennon has been elected as a Fellow of the Ecological Society of America.

Biology students receive esteemed research fellowships

Emma Boehm, Joshua A. Jones, and Abigail McClain were selected by the National Science Foundation to receive awards through its Graduate Research Fellowship Program. The NSF GRFP recognizes and supports outstanding graduate students who are pursuing full-time research-based



▲ Boehm



▲ Jones



▲ McClain

graduate degrees in NSF-supported STEM disciplines. The five-year fellowship provides three years of financial support, including an annual stipend of \$34,000 and a cost of education allowance of \$12,000 to the institution.

Boehm and Jones are pursuing Ph.D.s in the Evolution, Ecology, and Behavior Graduate Program at IU Bloomington. McClain graduated from IU in May with honors in biology (B.S.) and honors in Spanish (B.A.) as well as a minor in anthropology. She will attend George Washington University in Washington, D.C., in the fall as a master's student in human paleobiology.

Student profile: Eduardo Duro

Undergraduate receives prestigious national award

Indiana University undergraduate Eduardo Duro has been named a Goldwater Scholar for the 2021-22 academic year. The honor recognizes outstanding college sophomores and juniors who show great promise in math, science, or engineering.

From an estimated pool of over 5000 students, 1256 were nominated by 438 academic institutions to compete for the 2021 Goldwater Scholarships. Duro was among the 410 students selected by the Barry Goldwater Scholarship and Excellence in Education Foundation, the federally endowed agency that awards the coveted scholarships.

Duro, who will be a senior in the College of Arts and Sciences this fall, is pursuing an honors degree in biology (B.S.) and an honors degree in Portuguese (B.A.) as well as a minor in chemistry.

He has worked on research projects in the laboratory of W. Dan Tracey, professor of biology, where Tracey and Lydia Hoffstaetter, a postdoctoral fellow in the lab, served as his mentors. Projects with which Duro assisted included work on the nociceptive gene dubbed "smoke alarm," studies on Caribbean *Drosophila* related to melanization and the phenol oxidase cascade response in different *Drosophila* species, and research focused on *Drosophila* parasitoids.



▲ Eduardo Duro. Courtesy photo

Duro also devotes time to a self-devised research project he began last summer. From a fascination with day-flying moths and the iridescence they exhibit, Duro developed an interest in Lepidoptera and the mechanisms that regulate and give rise to wing color, color organization, and scale micro-structure. He hypothesized that perhaps developing structural coloration was a faster and simpler adaptation to transitioning to being diurnal than developing molecular pigmentation pathways.

Duro is grateful for the support and advice Tracey and Hoffstaetter have provided on his butterfly-wing pigmentation project.

"Eduardo has an incredible passion to understand everything there is to know about butterflies," said Tracey. "Even from an early age he began collecting them, and he has amassed a personal collection of specimens from several

continents. His passion for butterflies has now extended to the molecular and cellular mechanisms that give rise to their beautiful and diverse forms. I look forward to seeing what he discovers in his upward trajectory as a growing scientist."

To see images and videos of the moths Duro studies, follow him on Twitter (@lepidopteraman) where he provides science outreach and shares information about his research and interests.

Don't be surprised to find that some of the tweets aren't in English. Duro—who has lived in several countries—also speaks Portuguese, Spanish, and Mandarin.



▲ Among the moths Duro raises for his research is the luna moth. This luna moth was the first to exit its cocoon (July 9, 2020), followed by many more. *Photo by Eduardo Duro*

Duro is contemplating pursuing a Ph.D. in evolutionary biology after graduation. He is interested in conducting research in evolutionary biology and taxonomy. The Goldwater Scholarship will cover cost of tuition, mandatory fees, books, and room and board minus the amount of support received from other sources—up to a maximum of \$7,500—during Duro's senior year.

Eduardo Duro is the 16th departmental major to receive the honor.



IU Biology graduates by the numbers

Sep. 2020–Aug. 2021

350

undergraduate degrees

20

graduate degrees

Undergrad degrees/majors included:

- 9 double majors
- 42 dual degrees (two B.S. degrees or a B.S. degree and a B.A. degree)
- 3 triple degrees
- 1 B.S. + triple major

Graduate degrees:

- 2 Ph.D.s in Evolution, Ecology, and Behavior
- 7 Ph.D.s in Genome, Cell, and Developmental Biology
- 6 Ph.D.s in Microbiology
- 2 M.S. degrees in Biotechnology
- 3 M.S. degree in Genome, Cell, and Developmental Biology

Alum profile: *Jessica Duchicela*

Untangling the mysteries of mycorrhizae

Jessica Duchicela's research on mycorrhizal fungi pioneered a new understanding of plant invasion. Now she's working to build a massive database that will help expose the secrets of this fascinating fungus.

by Rena Kingery



▲ Graduation: Jessica Duchicela and her family pose for a photo in front of Sample Gates on the IU Bloomington campus in 2013. *Photo courtesy of Jessica Duchicela*

Jessica Duchicela arrived in Bloomington, Ind., in mid-winter 2007. She wore a light coat and shoes that would have been perfectly suitable for the climate of her Ecuadorian home but which were wholly inadequate for the harsh cold of January in the American Midwest. “I was not prepared for winter,” she says, laughing. Despite being fashionably unprepared, she had been working toward this moment for her entire career. On a Fulbright Scholarship, she was going to pursue her dream of furthering her studies in ecology.

The Fulbright launched Duchicela on a lifelong journey of researching a

true ecological wonder—mycorrhizal fungi. Mycorrhizal fungi are ancient microscopic life forms found in the soils of nearly every land ecosystem, and while they thrive inconspicuously underground, their influences on ecosystems are extraordinary.

Most notable is the symbiotic relationship they form with plants. The fungi’s filaments, called hyphae, penetrate or snuggle up to plant roots, bonding fungus to plant. Across this intimate connection, the fungi sends water and nutrients to the plant that it collects using its extensive network of hyphae, and the plant sends the fungi carbon that it needs to grow.

Duchicela's Ph.D. research on mycorrhizal fungi led to a novel strategy for managing invasive plant species in Ecuador's most treasured ecosystem—the Galápagos Islands. "Her work on the Galápagos is really pioneering," says James Bever, Ph.D., one of Duchicela's former advisors at IU. Now, Duchicela's commitment to untangling the mysteries of mycorrhizae has led her to her current mission of compiling data from thousands of studies on the fungi into one massive database to help scientists uncover the secrets of this fascinating organism.

Early Career

Duchicela studied agricultural engineering at the Universidad de las Fuerzas Armadas—ESPE outside of Quito, Ecuador, and a professor's talk on soil microbes piqued her interest in mycorrhizal fungi. For her thesis, she investigated how the fungi might protect tomatoes, an important Ecuadorian crop, from disease. For the first time, she "saw the mycelia and the structures of the mycorrhizae inside of the roots, and that was very exciting," she recalls.

Duchicela graduated from ESPE with honors in 2001, but in order to continue studying mycorrhizae, as she longed to do, she would need a scholarship. Ecuadorian universities did not offer graduate programs in soil ecology nor did they have enough funding to accept students.

Despite gaining skills in research, teaching, and English language, Duchicela was continually denied scholarships due to lack of experience. In 2004, she met her

husband, Roberto Terán, and they had a son. Just as she felt her dream of graduate studies slipping away, she learned about the Fulbright Student Program, a worldwide organization that offers funding to students seeking to do research and/or teach in different countries. It's a kind of academic exchange program. She decided to apply.

After a weeks-long waiting period, Duchicela received word that she had been granted the Fulbright Scholarship. The news delighted her, but there was a catch. Duchicela spoke limited English, so the Fulbright board required her to arrive in the U.S. six months in advance to take an intensive English training course. Her family, though, would have to stay behind so that speaking Spanish at home would not hinder her progress in English. "My little one [was] one and a half at that time, so he was very little for me to leave him," she says. "I thought maybe I could not do that." But with the support of her husband and Fulbright alumni, Duchicela accepted the challenge.

Mycorrhizae on the Galápagos

At IU Bloomington, Duchicela studied the role of mycorrhizal fungi in the restoration of prairie ecosystems. After completing her master's, she continued to work with them to earn her Ph.D. She wanted to investigate the role of mycorrhizae in Ecuador's most unique ecosystem—the Galápagos Islands.

The Galápagos Islands formed from land that rose out of the ocean around one million years ago. The 20 islands lie a whopping 1,000 kilometers

west of mainland Ecuador. Being isolated from the continent, they were devoid of all life when they first arose. Gradually, by wind and by sea, plants and animals journeyed across the ocean and established the islands' native population of flora and fauna.



▲ Jessica Duchicela in the Amazon Rainforest in Ecuador. *Photo courtesy of Jessica Duchicela*

Humans arrived in the 19th century and introduced agricultural crops from mainland Ecuador. Over time, these crops outcompeted the native plants, and today many of the islands' native species are endangered, an urgent issue given that many of these species are endemic to the islands, meaning they occur nowhere else on Earth.

Noting that the invasive species, when found on the mainland, partner with

mycorrhizae, Duchicela wondered how the fungi could be giving the crops a competitive advantage over native plants on the islands. Her question took her to Santa Cruz Island, the second largest of the Galápagos archipelago.

After identifying areas of the island that were heavily invaded and those that were still brimming with native species, Duchicela collected soil samples from each site and analyzed the mycorrhizal activity in both invaded and native plots. What she found turned out to be a monumental discovery: While the fungi boosted invasive species' growth and enhanced their ability to access water and nutrients, this effect on native species was negligible. In short, the mycorrhizae were helping the invasive plants outcompete the native species, and native plants could not benefit from the presence of the fungi.

The results presented a conundrum for island farmers who used mycorrhizal fungi to stabilize and fertilize soils for crops. They would have to decide between developing healthy soils for agriculture—a must for feeding the remote islands' 25,000 residents—or conserving the islands' precious native plants.

The Galápagos National Park, ironically, was also at fault for dispersing mycorrhizal fungi. In their efforts to save native plants, the park's ecologists had been growing native plant seedlings in soil that contained mycorrhizal fungi because this soil, with its earthy smell and dark color, appears healthier than the islands' native soil, which is sandy and dry. Thus upon transplantation of the

seedlings, the mycorrhizae spread throughout the island.

In light of Duchicela's findings, the park transitioned to using the Galápagos' natural soil to grow the seedlings, and farmers refrained from importing new strains of mycorrhizae to the island, though they would continue to use existing ones as fertilizer. "Those were the two things that, after many discussions, we were able to find together," says Duchicela. Her work in the Galápagos and subsequent research earned her Ecuador's Matilde Hidalgo National Medal in 2016, an award honoring innovative Ecuadorian scientists.

A Fungal Database

Now, Duchicela is focused on expanding a database of mycorrhizae studies to enhance scientists' understanding of the enigmatic fungi. Mycorrhizal fungi are notoriously difficult to study because of their many influences on ecosystems. Besides their symbiosis with plants, mycorrhizae protect plants from disease, enhance plant biodiversity, and stabilize soils. But these effects are not the same everywhere, and scientists struggle to generalize patterns based on individual studies of the fungi.

To address this issue, the database (called MycoDB) compiles the results of more than 4,000 studies to provide scientists with a pool of knowledge that they can use to determine overall patterns in mycorrhizal influences. The database "will help us to understand basic questions of the fungi: how the fungi are distributed and how did they get there," says

Duchicela. She explains that this knowledge is essential for determining novel uses for the fungi in restoration and agriculture.

Duchicela has also become a mentor for women and advocates for gender equality seeking careers in science. Her current mentee, Afrasa Mulatu, from Uganda, is working on his Ph.D. in Applied Microbiology at Addis Ababa University in Ethiopia. Duchicela says that Mulatu trusts that she will be able to guide him in overcoming the challenges that scientists from poor countries face—no funding, heavy duties in teaching, and little opportunity for academic growth. "Trying to overcome this," says Duchicela, "has helped me a little bit to share my experience with others who are experiencing the same situation."

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Rena Kingery is a student of the M.A. in Science Writing program at Johns Hopkins University. She always loved learning about science and graduated from Indiana University Bloomington in 2012



with a B.A. in biology. After trying out research and environmental education, she finally found her preferred way to engage in science: writing. She now works as a freelance science writer and fact checker for a variety of outlets. Check out her blog at <https://www.renakingery.com>.

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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>.

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