

# biology

UNIVERSITY *of* VIRGINIA

Fall 2023



## A Closer Look at Our “Tangled Bank”

Welcome to the Department of Biology and our inaugural newsletter. One of the most gratifying aspects of being department chair is that it is incumbent on me to really understand and promote the efforts of the many remarkable people in our community, especially those whose contributions are sometimes overlooked. The act of getting to know this department—and the satisfaction that this knowledge brings—reminds me of the final paragraph of Darwin’s *On the Origin of Species*:

“It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect [on] these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner. ... There is grandeur in this view of life ...”

Seen from a distance, a tangled bank may seem mundane and uninteresting. Take a closer look, and it teems with many kinds of activity. This newsletter is meant to bring into focus the myriad people who make up the department’s tangled bank, who devote their energy and talents each year to teaching thousands of students, finding answers to difficult scientific questions, training the next generation of scientists, and, no less important, attracting millions in grants and donations.

Because there are far more stories to tell than can be contained in a single publication, we intend to revisit this project every year.

In the meantime, please reach out, stay connected, and arrange a visit.



Douglas R. Taylor  
Commonwealth Professor and Chair of Biology



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Design: Roseberries  
Editing: Rosalind Hingeley  
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# Highlights from around the Department

## ▼ Department Makes Exciting New Hires

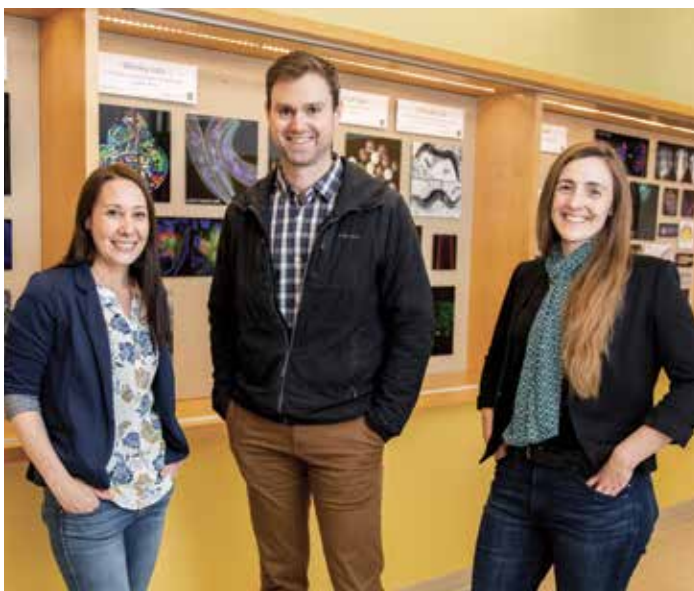
Biology had a banner year for hiring, with three tenure-track assistant professors joining our ranks. **Tracy Larson** is uncovering integrative aspects of adult neurogenesis and how it impacts singing behavior in sparrows and canaries. **Melanie Worley** is

discovering essential features of regeneration and cell fate plasticity using cutting-edge methods in *Drosophila*. And **Dan McIntyre** is defining how the behavior of stem cells depends on their environment using nematode, *C. elegans*. We are thrilled to have them here!



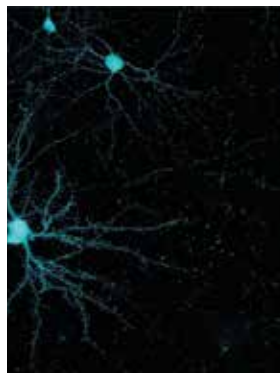
## ▲ Renovations at Gilmer Reinvigorate Biology and Neuroscience Programs

Quite literally, Gilmer Hall presents a new face to the world, highlighting the active learning, interdisciplinary research, and engagement with the broader University community that the renovated building is meant to foster. The formerly opaque concrete facade and interior walls were replaced with insulating glass to allow daylight to penetrate the building while simultaneously reducing its energy footprint. Gilmer is also the home of the newly formed Program in Fundamental Neuroscience (PFN). Together, Gilmer Hall renovations and the newly minted PFN highlight the creative and collaborative teaching and innovative research, training, and discovery animating the department.



## Access to Neuroscience Undergraduate Program Expands

Under the leadership of **J.C. Cang**, the Paul T. Jones Jefferson Scholars Foundation Professor of Neuroscience, the Neuroscience undergraduate major expanded in size from 25 to 100 students. Its new curriculum covers a wide range of topics from molecules to behavior and cognition. These developments not only meet students' growing interest in neuroscience, but also make the major more accessible



to students with diverse backgrounds. The program is administered through the Program in Fundamental Neuroscience.



## BOIP Builds Bridges to the Charlottesville Community

The Biology Outreach and Inclusion Program (BOIP) continued its grassroots outreach efforts to bridge the state-of-the-art science under way in the department with the local Charlottesville community. BOIP members brought a series of activities that highlight current research to a local Charlottesville farmer's market, collaborated with the Charlottesville Prolyfyck Kids Run Crew, and hosted lab tours for local middle school students.



### ▲ New DEI Chair Sets Ambitious Agenda

The department welcomed a new Diversity, Equity, and Inclusion chair, **Masashi Kawasaki**. Kawasaki's personal background—a first-generation immigrant, person of color, and a believer in the universal value of human individuality and diversity—complements his motivation for understanding

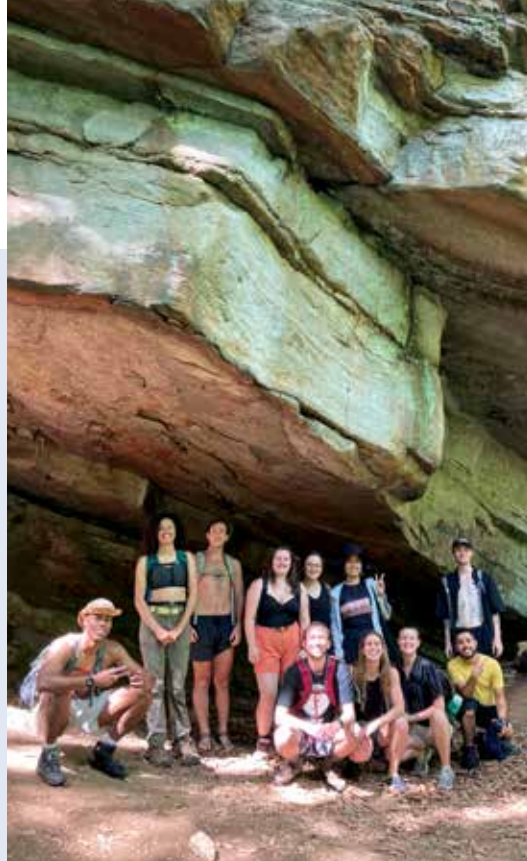
behavior of animals including humans. As chair, Kawasaki is heading initiatives to develop strategies, policies, and programs that will build a more inclusive and supportive environment in our classrooms, laboratories, and administrative offices.



### ◀ Biology Staff Spearheads STEM Food Drive

The difference Biology Department staff makes extends beyond the bounds of the University. Each year Administrative Coordinator **Sherrie Jones** coordinates the Annual STEM Food Drive, facilitating the donation of hundreds of

nonperishable items, infant supplies, and personal hygiene products to the Blue Ridge Area Food Bank. In 2022, Jones partnered with Fiscal Technician Mary Liberman to initiate the “personal shopper” option for donations. Together Jones and Liberman collected over 630 items from department members, winning for the second year in a row the friendly competition with other College and Graduate School of Arts & Sciences departments for most items donated!



### ▲ Gibson Recognized for Outstanding Teaching

Assistant Professor **Mandy Gibson** and three co-instructors led a workshop at the University's Mountain Lake Biological Station in Southwest Virginia. Supported by the Society for the Study of Evolution, graduate students spent an intense week brainstorming the big open questions in the field of evolutionary biology, developing testable hypotheses, and writing a grant proposal. This type of innovative effort has attracted well-deserved accolades. In May 2022, Gibson received the Alumni Board of Trustees Teaching Award. In December, the State Council of Higher Education for Virginia honored her with its “Outstanding Faculty Award—Rising Star,” recognizing exemplary accomplishments in teaching, research, and public service across Virginia's public and private colleges and universities.

### Department Increases Graduate Student Support

In response to affordability issues in Charlottesville, the Graduate Admissions Committee, headed by Associate Professor **Xiaorong Liu**, and the Graduate Committee, led by Associate Professor **Ali Güler**, advocated for increased financial support for biology graduate students. Liu and Güler secured

additional fellowships for the incoming graduate student cohort, an increase in the annual graduate student stipend, and an additional semester of fellowship support for students affected by the COVID-19 pandemic.

## Graduate Students Win University Accolades

Thanks to continued support from the Graduate Committee, biology graduate students swept University-wide awards in 2022. **Phoebe Cook** received the All-University Graduate Teaching Award. **Yingnan Gao**

received the Distinguished Graduate Teaching Award in STEM. And **Robin Brown** was selected for the Jefferson Scholars Foundation Dissertation Year Fellowship.



## ▲ iGEM Team Takes Home Gold Medal from Paris Competition

Team Virginia traveled to Paris in October to compete in the 2022 International Genetically Engineered Machine (iGEM) Competition. Advised by Associate Professor **Keith Kozminski**, the team of undergraduate students from diverse scientific backgrounds competed with students from over 350 institutions from more than 40 countries. Team Virginia presented 'AtheroSHuffle'—a novel point-of-care device to detect early-stage atherosclerosis—and received a Gold Medal and a nomination for the Best Diagnostic Prize, both significant recognition of the team's innovative research. Congrats to the iGEM team!

Pictured above: Team Virginia included Keith Kozminski (Biology), Marisa Guajardo (Neuroscience), Alexander Heise (Biology), Miranda Khoury (Biomedical Engineering), Jayati Maram (Biomedical Engineering), Godwin Oluwafemi (Biomedical Engineering and Economics), Justin Orchard-Hays (Chemistry), Isha Patel (Biomedical Engineering), Ivory Tang (Mathematics), Peneeta Wojcik (Biomedical Engineering), and Yilun Zhou (Chemistry and Neuroscience); not shown are Alyssa Dioguardi (Biology and Commerce) and Yasir Mahboda (Biology and Data Science).

## ▶ Debbie Roach Retires

The Department of Biology would like to recognize the service of **Deborah Roach**, Professor of Biology, faculty at UVA for 25 years, and now an emeritus professor. Roach's research centered on the process of aging and senescence and was novel in her focus on the aging process in plants. Roach was widely regarded for her outstanding teaching, especially in her signature course, "The Biology of Aging." She was recognized by the department, by the University and by the State of Virginia for her teaching excellence. Roach cultivated teaching expertise in others and was aggressive in nominating her



colleagues for recognition. As an administrator, she was extraordinary in curriculum design and implementation. As chair of the department, she demonstrated leadership in interdisciplinary graduate education through the EXPAND program. We thank Roach for her decades of service.



## ▼ Pani Lab Develops New System to Track Regeneration

Assistant Professor **Ari Pani**'s lab is developing novel tools to explore how cells communicate during whole-body regeneration in acoelomorph flatworms. Although acoelomorphs can accomplish the remarkable feat of regrowing their entire body from a small fragment, the underlying cell biological mechanisms are not known. Adapting genome engineering and lineage tracing methods from model organisms—a difficult task—the Pani Lab hopes to shed light on this process of regeneration.





# next-generation biology

## Producing and Distributing Science

Our goal is to release 2D videos and 3D immersive environments that can have an impact on people's lives regardless of where they live.

When Associate Professor Jennifer Güler was a student, she traveled extensively. “I was repeatedly struck that people in other areas of the world suffered from diseases that weren’t much of a problem for us in the United States,” she says. Having majored in microbiology, Güler felt it would not be a tremendous leap to focus on protozoan diseases. She began by characterizing mitochondrial metabolic pathways of *Trypanosoma brucei*, with the idea of identifying new drug targets for the treatment of African sleeping sickness, and then switched to *Plasmodium falciparum*, the parasite that causes malaria. “Although we have long had drugs to treat malaria and are developing vaccines, there are still many fundamental questions about the organism to be answered,” Güler says.

One of these is metabolic adaptation. Malaria and many other protozoans have extreme metabolic flexibility, which gives them the ability to switch back and forth between nutrients sourced from their environment and those they produce themselves. This ability allows them to adjust to different environments and enhances their survival.

Another fundamental part of the parasite’s biology is its ability to change its genome. In the case of *Plasmodium falciparum*, Güler surmises that its

adaptability may be a function of its AT-rich genome, almost 90 percent of which is constituted from two of the four bases found in a DNA molecule: adenine and thymine. This special feature of its DNA may also lead to drug resistance. “Our hypothesis is that because of the preponderance of A and T, the parasite can more easily change its genome and acquire resistance,” she says.

### ID in 3D

Research is how Güler produces knowledge for the scientific community. Throughout her career, she has also been deeply involved in distributing that knowledge to the public. In 2019, with funding from the Jefferson Trust, part of the UVA Alumni Association, she launched Infectious Disease (ID) in 3D, a collaboration with Arin Bennet from the University Library’s Scholar’s Lab, Jason Bennett from the College’s Learning Design and Technology center, and her lab tech, Michelle Warthan. This year-long program takes students through

Alan Bergland, Eyleen O’Rourke, and Jennifer Güler all joined the department in 2022.

the process of designing and building virtual or augmented reality environments that improve public understanding of infectious disease. Over the last three years, the program has covered antibiotic resistance, COVID transmission, and HPV infections. The current project focuses on *M. pox*. To date, the initiative has attracted studio art and archaeology majors as well as those in biology and biomedical engineering.

A challenge for the group is balancing quality with access. “Our goal is to release 2D videos and 3D immersive environments that can have an impact on people’s lives regardless of where they live,” she says. “We are working to find ways to make our technology compatible with the most readily available open-source platforms in ways that won’t compromise their quality.”



## Following Her Passion to Virginia

It is always  
rewarding to  
see young minds  
open up to this  
microscopic,  
cellular world  
that is the  
foundation for  
our health and  
well-being.

While Associate Professor **Eyleen O'Rourke's** journey from a working-class family in Patagonia to a tenured faculty position at the University of Virginia is unusual, it is hardly inexplicable. O'Rourke credits the example of her parents—the cre-

ativity and curiosity of her father and the resolve of her mother—for shaping her personality. She also praises the Argentine system of higher education, which makes up for whatever resources it lacks with a determination to provide the best possible support and education for its students. "There is the sense that one person's success is the success of the whole community," she says. "As a result, mentors are extremely helpful and generous in ways that are extraordinary."

But ultimately, O'Rourke's success has as much to do with her passion for science and her willingness to pursue it wherever it takes her. After completing her doctorate at the Universidad de Buenos Aires, for instance, she moved to Boston for a postdoc, having only begun to formally learn English at 26.

O'Rourke is a geneticist who studies conserved gene networks that evolved to help animals survive in environments where food is scarce. In times of plenty, however, these same genes can cause obesity, diabetes, and cardiovascular disease. Her goal is to understand these networks at a granular level, relating the activity of individual genes to metabolism and survival at the whole organism level. This is not an easy task. "The metabolic system itself is extremely complex," she says. "When you add the environmental, psychological, and cultural factors that intersect with it, understanding these relationships becomes exponentially more complicated."

O'Rourke, however, finds this added complexity inspirational. "My amazement at the complexity of the natural world both motivates and challenges me," she says. "I find the creativity required to devise the most direct, rigorous, and meaningful approaches to the questions I ask deeply satisfying."

### Opening Eyes to an Unseen World

That sense of wonder shapes her interaction with students in the classroom and laboratory. "It is always rewarding to see young minds open up to this microscopic, cellular world that is the foundation for our health and well-being," she says. "I sometimes feel like a magician, revealing wonderful insights that then become a part of their reality."

At the same time, O'Rourke encourages her students to go beyond the existing facts of molecular biology or genetics and to look critically at the world. "It's important that we understand the limits of what we know, what is yet to be defined," she says. "That's the first step in going after something that's waiting to be discovered."

## Understanding Seasonal and Environmental Drivers of Evolution

As Associate Professor **Alan Bergland** notes, the event that set his professional trajectory on its current course occurred when he was an undergraduate at the University of Oregon: Professors Bill Bradshaw and Christina Holzapfel invited him to join their laboratory. "That experience immersed me in evolutionary biology and gave me my first opportunity to do field work," he says. As part of the program, Bergland traveled to a field



station in Wisconsin to study insects that live in carnivorous pitcher plants. “Ultimately, joining their lab was the first step along a path that has led to my current interest: the genetics and evolutionary dynamics of how organisms respond to environmental stress.”

Among other projects, Bergland studies the genetically based phenotypic differentiation that emerges among wild *Drosophila melanogaster* over the course of a season, which in fruit-fly terms is equivalent to 10 to 15 generations. The descendants of individuals that survive winter, for instance, tend to be hardier than those sampled after a summer. Bergland also focuses on the evolutionary dynamics of adaptation to predation in *Daphnia*

**Most people remember doing some sort of experiment with fruit flies in high school or college biology.**

*pulex*, a model system he has developed since arriving at UVA. Using quantitative- and population-genomic analyses, Bergland and his colleagues are resurrecting *Daphnia* lineages to examine the long-term history of rapid adaptation to fluctuations in predation pressure while predicting adaptive evolutionary outcomes in the near future.

“One source of professional joy in my career is learning to make sense of large complex data sets that combine genetic information, environmental information, and information about the traits and behaviors of organisms,” he says. “I like the challenge of turning these data sets into a story.”

#### **Recruiting Citizen Scientists**

Bergland also finds satisfaction in involving the public in his research,

greatly amplifying the number of sampling locations he can use in his research and building a larger constituency for science. He has launched an initiative called Backyard Evolution that enlists citizen scientists in Virginia and North Carolina to collect *Drosophila* from their compost piles. He recruits partners through the Master Gardener network and is also a presence at local farmer’s markets.

Bergland distributes kits containing everything volunteers need to participate and has created a series of instructional videos explaining the goals of his experiments and demonstrating the sampling procedure. “Most people remember doing some sort of experiment with fruit flies in high school or college biology,” he says. “Many are quite enthusiastic about participating.”



# partnerships for diversity

## Applying Population Genetics to Human Beings

One of the advantages a university has over its corporate counterparts is that, quite often, it has the in-house expertise to support the professional development of its administrative staff. In most cases, this entails tapping the insights of its business school faculty for topics like finance or management, but Lisa Harris, a senior learning and development consultant with UVA Human Resources, took an unusual approach. Why not bring in an evolutionary biologist to lead a session on diversity for the University's Leadership Essentials program, a semester-long course that covers leadership foundations and effective management? She approached Associate Professor **Alan Bergland**, and he recruited his postdoctoral research associate, **Joaquin C. B. Nunez**, to collaborate on the course.

Her choice was inspired. Both Bergland and Nunez study how temporal and spatial fluctuations in selection pressures maintain genetic variation associated with fitness-related traits and, specifically, the role of environmental variation as a diversifying evolutionary force. And they both believe that by introducing nonscientists to the fundamental genetic and evolutionary facts that form the basis of their research, they can contribute to the fight against racism.

### An Established Commitment to DE&I

Bergland had already taken steps in this direction. He had created Molecular Evolution: Diversity, Mutants, and the Biological Myth of Race, a senior-level undergraduate course exploring the forces that generate diversity in a population. "Population genetics can seem esoteric, but one of the things I've tried to do over the last few years is to move the focus to human diversity and to what race is and isn't," he says.

When Harris approached him, Bergland immediately thought of Nunez as a collaborator. "I knew from

**They both believe that by introducing nonscientists to the fundamental genetic and evolutionary facts that form the basis of their research, they can contribute to the fight against racism.**

talking to Joaquin that he would be interested in trying this out," Bergland says. "He is well-versed in the historical and sociological aspects of how race has been constructed as an idea. I had already learned a lot from him."

Nunez was a founding member of the University-wide Diversity Influencers task force, where he helped organize a winter diversity retreat and a panel discussion on equity and justice issues that emerged during the COVID pandemic. And he had long been active in science outreach to students from underrepresented backgrounds. "My view," he says, "is that if you are not on the ground organizing events and mobilizing students, if you are not taking time from your day to do things that fundamentally transform systems and spaces, you are not doing DE&I right."

### Taking the Facts to Adult Learners

Even with their experience, Bergland and Nunez found the prospect of teaching the course intimidating. "It's one thing to teach DE&I to students, who by and large are receptive to new ideas," Nunez says. "It's another thing to teach adults, who often have very

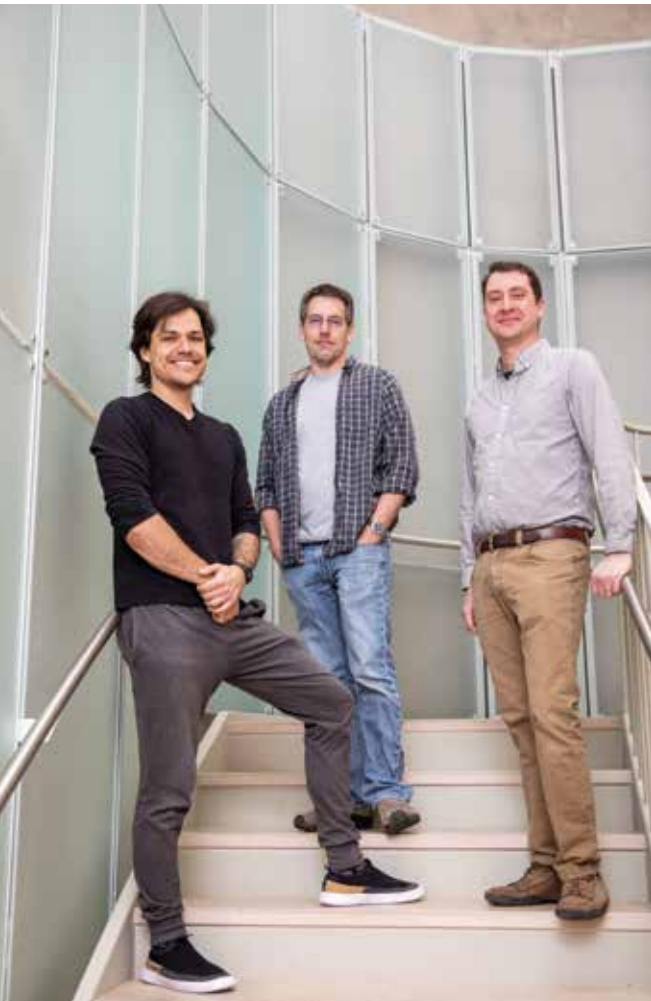
well-formed ways of looking at the world, and tell them things that will upset their preconceptions."

Bergland and Nunez recalibrated their presentation in a number of ways. "When I taught the undergraduate class, I could assume that the students were well-grounded in genetics and evolution," Bergland says. "For Leadership Essentials, we had to be sure to cover the basics in an approachable way."

Bergland and Nunez also made sure to connect the curriculum with specific challenges like hiring and promotion that the participants face in the course of their jobs. Equally important, they emphasized, citing examples from healthcare and medicine, that the myth of race not only damages individuals but also reinforces entrenched systems of power and privilege. "Misconstruing what the biology tells us can have massive consequences for society as well as individuals," Nunez says.

Joaquin Nunez (left) and Alan Bergland co-taught a session on diversity for UVA's Leadership Essentials program.





With the help of professors David Parichy (center) and Robert Cox (right), Pietro de Mello (left), the department's first Rising Scholars Postdoctoral Fellow, is shifting his focus from ecology and evolutionary biology to cell and developmental biology.

## Diversifying the STEM Faculty

The Rising Scholars fellowship is an opportunity to enhance diversity.

For institutions of higher education, achieving a broadly diverse faculty has been a frustratingly elusive goal, especially in STEM. In response, the University of Virginia created its Rising Scholars Postdoctoral Fellows Program to support the professional development of scientists from underrepresented communities, underrepresented ethnicities such as Latinx, members of the LGBTQIA+ community, and people with disabilities, to name a few.

This year, **Pietro de Mello**, a Brazilian, became the Biology Department's first Rising Scholar

fellow. He is working with **David Parichy**, the Pratt-Ivy Foundation Distinguished Professor of Morphogenesis, and Professor **Robert Cox**. This dual relationship highlights one of the critical advantages of the program: it can be customized to the needs of the individual fellow. De Mello holds a PhD in ecology and evolutionary biology, Cox's area of expertise, but is intent on shifting to cell biology and developmental biology, which is Parichy's.

"I am interested in understanding how traits like color or size are produced, and I realized when I was working on my doctorate that it would be helpful to go beyond genetic sequencing to know all the steps in how a trait emerges," he says. De Mello is developing the use of Trinidadian guppies as a model system and hopes to understand both the genetic and cellular mechanisms responsible for the establishment of the distinct color patterns of male and female guppies. Ultimately, he hopes to apply this expertise to the study of wild populations. "I believe scientists who can work across fields are going to be more competitive in securing academic positions," he says.

Traditional funding sources typically do not support this level of collaboration during a career transition. The two years of support provided by the Rising Scholars fellowship will enable de Mello to add a skill set in developmental biology. "In this case, the Rising Scholars fellowship is an opportunity to enhance diversity in the ways people usually think about it and also to extend that diversity across disciplinary lines," Parichy says.

### A Mutually Beneficial Arrangement

Both Cox and Parichy are providing guidance and mentoring. One of the expectations of the fellowship is that fellows teach a class, and de Mello has worked closely with them to create a compelling course. They are also helping him navigate the different research traditions that distinguish cell and evolutionary biology. "One of the biggest advantages for Pietro of having two mentors is gaining insight into each of these models," Cox says.

At the same time, both Parichy and Cox benefit from the arrangement. "Dave's group offers him new techniques that Pietro wants to add to his repertoire, and our group offers him a comfortable intellectual home," Cox says. De Mello's expertise in bioinformatics has also been valuable to members of Cox's lab, where he is helping them develop strategies for analyzing large genomic and gene expression datasets.

### Multiple Perspectives on Race

The Rising Scholars program is also a good fit for de Mello because of his long-standing interest in promoting diversity, equity, and inclusion. During his graduate studies, for instance, he started a DE&I discussion group in his department, and his understanding of traits like color only reinforces his sense of the artificiality of social constructs around race.

His own multifaceted experience of race also reflects the multiple perspectives he hopes to develop in his research. As a Brazilian of European descent, he knows what it is like to experience privilege, but as an immigrant in the United States, he has come face to face with prejudice. "Having the experience of both worlds has enabled me to gain a more nuanced understanding of the challenges involved in achieving diversity," he says.

# giants in the field

## Tackling Big Questions in Ecology and Evolutionary Biology

We demonstrated that it is not only the number of your progeny that matters but also their genetics, and that ecological distribution depends on evolution.

As a young Latvian immigrant growing up outside London in the 1950s, **Janis Antonovics** did not start reading English until he was seven or eight, and, when he did, he gravitated toward the straightforward language of science. As he grew older, he began spending time cycling through the Kent countryside, where he realized that science gave him a way to discover more about the plants he encountered during his excursions.

Over the course of his career, Antonovics, formerly the Lewis and Clark Professor of Biology, translated his love of plants into a series of insights that has made him one of the preeminent ecological and evolutionary biologists of his generation. But even 70 years later, his enthusiasm for plants—and for cycling—is undimmed. If you're curious, he can tell you exactly where to find a patch of sweet vernal grass a few miles from the University.

"My interest in plants has nourished me my entire life," he says. "From an experimental point of view, their utility is often underestimated. Plants do essentially the same thing as animals, but they are always accessible, and using them poses no ethical issues."

### Finding Opportunities to Make a Difference

Although Antonovics went to Cambridge with the intention of studying botany, lectures given by geneticist John Thoday sent his career in a different direction. Thoday was an expert on effects of selection on genetic variation—and Antonovics decided that he could harness his love of plants to study genetics and evolution.

When Antonovics was a graduate student at the University of Wales, his work on the evolution of tolerance to

heavy metals established the importance of selection and gene flow in population differentiation and speciation. "The prevailing wisdom was that evolution was slow and that speciation required geographic separation," he says. "My research showed that populations could become genetically differentiated over very short distances. You could lean to the left and pick up grasses that were metal-sensitive genetically and lean to the right and find plants with genetic resistance. They also differed in flowering time, showing the beginnings of reproductive isolation and speciation."

At Duke University, Antonovics moved on to explore another big question: the evolutionary advantage of sexual reproduction over asexual reproduction. He distributed rooting grass shoots, or tillers, grown from seed or cloned from the plant that produced those seeds and found that those identical to the maternal plant did less well than those produced by outcrossing. "We demonstrated that it is not only the number of your progeny that matters but also their genetics," he says, "and that ecological distribution depends on evolution."

For the last 20 years, Antonovics has become what he calls "a born-again disease biologist," having seen an opportunity to provide a missing perspective on the relationship of evolution to the epidemiology of infectious disease in natural populations. His current research, funded by the National Institutes of Health and the National Science Foundation, has focused on the role of diseases



Ray Keller (left) and Janis Antonovics are among the preeminent scientists of their generation, Keller in developmental biology and Antonovics in ecology and evolutionary biology.

in determining species range limits, host-pathogen co-evolution, and the evolution of transmission mode. And although his empirical research is on sexually transmitted diseases in plants, he has expanded his horizons, analyzing datasets on organisms ranging from bumblebees to humans.

### The Thrill of Discovery

Antonovics has been widely recognized for his work. He is a fellow of the American Academy of Arts & Sciences and of the Royal Society and past president of the Society for the Study of Evolution. But he is most proud of his postdocs, graduate students, and the undergraduates who have passed through his lab. "I encourage them to do their own independent research," he says. "I've always enjoyed the thrill of discovery, and I want my students to have this experience for themselves."



## Revealing the Mechanisms of Embryonic Development

I love it when my students make a discovery. It doesn't have to be something that is new to the world as long as it is new to them.

People are known by the company they keep. That is certainly true of **Ray Keller**, the Alumni Council Thomas Jefferson Professor of Biology. In 2020, Keller was awarded the Society for Developmental Biology Lifetime Achievement Award, recognized for sustained outstanding contributions in the field, exceptional mentoring of the next generation of scientists, and service to the scientific community. The previous two years' winners were Noble Prize laureates.

But Keller would be the last person to point this out. He generously shares credit with mentors, colleagues, and students who helped make his achievements possible. "Most of the things I've done—in fact, everything I've done—have been as part of a collaboration," he says. As if to emphasize this, he titled his acceptance speech, "Fifty Years of Adventures with Friends in Morphogenesis."

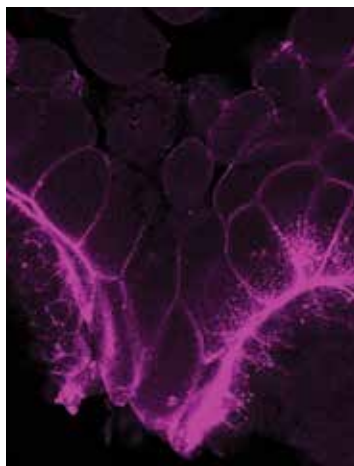
### The Determinants of Shape

Raised on a farm in Missouri, Keller has always been fascinated by machinery; in fact, the stages in his career can be marked by the motorcycles he has owned. For Keller, developmental biology was ultimately another machine he could take apart. "I just started dismantling embryos, observing what the pieces did, and envisioning a mechanism that explains how they work together to produce changes in shape," he says.

Keller is known for his groundbreaking analysis of the cellular, molecular, and biomechanical basis of early amphibian morphogenesis, and in particular the convergent extension movements that function in gastrulation, neural tube formation, and shaping of the vertebrate body plan. In the process, he challenged the prevailing model that the three embryonic germ layers organized themselves exclusively through differential adhesion and yielded a thermodynamically stable structure.

"It is hard to make a shaped organism just using this principle because a thermodynamic model that involves minimization of tissue surface energy inevitably produces spheres," he says.

Finding a more comprehensive explanation required Keller to call on expertise—and colleagues—from other fields. To address the question of how molecular and cellular events generate the patterned forces and tissue



mechanical properties that shape the embryo, Keller pioneered the use of high-resolution imaging of cell motility and biomechanical measurements of normal and experimentally manipulated embryonic tissues. He and his collaborators also developed methods to directly measure embryonic forces and tissue material properties as well as specialized preparations to study morphogenesis.

Keller employed these techniques to yield a series of fundamental breakthroughs that have been instrumental in setting the direction for the field. They include characterization of convergent extension tissue movements, which is the idea that active, patterned cell intercalation is a major mechanism of morphogenesis.

### Passing the Torch

But scientific discovery is only one aspect of Keller's career. He is also a devoted teacher. For many years, he taught in the embryology course at the Marine Biological Laboratory in Woods Hole and in the *Xenopus* course at Cold Spring Harbor, but he has a special affection for his undergraduate developmental biology laboratory class. "I love it when my students make a discovery," he says. "It doesn't have to be something that is new to the world as long as it is new to them. It empowers them to know that they too can reveal something new about the natural world."

Many of the postdocs and graduate students who passed through his lab over the decades have gone on to groundbreaking careers of their own—and the sheaf of testimonials the Lifetime Achievement Award Committee received reveals their sense that they are following in his footsteps. In the case of Jeffrey Hardin, one of Keller's first graduate students, this relationship has been formalized. When the University of Wisconsin created the Raymond E. Keller Professorship in Integrative Biology, Hardin was named the inaugural chairholder.

# recognized leaders



## Building Momentum through Consensus

Since arriving at the University of Virginia in 2009, Professor **Sarah Kucenas** has taken on leadership positions with ever-wider spheres of responsibility. After helping direct the department's Distinguished Majors Program, she became associate director of the Neuroscience Graduate Program. Then, for the College, she chaired the assessment committee that helped pass the new College curriculum and, more recently, chaired the search committee that led to the hiring of the dean of the College and Graduate School of Arts & Sciences. Currently, Kucenas is the director of the Program for Fundamental Neuroscience (PFN), which brings together faculty from biology and psychology, and she co-directs the Brain Institute, one of the University's Grand Challenge Research Initiatives.

was not leadership material, a message that she internalized. "That stuck with me for the longest time," she says. When she came to UVA, however, she was praised by colleagues for being a good listener and thanked for helping them get things done. "I decided that while I may not be the perfect leader, I have a set of skills that are valuable," she says. "And there are plenty of places where I can apply them."

Kucenas studies the cellular and molecular mechanisms that mediate glial-glia interactions in the developing and regenerating nervous system. Although deeply committed to her students and her lab, she makes the time to contribute to the larger community. "I see the lab as my home, which will be a better place to live as the neighborhood improves," she says.

This was certainly not her intention. As a collegiate swimmer, Kucenas had been told by her coach that she

**Proximity promotes the spontaneous exchange of ideas, which is not only exciting, but also leads to more productivity.**

Laura Galloway (left) and Sarah Kucenas have both taken on administrative responsibilities in addition to their work as teachers and researchers. Galloway is associate dean for sciences in the College and Graduate School of Arts & Sciences, while Kucenas directs the Program for Fundamental Neuroscience.

### **Creating a Home for Neurosciences**

Her work with the PFN is a case in point. The program was created to reinvigorate the neuroscience major, which had languished without a true home in either the Biology or Psychology department. It had no dedicated faculty, which meant those who were teaching neuroscience courses had to take time away from their primary departmental responsibilities. And its enrollment was limited to just 25 students, which, as the University came to realize, posed significant equity issues. "We are elevating and nurturing the major, expanding and diversifying it, and creating an infrastructure that will enable it to evolve and improve over time," she says.



A milestone for the program is the recently completed renovation of Gilmer Hall, which brought neuroscientists from both departments together in one building for the first time. “We can now think of ourselves as a unified neuroscientist community,” Kucenas says. “And proximity promotes the spontaneous exchange of ideas, which is not only exciting, but also leads to more productivity.”

### Fostering Change across the University

One of the challenges of leading PFN is that the program came with no additional funding. In response, Kucenas drew on her ability to engage colleagues in identifying obstacles, finding ways to overcome them, and acting on these solutions. With the Brain Institute, Kucenas has the resources to be even more ambitious.

In June, the University announced it will invest more than \$75 million in an interdisciplinary effort to pioneer life-changing advances in neuroscience while simultaneously mapping the workings of the human brain. The University will make more than 20 strategic faculty hires to expand neuroscience research on Grounds and will initiate a Next-Generation Scholars Program, which will recruit and train 15 outstanding post-doctoral researchers, with an emphasis on diversifying the field. “Almost every school has neuroscience faculty, and our job is to fund projects that cross school boundaries and get everyone who studies the brain at UVA both literally and figuratively together in the same room,” she says.

But as someone who has now more than a decade of experience as a promoter of change, Kucenas understands that money only goes so far. Equally important, in her view, is the behind-the-scenes work to revamp and replace obsolete University and College requirements and procedures that can undermine this larger, more generous, and more collaborative view of science. “Creating an administrative infrastructure that advances our work will be critical in realizing the full potential of our people,” she says.

## From Observations to Answers

When Professor **Laura Galloway** arrived at UVA in 1996, she imagined her career would unfold as a progression of projects designed to explore evolutionary biology’s larger conceptual questions. “It’s the approach I learned as a graduate student and that I still teach my graduate students,” she says, “but it is not how my career evolved, especially its second half.”

At Mountain Lake Biological Station, Galloway began working with wild populations of *Campanula americana*, the tall bellflower, and she soon discovered that her experiments would occasionally produce results that seemed anomalous. When she crossed plants from Mountain Lake with populations elsewhere in the *Campanula*’s range, she found that some of the resulting seedlings were yellow or white with much shorter life spans. “My inclination was to dismiss these results—to treat them as an annoyance—and to continue with my work,” she says. “But they stayed in the back of my brain, and ultimately I realized that there might be something interesting there.”

Galloway later returned to this problem, which ultimately led her to home in on the early stages of speciation, a major evolutionary question. As she said last summer in her presidential plenary address to the Society for the Study of Evolution, “It’s important to keep your eyes wide and be open to what you see.”

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### Building a More Inclusive Pipeline

Her ability to go from first principles to observations has also guided Galloway’s career as an administrator. One reason she agreed to accept the post of associate dean for the sciences is that it gave her the chance to try a new approach to increasing diversity in STEM fields. As department chair and leader of several faculty searches, she had seen that the conventional approach—building a more representative faculty—was more difficult than she imagined. “There is not a lot of diversity in the pipeline,” she says. “Because many institutions are competing for the same talent, it’s difficult to make broad gains through recruiting.”

While maintaining her focus on hiring, Galloway has also adopted the longer view, concentrating on issues that restrict the pipeline in the first place. She was part of the team that successfully secured a \$2.5 million grant from the Howard Hughes Medical Institute’s Driving Change initiative, a wide-ranging program that aims to enhance the academic experience and success of STEM students, particularly those in historically excluded groups. Among other efforts, UVA will be looking at ways that different teaching methods can close performance gaps among students.

“The conventional wisdom has been that if you didn’t have a strong high school background in STEM, you were not going to perform well in college,” Galloway says. “It turns out, however, that how science is taught at the university level makes a difference. If you replace the traditional 50-minute lecture format with a learning environment where students grapple with fundamental concepts, you level the playing field among students.”

Galloway’s commitment to strengthening STEM diversity at UVA is part of her overall goal of elevating the role of science at the University. And with the University adopting a series of Grand Challenge Research Initiatives—including one for the neurosciences—she believes that this is a good time for her to be in the dean’s office. “Although I am a deeply committed evolutionary biologist, I find it easy to get excited about all kinds of science,” she says. “We are now in a good place at UVA to make things happen.”



# mentoring the future

## Ensuring Students Have an Amazing Experience

Professor **Christopher Deppmann** has two primary goals when mentoring his postdocs: to nurture their ability to think independently and creatively about science and to prepare them to lead and run their own laboratory. “I want my postdocs to be more prepared than I was when I started out as a faculty member,” he says. “Essentially, my process is to have them run a lab within a lab.”

Deppmann provides guidance as his postdocs master the business of science—writing grant proposals, conducting experiments, and producing papers. But he also helps them become better mentors to the graduate students and undergraduates they supervise. “I tell them it’s their job to make sure their students have an amazing experience,” he says. “This means sharing their love of science and conveying the thrill of wrestling with big scientific questions that are still unresolved.”

But Deppmann is not prescriptive about how they accomplish these goals. “I’m not interested in producing clones,” he says. “Everyone has their own style. My job is to help them develop it.”

Postdoc **Austin Keeler** appreciates this freedom. For Keeler, successful mentorship requires mutual respect. “During the first year, I work on establishing trust through open and honest conversations with my students. I share my experiences in science and listen as they describe their aspirations. This provides the foundation for us to tailor the

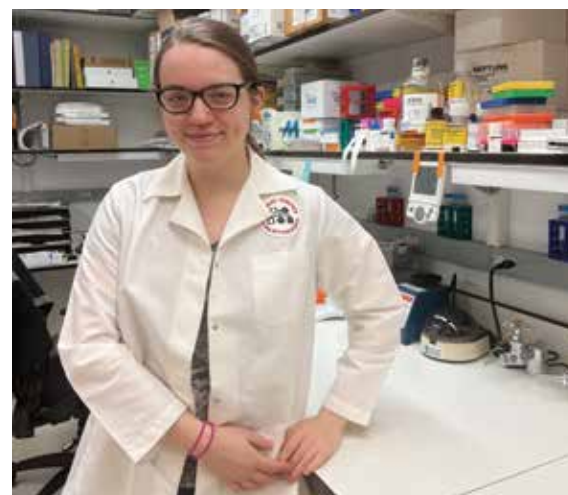
research experience to their needs.”

And as Keeler attests, these mentorships can become reciprocal. When he needed to

learn coding to analyze data from mass cytometry images, he turned to one of his undergraduate students, **Ashley Hirt**, who had solidified her knowledge of coding at UVA. “We had fantastic exchanges,”

Keeler says. “Ashley taught me much of what I now know about coding, and I would explain the scientific rationale for what we were doing and present problems for her to solve.”

Hirt, now doing two postbac years at the NIH, appreciated the exchange as well as the guidance and support she received from Keeler. “Austin was a great mentor,” she says. “Since I’ve gotten here, I’ve realized that my mentorship experience was much more positive than my peers’.”



I’m not interested in producing clones. Everyone has their own style. My job is to help them develop it.



For Professor Christopher Deppmann (right), postdoc Austin Keeler (left), and former undergraduate Ashley Hirt, (above) mentoring is a mutually beneficial process.



## Inspiring Students to Pursue Careers in Science

I want my postdocs to be more prepared than I was when I started out as a faculty member.

**M**atthew Kustra is now a fifth-year PhD student in ecology and evolutionary biology at the University of California, Santa Cruz—a program he might not have joined if it hadn't been for the three years he spent as an undergraduate researcher in Professor **Robert Cox's** lab. Kustra had taken a summer field course at Mountain Lake Biological Station after his first year. "I thought it was really fun," Kustra says. "The week I got back, I reached out to Bob to see if he had any opportunities in his lab—and that's how I got started."

Over the course of his three years, Kustra gradually became a full-fledged member of Cox's lab. After a semester of having Kustra learn basic lab techniques and care for laboratory animals, Cox offered him the option of working with one of the lab's graduate students on a project. He decided to work with Ariel Kahrl, now an assistant professor at Hamilton College, an expert in the sperm morphology of anoles and other lizards. "The first predictor of success for undergraduates is having someone who can work with them at a detailed level," Cox says. "And that means collaborating closely with a graduate student or postdoc."

At the end of his first year, Cox invited Kustra to join the lab's quarterly field trip to an island off the coast of Florida to monitor a wild population of lizards. "Field work has been the ultimate inspiration for the research I do," Cox says. "For me, it's important to take students out of the lab to see organisms in their natural environment." It certainly had an impact on Kustra: "That trip was a decisive step for me," he says.

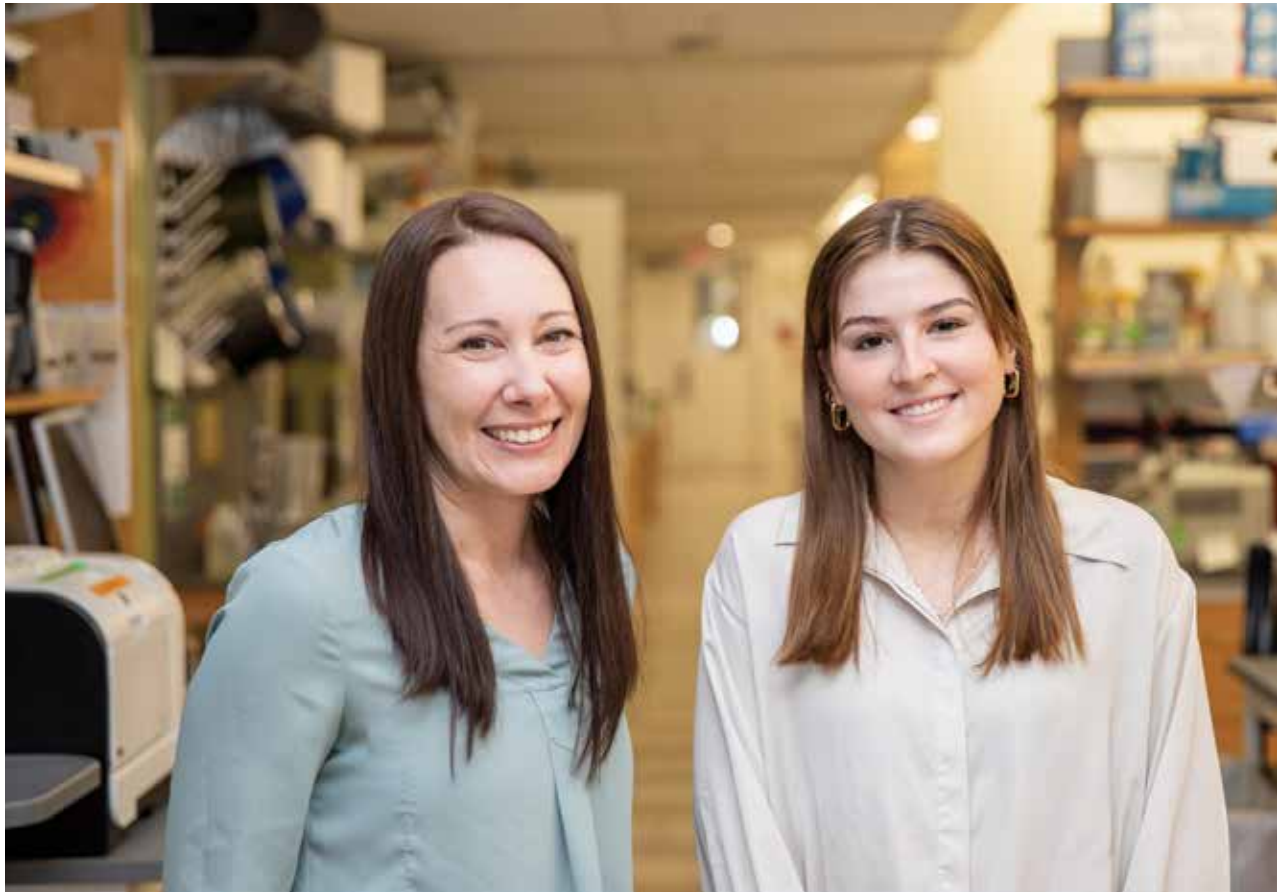
When he returned, Cox started Kustra on his own independent project examining the impact of population density on sperm morphology and sperm count. The result was Kustra's

Matthew Kustra's experience working in Robert Cox's lab inspired him to pursue a doctorate of his own in ecology and evolutionary biology.

first peer-reviewed paper, which was published in *Oecologia* shortly after he graduated from UVA. Kustra was the lead author—while Cox, Kahrl, and other members of the lab were coauthors. Kustra is now looking forward to completing his doctorate at Santa Cruz and securing a postdoctoral position.

"When a student like Matt decides to pursue a career in our field, you feel like you've made a difference," Cox says.





## Moving Students Out of Their Comfort Zones

For Assistant Professor **Tracy Larson**, the opportunity to mentor students is one of the reasons she was attracted to academia. “The whole point of being an academic researcher—as opposed to working in industry—is that you have the opportunity to help train the next generation,” she says. “I am constantly thinking about ways that I can improve the mentoring of my undergraduates, considering new techniques and new ways to structure their experiences in my lab to meet their needs.”

Larson takes a broad view of mentoring. Her role, she believes, is to help students develop skills that will be valuable as they pursue their careers, regardless of whether they intend to become scientists. For instance, one reason that Larson encourages her students to develop their own research questions is to give them the confidence

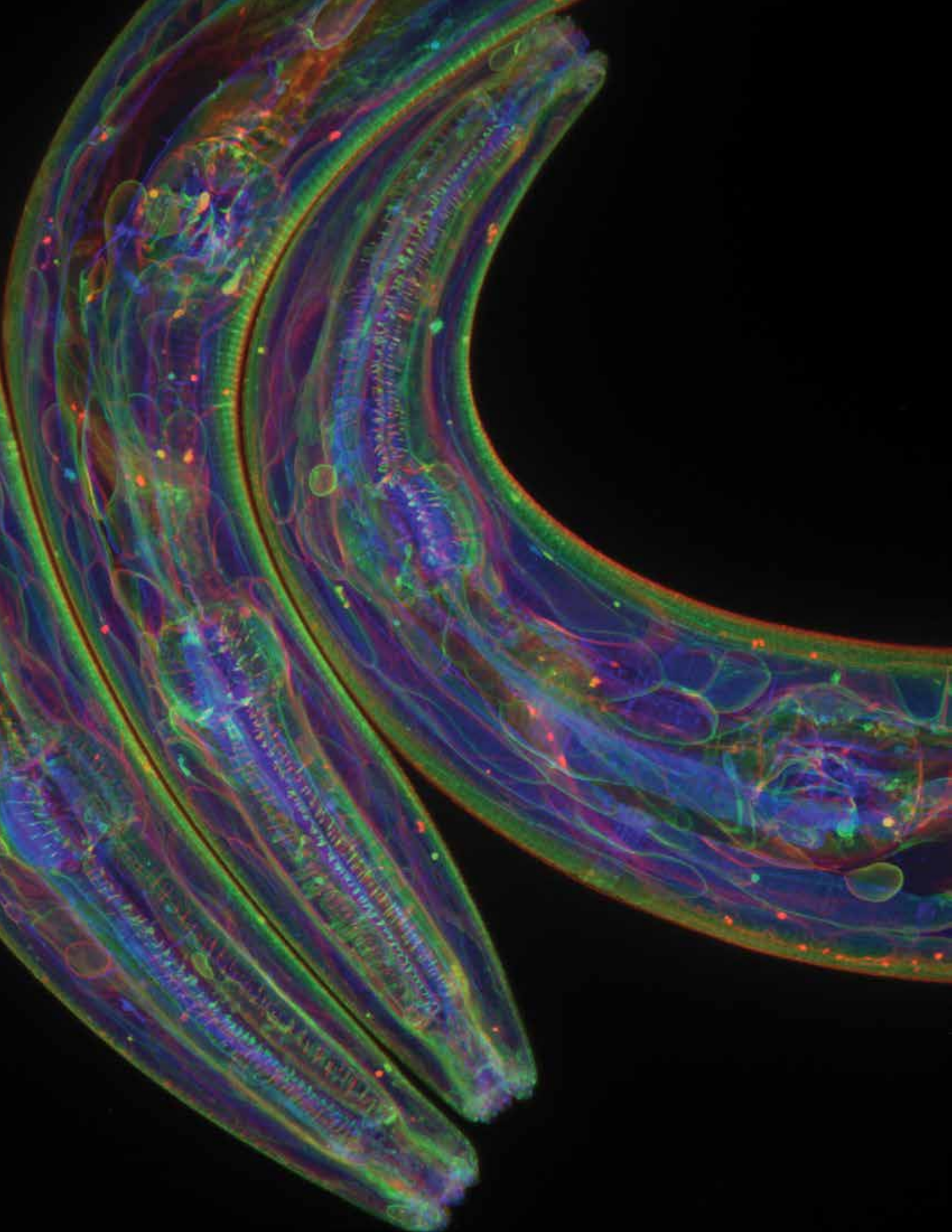
**The whole point of being an academic researcher – as opposed to working in industry – is that you have the opportunity to help train the next generation.**

to take on large projects with uncertain outcomes. “Our undergraduates are extremely talented and have learned to perform exceptionally well in a structured educational environment,” she says. “I work with them to push through the uncomfortable feelings that arise when things don’t work out as expected. That’s a skill they’ll need.”

Larson frequently checks in with her students, assessing how they are doing and helping them set milestones—but she allows them a great deal of latitude to find their own way, something that **Elizabeth Scalzi**, a fourth-year neuroscience major in Larson’s lab, appreciates. “I didn’t even know it was possible to have an independent research project as an undergraduate,” Scalzi says. “I learned from Tracy what I needed to move forward on my own.”

For most of her undergraduate career, Elizabeth Scalzi has worked in Tracy Austin’s lab, focusing on a project that helped her win two grants and served as the basis for her senior thesis.

Scalzi is studying two regions of the brain that, she hypothesized, were competing for space during development. This project has served as a springboard for Scalzi’s academic career. With Larson’s guidance, Scalzi wrote two successful grants that helped fund her research and is writing her senior thesis on it. “Having the experience of working on a single large project for several years has been eye-opening,” Scalzi says. “I’ve really enjoyed the challenge.”



# 2022 Grants, Awards, and Honors

## Grants

### Bergland, Alan

- CAREER: Backyard Evolution across a Seasonal Metapopulation in *Drosophila* U.S. National Science Foundation (NSF). \$1,066,257.

### Bloom, George

- Toxic Effects of Extracellular Tau Oligomers on Neurons. Cure Alzheimer's Fund. \$390,952.
- Development of Adult Human iNeuron Cultures from Patients with Posterior Cortical Atrophy and Other Forms of Alzheimer's Disease. Rick Sharp Alzheimer's Foundation. \$50,000.

### Campbell, John

- Identification of Cell-Type Specific Visual Circuits in the Ventral Lateral Geniculate Nucleus (R21 EY033528), National Institutes of Health (NIH). \$153,120.

### Deppmann, Christopher

- National Institute of Neurological Disorders and Stroke (NINDS). NIH. \$34,885.

### Gibson, Amanda

- Early-Career Vocational Opportunities Workshop Grant: Graduate Student Workshop in Evolutionary Biology Society for the Study of Evolution. \$3,000.



### Güler, Ali

- Interplay between Circadian and Reward Pathways in Homeostatic Response and Pathology (Supplement). National Institute of General Medical Sciences (NIGMS). \$155,520.

### Kozminski, Keith

- iGEM Program at the University of Virginia. NSF. \$98,356.
- Virginia iGEM Program. MITRE Corporation. \$10,000.

### Liu, Xiaorong

- Visible-light Optical Coherence Tomography for Clinical Glaucoma Management. Small Business Innovation Research (SBIR) Phase II. NIH. \$60,000.

### Parichy, David

- AS-BIOL Developmental Origins and Homeostatic Mechanisms Underlying Adult Phenotypes—Renewal. NINDS. \$589,160.
- AS-BIOL Diversity Supplement to Developmental Origins and Homeostatic Mechanisms Underlying Adult Phenotypes. NIGMS. \$164,103.

### Periasamy, Ammasi

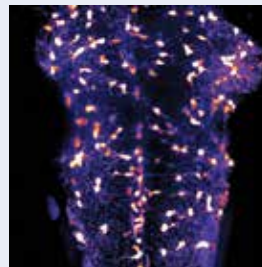
- Leica tauSTED Super Resolution Microscopy for Molecular Imaging in Fixed and Live Specimens. NIH Office of the Director. \$850,357.

### Siegrist, Sarah

- Nutrient-Dependent Regulation of Neural Stem Cell Proliferation and Neural Circuit Formation. R35 equipment supplement. NIH. \$16,402.

### Timko, Michael

- Development of Germplasm, Materials and Processes for Fabrication and Testing of Phytocannabinoid Based Therapeutics. Trulieve, Inc. \$720,696.
- Increasing Efficiency of sdFv Production in a Tobacco-Based System for Synthetic Platelet Design. SelSym Biotech, Inc. \$145,350.



## Faculty Awards and Honors

### Brodie, Edmund

- 2022 Distinguished Herpetologist Award - Herpetologist's League. Plenary lecture given at the annual Joint Meeting of Ichthyologists and Herpetologists. July 2022, Spokane, WA.

### Campbell, John

- UVA's nominee for the 2023 Brain Research Foundation Fay Frank Seed Grant.

### Gibson, Amanda

- Alumni Board of Trustees Teaching Award, April 2022.
- State Council for Higher Education of Virginia. Outstanding Faculty Award, Rising Star Category. Recognizes teaching, research, and public service. UVA nomination in August 2022 and receipt in December 2022.

### Güler, Jennifer

- UVA Vice President for Research Research Achievement Award. 2022.

### Keller, Raymond

- Department of Biology Teaching Award. 2022.

### Kucenas, Sarah

- Invited by Dr. Walter Koroshetz, Director of NINDS, to serve on the Fundamental Neuroscience Working Group (FNWG) of the National Advisory Neurological Disorders and Stroke Council (NANDSC).

### Larson, Tracy

- Cosponsored participant, Faculty Success Program, National Center for Faculty Development and Diversity.

### Manson, Jessamyn S.

- Professional Development Award, UVA HHMI leadership team (Provost's office). Awarded to attend pedagogy conference. Declined due to scheduling conflict.
- Advance Fellow, Faculty-led STEM Student Success Initiative, College of Arts and Sciences.

## Student/Post-Doc Awards and Honors

### Campbell, John

- Ian Irushalmi and Tatiana Coverdell awarded a Double Hoo Award.
- Anirudh Gadicherla awarded a Harrison Undergraduate Research Award.
- Veronica Gutierrez awarded a Harrison Undergraduate Research Award.
- Kandace Moore awarded a Harrison Undergraduate Research Award (declined).
- Kandace Moore awarded a summer research internship.

### Deppmann, Christopher

- Carol Cho awarded a Double Hoo Award.
- August Kahle awarded a Harrison Undergraduate Research Award.
- Sarah Hunter Chang and Riya Verma selected as 2022 Raven Fellows.
- Ashley Mason awarded an F31 National Research Service Award (NIH).

- Tanvika Vegiraju awarded a 2022 summer research fellowship from the UVA Brain Institute.
- Jonathon Sewell elected to the Cell and Molecular Biology Training Grant.
- Sarah Hunter Chang awarded a Wagner Fellowship.

### Kucenas, Sarah

- Ginger Smith awarded a 2022 Harrison Undergraduate Research Award.
- Rebecca Wu awarded a 2021 Beckman Scholarship
- Awarded a 2022 Harrison Undergraduate Research Award (declined).

### Larson, Tracy

- Elizabeth Scalzi awarded a Harrison Undergraduate Research Award.
- Jack Boyd awarded a Harrison Undergraduate Research Award (declined).

### Liu, Xiaorong

- Noelle Nilak awarded a 2022 Harrison Undergraduate Research Award.
- Wenjin Xu awarded a GSAS Research and Development Fellowship.
- James Cole awarded a 2022 UVA ISER/BrightFocus Glaucoma Symposium Travel Award.

# 2022 Publications

## BERGLAND

Barnard-Kubow, K., Becker, D., Murray, C. S., Porter, R., Gutierrez, G., Erickson, P., ... & **Bergland, A. O.** (2021). Polygenic variation in sexual investment across an ephemerality gradient in *Daphnia pulex*. *bioRxiv*, 2021-06.

Becker, D., Barnard-Kubow, K., Porter, R., Edwards, A., Voss, E., Beckerman, A. P., & **Bergland, A. O.** (2021). Stabilizing selection shapes variation in phenotypic plasticity. *bioRxiv*, 2021-07.

Yu, Y., & **Bergland, A. O.** (2021). Unique signals of clinal and seasonal allele frequency change at eQTLs in *Drosophila melanogaster*. *bioRxiv*, 2021-07.

## BLOOM

Norambuena, A., Sun, X., Wallrabe, H., Cao, R., Sun, N., Pardo, E., Periasamy, A., ... & **Bloom, G. S.** (2022). SOD1 mediates lysosome-to-mitochondria communication and its dysregulation by amyloid- $\beta$  oligomers. *Neurobiology of disease*, 169, 105737.

Sharlow, E. R., Llana, D. C., Grever, W. E., Mingle, G. A., Mendelson, A. J., **Bloom, G. S.**, & Lazo, J. S. (2022). High content screening miniaturization and single cell imaging of mature human feeder layer-free iPSC-derived neurons. *SLAS Discovery*.

Wu, L., Wang, Z., Lad, S., Gilyazova, N., Dougherty, D. T., Marcus, M., **Bloom, G. S.**, ... & Xu, B. (2022). Selective detection of misfolded tau from postmortem Alzheimer's disease brains. *Frontiers in Aging Neuroscience*, 14, 945875.

## BRODIE

**Brodie III, E. D.**, Cook, P. A., Costello, R. A., & Formica, V. A. (2022). Phenotypic assortment changes the landscape of selection. *Journal of Heredity*, 113(1), 91–101.

McGlothlin, J. W., Akçay, E., **Brodie III, E. D.**, Moore, A. J., & Van Cleve, J. (2022). A synthesis of game theory and quantitative genetic models of social evolution. *Journal of Heredity*, 113(1), 109–119.

De Lisle, S. P., Bolnick, D. I., **Brodie III, E. D.**, Moore, A. J., & McGlothlin, J. W. (2022). Interacting phenotypes and the coevolutionary process: Interspecific indirect genetic effects alter coevolutionary dynamics. *Evolution*, 76(3), 429–444.



Costello, R. A., Cook, P. A., Formica, V. A., & **Brodie III, E. D.** (2022). Group and individual social network metrics are robust to changes in resource distribution in experimental populations of forked fungus beetles. *Journal of Animal Ecology*, 91(4), 895–907.

Cook, P. A., Baker, O. M., Costello, R. A., Formica, V. A., & **Brodie III, E. D.** (2022). Group composition of individual personalities alters social network structure in experimental populations of forked fungus beetles. *Biology Letters*, 18(3), 20210509.

Gall, B. G., Stokes, A. N., **Brodie III, E. D.**, & Brodie Jr, E. D. (2022). Tetrodotoxin levels in lab-reared rough-skinned newts (*Taricha granulosa*) after 3 years and comparison to wild-caught juveniles. *Toxicol*, 213, 7–12.

Mitchem, L. D., Formica, V. A., Debray, R., Homer, D. E., & **Brodie III, E. D.** (2022). Mycophagous beetle females do not behave competitively during intrasexual interactions in presence of a fungal resource. *Ecology and Evolution*, 12(6), e8977.

Reimche, J. S., Del Carlo, R. E., Brodie Jr, E. D., McGlothlin, J. W., Schlauch, K., Pfrender, M. E., **Brodie III, E. D.**, ... & Feldman, C. R. (2022). The road not taken: Evolution of tetrodotoxin resistance in the Sierra garter snake (*Thamnophis couchii*) by a path less travelled. *Molecular Ecology*, 31(14), 3827–3843.

McGlothlin, J. W., Kobiela, M. E., Wright, H. V., Kolbe, J. J., Losos, J. B., & **Brodie III, E. D.** (2022). Conservation and convergence of genetic architecture in the adaptive radiation of *Anolis* lizards. *The American Naturalist*, 200(5), E207–E220.

Hague, M. T., Miller, L. E., Stokes, A. N., Feldman, C. R., Brodie Jr, E. D., & **Brodie III, E. D.** (2022). Conspicuous coloration of toxin-resistant predators implicates additional trophic interactions in a predator–prey arms race. *Molecular Ecology*.

## CAMPBELL

Coverdell, T. C., Abraham-Fan, R. J., Wu, C., Abbott, S. B., & **Campbell, J. N.** (2022). Genetic encoding of an esophageal motor circuit. *Cell reports*, 39(11).

Somaiya, R. D., Stebbins, K., Gingrich, E. C., Xie, H., **Campbell, J. N.**, Garcia, A. D. R., & Fox, M. A. (2022). Sonic hedgehog-dependent recruitment of GABAergic interneurons into the developing visual thalamus. *Elife*, 11, e79833.

Zhang, Q., Tang, Q., Purohit, N. M., Davenport, J. B., Brennan, C., Patel, R. K., **Campbell, J. N.**, ... & Güler, A. D. (2022). Food-induced dopamine signaling in AgRP neurons promotes feeding. *Cell Reports*, 41(9).

## CANG

Tohmi, M., & **Cang, J.** (2023). Rapid development of motion-streak coding in the mouse visual cortex. *IScience*, 26(1).

Li, C., McHaney, K. M., Sederberg, P. B., & **Cang, J.** (2022). Tree Shrews as an Animal Model for Studying Perceptual Decision-Making Reveal a Critical Role of Stimulus-Independent Processes in Guiding Behavior. *Eneuro*, 9(6).

Tanabe, S., Fu, J., & **Cang, J.** (2022). Strong tuning for stereoscopic depth indicates orientation-specific recurrent circuitry in tree shrew V1. *Current Biology*, 32(24), 5274–5284.

Skyberg, R., Tanabe, S., Chen, H., & **Cang, J.** (2022). Coarse-to-fine processing drives the efficient coding of natural scenes in mouse visual cortex. *Cell reports*, 38(13).

## COX

**Cox, C. L.**, Logan, M. L., Nicholson, D. J., Chung, A. K., Rosso, A. A., McMillan, W. O., & Cox, R. M. (2022). Species-Specific Expression of Growth-Regulatory Genes in 2 Anoles with Divergent Patterns of Sexual Size Dimorphism. *Integrative Organismal Biology*, 4(1), obac025.

Wittman, T. N., Carlson, T. A., Robinson, C. D., Bhawe, R. S., & **Cox, R. M.** (2022). Experimental removal of nematode parasites increases growth, sprint speed, and mating success in brown anole lizards. *Journal of Experimental Zoology Part A: Ecological and Integrative Physiology*, 337(8), 852–866.

**Cox, R. M.**, Hale, M. D., Wittman, T. N., Robinson, C. D., & Cox, C. L. (2022). Evolution of hormone-phenotype couplings and hormone-genome interactions. *Hormones and Behavior*, 144, 105216.

Hale, M. D., Robinson, C. D., Cox, C. L., & **Cox, R. M.** (2022). Ontogenetic Change in Male Expression of Testosterone-Responsive Genes Contributes to the Emergence of Sex-Biased Gene Expression in *Anolis sagrei*. *Frontiers in Physiology*, 13, 886973.

Reinke, B. A., Cayuela, H., Janzen, F. J., Lemaître, J. F., Gaillard, J. M., Lawing, A. M., **Cox, R. M.**, ... & Miller, D. A. (2022). Diverse aging rates in ectothermic tetrapods provide insights for the evolution of aging and longevity. *Science*, 376(6600), 1459–1466.

Fargevieille, A., Reedy, A. M., Kahr, A. F., Mitchell, T. S., Durso, A. M., Delaney, D. M., **Cox, R. M.**, ... & Warner, D. A. (2022). Propagule size and sex ratio influence colonisation dynamics after introduction of a non-native lizard. *Journal of Animal Ecology*, 91(4), 845–857.

## DANNA

Zhang, X., Khadka, P., Puchalski, P., Leehan, J. D., Rossi, F. R., Okumoto, S., ... & **Danna, C. H.** (2022). MAMP-elicited changes in amino acid transport activity contribute to restricting bacterial growth. *Plant Physiology*, 189(4), 2315–2331.

## DEPPMANN

Keeler, A. B., Van Deusen, A. L., Gadani, I. C., Williams, C. M., Goggin, S. M., Hirt, A. K., **Deppmann, C. D.**, ... & Zunder, E. R. (2022). A developmental atlas of somatosensory diversification and maturation in the dorsal root ganglia by single-cell mass cytometry. *Nature Neuroscience*, 25(11), 1543–1558.

McDermott, C., Gaona-Gamboa, A., Lee, S. H., SESCO, E., & **Deppmann, C.** The Role of Posttranslational Modification in Cellular Function. *eLS*, 2, 1–10.



Favichia, M., Gibney, T., Kowalewski, K., Pani, A., & **Deppmann, C.** Salt, Fat, Acid, Heat: Modulators of Signal Transduction. *eLS*, 2, 1–9.

#### GALLOWAY

Koski, M. H., **Galloway, L. F.**, & Busch, J. W. (2022). Hybrid breakdown is elevated near the historical cores of a species' range. *Proceedings of the Royal Society B*, 289(1971), 20220070.

#### GIBSON

Mundim, F. M., & **Gibson, A. K.** (2022). A diverse parasite pool can improve effectiveness of biological control constrained by genotype-by-genotype interactions. *Evolutionary Applications*, 15(12), 2078–2088.

Bubrig, L. T., Janisch, A. N., Tillet, E. M., & **Gibson, A. K.** (2022). Contrasting parasite-mediated reductions in fitness within versus between patches of a nematode host. *Evolution*, 76(7), 1556–1564.

**Gibson, A. K.** (2022). Genetic diversity and disease: The past, present, and future of an old idea. *Evolution*, 76(st), 20–36.

#### GRAINGER

Nakayama, T., Cox, A., Howell, M., & **Grainger, R. M.** (2022). Gynogenetic Production of Embryos in *Xenopus tropicalis* Using a Cold Shock Procedure: Rapid Screening Method for Gene Editing Phenotypes. *Cold Spring Harbor Protocols*.

Nakayama, T., **Grainger, R. M.**, & Cha, S. W. (2022). Homology-Directed Repair by CRISPR-Cas9 Mutagenesis in *Xenopus* Using Long Single-Stranded Donor DNA Templates via Simple Microinjection of Embryos. *Cold Spring Harbor Protocols*.



Nakayama, T., Gray, J., & **Grainger, R. M.** (2022). Production of Transgenic F0 Animals and Permanent Lines by Sperm Nuclear Transplantation in *Xenopus tropicalis*. *Cold Spring Harbor Protocols*.

Nakayama, T., & **Grainger, R. M.** (2022). Best Practices for *Xenopus tropicalis* Husbandry. *Cold Spring Harbor Protocols*.

Nakayama, T., Roubroeks, J. A., Veenstra, G. J. C., & **Grainger, R. M.** (2022). Preparation of Intact Nuclei for Single-Nucleus Omics Using Frozen Cell Suspensions from Mutant Embryos of *Xenopus tropicalis*. *Cold Spring Harbor Protocols*.

#### A. GÜLER

Zhang, Q., Tang, Q., Purohit, N. M., Davenport, J. B., Brennan, C., Patel, R. K., ... & **Güler, A. D.** (2022). Food-induced dopamine signaling in AgRP neurons promotes feeding. *Cell Reports*, 41(9).

Chadwick, S. R., & **Güler, A. D.** (2022). Local Drd1-neurons input to subgroups of arcuate AgRP/NPY-neurons. *Science*, 25(7).

Tang, Q., P Williams, S., & **Güler, A. D.** (2022). A building block-based beam-break (B5) locomotor activity monitoring system and its use in circadian biology research. *BioTechniques*, 73(2), 104–109.

Lacerda, J. T., Gomes, P. R., Zanetti, G., Mezzalana, N., Lima, O. G., de Assis, L. V., **Güler, A. D.**, ... & Moraes, M. N. (2022). Lack of TRPV1 channel modulates mouse gene expression and liver proteome with glucose metabolism changes. *International Journal of Molecular Sciences*, 23(13), 7014.

Rainwater, A., & **Güler, A. D.** (2022). Food preference assay in male and female C57BL/6 mice. *Journal of neuroscience methods*, 365, 109384.

Tang, Q., Assali, D. R., **Güler, A. D.**, & Steele, A. D. (2022). Dopamine systems and biological rhythms: Let's get a move on. *Frontiers in Integrative Neuroscience*, 16, 957193.

#### J. GÜLER

Carey, M. A., Medlock, G. L., Stolarczyk, M., Petri Jr, W. A., **Güler, J. L.**, & Papin, J. A. (2022). Comparative analyses of parasites with a comprehensive database of genome-scale metabolic models. *PLoS computational biology*, 18(2), e1009870.



#### KAWASAKI

Leonard, J., Matsushita, A., & **Kawasaki, M.** (2022). Morphology and receptive field organization of a temporal processing region in *Apterontotus albifrons*. *Journal of Comparative Physiology A*, 208(3), 405–420.

#### KELLER

Shook, D. R., Wen, J. W., Rolo, A., O'Hanlon, M., Francica, B., Dobbins, D., ... & **Keller, R. E.** (2022). Characterization of convergent thickening, a major convergence force producing morphogenic movement in amphibians. *Elife*, 11, e57642.

#### KUCENAS

Morioka, S., Kajioaka, D., Yamaoka, Y., Ellison, R. M., Tufan, T., Werkman, I. L., **Kucenas, S.** ... & Ravichandran, K. S. (2022). Chimeric efferocytic receptors improve apoptotic cell clearance and alleviate inflammation. *Cell*, 185(26), 4887–4903.

Arena, K. A., Zhu, Y., & **Kucenas, S.** (2022). Transforming growth factor beta signaling modulates perineurial glial bridging following peripheral spinal motor nerve injury in zebrafish. *Glia*, 70(10), 1826–1849.

Wiltbank, A. T., Steinson, E. R., Criswell, S. J., Piller, M., & **Kucenas, S.** (2022). Cd59 and inflammation regulate Schwann cell development. *Elife*, 11.

Xu, B., **Kucenas, S.**, & Zong, H. (2022). zMADM (zebrafish mosaic analysis with double markers) for single-cell gene knockout and dual-lineage tracing. *Proceedings of the National Academy of Sciences*, 119(9), e2122529119.

Brown, E. A., Kawakami, K., & **Kucenas, S.** (2022). A novel gene trap line for visualization and manipulation of *erbb3b*<sup>+</sup> neural crest and glial cells in zebrafish. *Developmental Biology*, 482, 114–123.

Barber, H. M., Ali, M. F., & **Kucenas, S.** (2022). Glial patchwork: oligodendrocyte progenitor cells and astrocytes blanket the central nervous system. *Frontiers in Cellular Neuroscience*, 15, 803057.

Liu, K. E., Raymond, M. H., Ravichandran, K. S., & **Kucenas, S.** (2022). Clearing Your Mind: Mechanisms of Debris Clearance After Cell Death During Neural Development. *Annual review of neuroscience*, 45, 177–198.

#### LIU

Gao, J., Provencio, I., & **Liu, X.** (2022). Intrinsically photosensitive retinal ganglion cells in glaucoma. *Frontiers in Cellular Neuroscience*, 16, 992747.

Ghassabi, Z., Kuranov, R. V., Schuman, J. S., Zambrano, R., Wu, M., **Liu, X.**, ... & Ishikawa, H. (2022). In vivo sublayer analysis of human retinal inner plexiform layer obtained by visible-light optical coherence tomography. *Investigative Ophthalmology & Visual Science*, 63(1), 18–18.

Gao, J., Griner, E. M., Liu, M., Moy, J., Provencio, I., & **Liu, X.** (2022). Differential effects of experimental glaucoma on intrinsically photosensitive retinal ganglion cells in mice. *Journal of Comparative Neurology*, 530(9), 1494–1506.

Cole, J. D., McHaney, K. M., Rabiee, B., Gao, J., Rodriguez, C., Miller, D. A., ... & **Liu, X.** (2022). Long-term retinal protection by MEK inhibition in Pax6 haploinsufficiency mice. *Experimental eye research*, 218, 109012.

#### O'ROURKE

Armingol, E., Ghaddar, A., Joshi, C. J., Baghdassarian, H., Shamie, I., Chan, J., **O'Rourke, E. J.**, ... & Lewis, N. E. (2022). Inferring a spatial code of cell-cell interactions across a whole animal body. *PLoS computational biology*, 18(11), e1010715.

Joshi, C. J., Ke, W., Drangowska-Way, A., **O'Rourke, E. J.**, & Lewis, N. E. (2022). What are housekeeping genes?. *PLoS computational biology*, 18(7), e1010295.

## 2022 Publications

### PANI

Pani, A. M., Gibney, T. V., Medwig-Kinney, T. N., Matus, D. Q., & Goldstein, B. (2022). A new toolkit to visualize and perturb endogenous LIN-12/Notch signaling in *C. elegans*. *MicroPublication Biology*, 2022.

Medwig-Kinney, T. N., Sirota, S. S., Gibney, T. V., Pani, A. M., & Matus, D. Q. (2022). An in vivo toolkit to visualize endogenous LAG-2/Delta and LIN-12/Notch signaling in *C. elegans*. *MicroPublication Biology*, 2022.

Favichia, M., Gibney, T., Kowalewski, K., Pani, A., & Deppmann, C. Salt, Fat, Acid, Heat Modulators of Signal Transduction. *eLS*, 2, 1–9.

### PARICHY

Toomey, M. B., Marques, C. I., Araújo, P. M., Huang, D., Zhong, S., Liu, Y., Parichy, D. M., ... & Corbo, J. C. (2022). A mechanism for red coloration in vertebrates. *Current Biology*, 32(19), 4201–4214.

Lalonde, R. L., Kemmler, C. L., Riemsdijk, F. W., Aman, A. J., Kresoja-Rakic, J., Moran, H. R., Parichy, D. M., ... & Mosimann, C. (2021). Heterogeneity and genomic loci of ubiquitous Cre reporter transgenes in zebrafish. *bioRxiv*, 2021-12.



### PERIASAMY

Norambuena, A., Sun, X., Wallrabe, H., Cao, R., Sun, N., Pardo, E., Periasamy, A., ... & Bloom, G. S. (2022). SOD1 mediates lysosome-to-mitochondria communication and its dysregulation by amyloid- $\beta$  oligomers. *Neurobiology of disease*, 169, 105737.

Alam, S. R., Wallrabe, H., Christopher, K. G., Siller, K. H., & Periasamy, A. (2022, March). Characterization of phototoxic effects in multiphoton FLIM. In *Multiphoton Microscopy in the Biomedical Sciences XXII* (Vol. 11965, pp. 74–80). SPIE.

### PROVENCIO

Gao, J., Provencio, I., & Liu, X. (2022). Intrinsically photosensitive retinal ganglion cells in glaucoma. *Frontiers in Cellular Neuroscience*, 16, 992747.

### SIEGRIST

Dillon, N., Cocanougher, B., Sood, C., Yuan, X., Kohn, A. B., Siegrist, S. E., ... & Doe, C. Q. (2022). Single cell RNA-seq analysis reveals temporally-regulated and quiescence-regulated gene expression in *Drosophila* larval neuroblasts. *Neural Development*, 17(1), 1–18.

Sood, C., Justis, V. T., Doyle, S. E., & Siegrist, S. E. (2022). Notch signaling regulates neural stem cell quiescence entry and exit in *Drosophila*. *Development*, 149(4), dev200275.

Doyle, S. E., & Siegrist, S. E. (2022). Neural Stem Cell Reactivation in Cultured *Drosophila* Brain Explants. *Journal of Visualized Experiments: Jove*, (183).

### TIMKO

Bian, S., Sui, X., Wang, J., Tian, T., Wang, C., Zhao, X., Timko, M. P., ... & Zhang, H. (2022). NtMYB305a binds to the jasmonate-responsive GAG region of NtPMT1a promoter to regulate nicotine biosynthesis. *Plant Physiology*, 188(1), 151–166.

Wang, C., Ding, Y., Wang, W., Zhao, X., Liu, Y., Timko, M. P., ... & Zhang, H. (2022). Insights into gene regulation of jasmonate-induced whole-plant senescence of tobacco under non-starvation conditions. *Plant and Cell Physiology*, 63(1), 45–56.

Liu, H., & Timko, M. P. (2022). Improving protein quantity and quality—The next level of plant molecular farming. *International Journal of Molecular Sciences*, 23(3), 1326.

Wu, D., Shen, E., Jiang, B., Feng, Y., Tang, W., Timko, M. P., ... & Ye, C. Y. (2022). Genomic insights into the evolution of *Echinochloa* species as weed and orphan crop. *Nature communications*, 13(1), 689.

da Silva Matos, M. K., Benko-Iseppon, A. M., Bezerra-Neto, J. P., Ferreira-Neto, J. R. C., Wang, Y., Timko, M. P., ... & Brasileiro-Vidal, A. C. (2022). The WRKY transcription factor family in cowpea: Genomic characterization and transcriptomic profiling under root dehydration. *Gene*, 823, 146377.

Wu, D., Jiang, B., Ye, C. Y., Timko, M. P., & Fan, L. (2021). Horizontal Transfer and Evolution of the Biosynthetic Gene Cluster for Benzoxazinoid. *bioRxiv*, 2021-12.

Heineman, J. T., Forster, G. L., Stephens, K. L., Cottler, P. S., Timko, M. P., & DeGeorge Jr, B. R. (2022). A randomized controlled trial of topical cannabidiol for the treatment of thumb basal joint arthritis. *The Journal of hand surgery*, 47(7), 611–620.

Stephens, K. L., Heineman, J. T., Forster, G. L., Timko, M. P., & DeGeorge Jr, B. R. (2022). Cannabinoids and Pain for the Plastic Surgeon: What Is the Evidence?. *Annals of Plastic Surgery*, 88(5), S508–S511.

Shen, Y., Yu, F., Zhang, D., Zou, Q., Xie, M., Chen, X., Timko, M. P., ... & Chen, Y. (2022). Dynamic Alterations in the Respiratory Tract Microbiota of Patients with COVID-19 and its Association with Microbiota in the Gut. *Advanced Science*, 9(27), 2200956.



Li, J., Yang, X., Chu, Q., Xie, L., Ding, Y., Xu, X., Timko, M. P., & Fan, L. (2022). Multi-omics molecular biomarkers and database of osteoarthritis. *Database*, 2022, baac052.

Awuku, F. J., Kusi, F., Danquah, A., Tongoona, P., & Timko, M. P. (2022). Morphological and molecular profiling of *Striga gesnerioides* on cowpea in Ghana. *Ecological Genetics and Genomics*, 25, 100141.

Zheng, Y., Yao, J., Shen, X., Cheng, H., Peng, Y., Timko, M. P., ... & Fan, L. (2023). A Manually Curated Database and Analysis Platform of Cell Markers of Scars. *The Journal of investigative dermatology*, 143(4), 673–676.

Ohlson, E. W., & Timko, M. P. (2022). Mapping and Validation of *Alectra vogelii* Resistance in the Cowpea Landrace B301. *Agronomy*, 12(11), 2654.

Ruan, J., Xu, S., Chen, R., Qu, W., Li, Q., Ye, C., Timko, M. P., ... & Shen, Y. (2022). EMLI-ICC: an ensemble machine learning-based integration algorithm for metastasis prediction and risk stratification in intrahepatic cholangiocarcinoma. *Briefings in Bioinformatics*, 23(6), bbac450.

Yoyo, F. D. M., Gonne, S., Kosma, P., Pierre, T. F., Liliane, I., Arlette, Z. Z., ... & Timko, M. P. (2022). Morphological and Biometric Diversity of *Colletotrichum capsici* Isolates, Causal Agent of Cowpea Brown Blotch Disease (*Vigna unguiculata* (L.) Walp) in the Sudano-Sahelian Zone of Cameroon. *Open Journal of Applied Sciences*, 12(11), 1837–1855.

### WU

Gao, Y., & Wu, M. (2022). Microbial genomic trait evolution is dominated by frequent and rare pulsed evolution. *Science Advances*, 8(28), eabn1916.

Gao, Y., & Wu, M. (2022). Modeling pulsed evolution and time-independent variation improves the confidence level of ancestral and hidden state predictions. *Systematic Biology*, 71(5), 1225–1232.

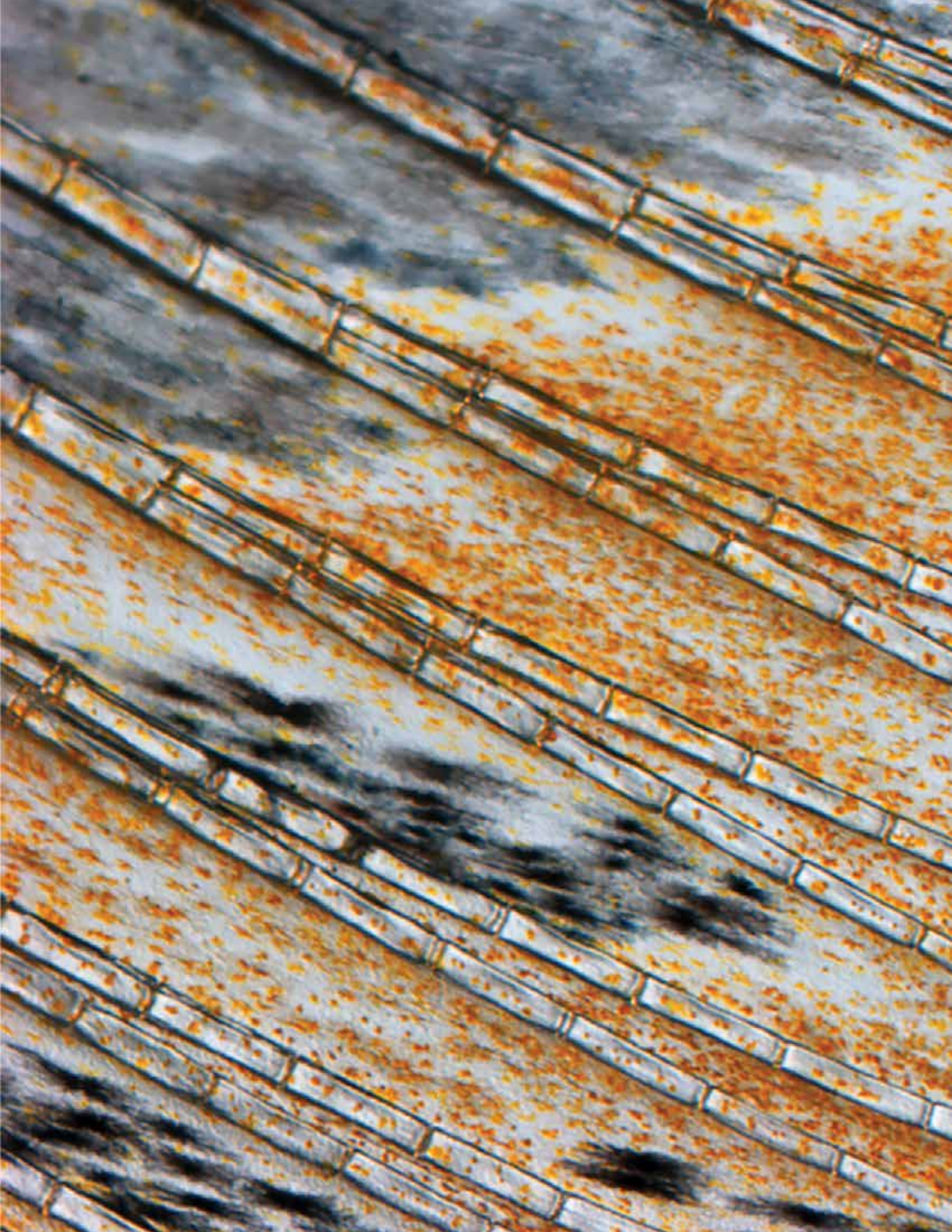
Shanmugakani, R. K., & Wu, M. (2022). An isothermal amplification-coupled dipstick for the rapid detection of COVID-19. *Journal of Medical Microbiology*, 71(4), 001519.

Petrullo, L., Ren, T., Wu, M., Boonstra, R., Palme, R., Boutin, S., ... & Dantzer, B. (2022). Glucocorticoids coordinate changes in gut microbiome composition in wild North American red squirrels. *Scientific Reports*, 12(1), 2605.

Costa, D. V., Pham, N. V., Hays, R. A., Bolick, D. T., Goldbeck, S. M., Wu, M., ... & Warren, C. A. (2022). Influence of binary toxin gene detection and decreased susceptibility to antibiotics among *Clostridioides difficile* strains on disease severity: a single-center study. *Antimicrobial Agents and Chemotherapy*, 66(8), e00489-22.

Li-Gao, R., Grubbs, K., Bertoni, A. G., Hoffman, K. L., Petrosino, J. F., Ramesh, G., Wu, M., ... & Sheridan, P. A. (2022). The Roles of Gut Microbiome and Plasma Metabolites in the Associations between ABO Blood Groups and Insulin Homeostasis: The Microbiome and Insulin Longitudinal Evaluation Study (MILES). *Metabolites*, 12(9), 787.

Cui, J., Ramesh, G., Wu, M., Jensen, E. T., Crago, O., Bertoni, A. G., ... & Goodarzi, M. O. (2022). Butyrate-producing bacteria and insulin homeostasis: The microbiome and insulin longitudinal evaluation study (MILES). *Diabetes*, 71(11), 2438–2446.



**Department of Biology**

326 Gilmer Hall  
University of Virginia  
485 McCormick Road  
P.O. Box 400328  
Charlottesville, VA  
22904-4328

VIEW US ONLINE AT [bio.as.virginia.edu](http://bio.as.virginia.edu)

CONTACT US AT [smb3n@virginia.edu](mailto:smb3n@virginia.edu)