THE Physiologist MAGAZINE
NOVEMBER 2025

Perseverance in Pediatrics

Fong Lam, MD, and his persistent questions may pave the way for a new treatment for infants.

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Cover photo by Rocky Kneten

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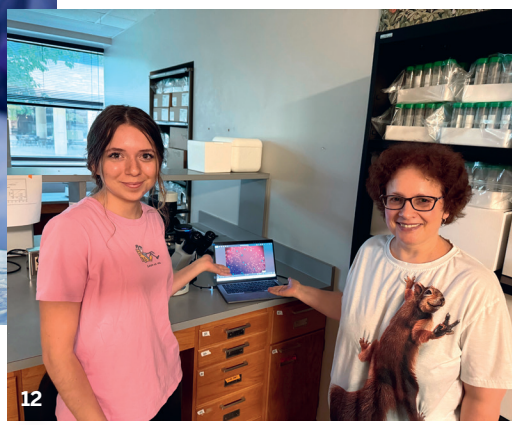

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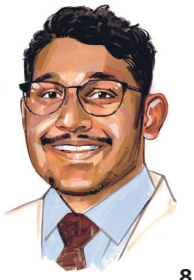

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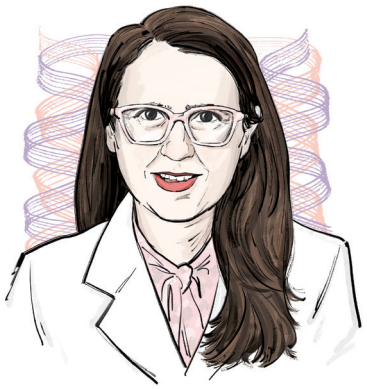

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Recognizing Excellence in Physiology

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american physiology summit

APRIL 23–26, 2026
MINNEAPOLIS

Paws, Claws and Chaos

BY AMANDA BERTHOLF, MA

We recently adopted two kittens. They're adorable, curious and completely unbothered by the idea of personal space and sleep schedules. Immediately, our comfortable, usual household routine turned into a whirlwind of pouncing, meowing, climbing and trying to keep my beloved houseplants out of harm's way. There's a certain kind of chaos that comes with not knowing where your next step will land (especially if it's on a cat toy). It's been a reminder of how much we all crave a sense of control—and how uncomfortable uncertainty can be.

This type of chaos shows up in bigger—and less fun—ways, too. Anxiety, fear, worry, burnout … they all seem to be common experiences in our personal and professional lives and as we look at the world around us. Often those concerns bring feelings of uncertainty. The human nervous system prefers the known, and uncertainty can cause it stress. When we don't know what is coming down the road—or we fear what tomorrow might bring—our brains and bodies react physiologically. On page 22, we examine the science behind uncertainty and how it affects us.

"Amid all the uncertainty, one thing that feels steady is the work you do."

One thing that is certain is the importance of communicating science to the general public, future scientists and lawmakers—now more than ever. You know the science, but how do you explain it to people who may know little about physiology? How do you share your science in a clear and interesting way? We interviewed some experts, and on page 28, we share five tips that will make your communication more effective.

In this issue's member profile, we feature the story of a practicing physician who is passionate about physiology. Fong Lam, MD, uses physiology every day as he treats infants and kids at Texas Children's Hospital in Houston, while also researching microcirculation. He loves teaching physiology to medical residents and fellows, imparting on them the importance of understanding physiological processes to be better doctors. Read about his journey on page 16.

Amid all the uncertainty, one thing that feels steady is the work you do—asking questions, uncovering answers and sharing your findings. In this issue, we highlight a few ways physiologists are navigating that work with clarity and purpose. Whether it's learning how to communicate science more effectively or seeing how physiology shapes patient care, these stories remind us that curiosity drives this field.

While life with kittens has been a crash course in unpredictability, it has also been a lesson in curiosity. Their instinct to explore and test the limits without hesitation is messy, but it's also courageous. And maybe that's something we all need right now: not certainty, but curiosity to keep us moving forward.

Amanda Bertholf, MA, is APS director of communications and the editor-in-chief of *The Physiologist Magazine*. Send questions or comments to the editor at tphysmag@physiology.org.

THE Physiologist MAGAZINE

VOL. 68 | NOVEMBER 2025

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The Physiologist Magazine (ISSN 0031-9376) is published six times a year by the American Physiological Society (APS), 6120 Executive Blvd., Suite 575, Rockville, MD, 20852-4911.

APS*select*

Astronauts' Arteries Weather Long Spaceflights

The structure and function of astronauts' arteries are stable and disease-free up to five years after they've returned from the International Space Station. It's well-known that short-term adaptations in astronauts' cardiovascular system—in microgravity and shortly after returning to Earth—include less blood circulating throughout the body, less ability to physically exert themselves, and dizziness or lightheadedness when standing. However, longer-term changes and changes that occur after a long-duration mission (some of the astronauts studied spent almost a year in space) aren't as well-understood. In this study from the *Journal of Applied Physiology*, NASA astronaut volunteers had higher markers of inflammation and oxidative stress in their blood and urine, but these resolved within one week after landing. The researchers saw no increase in carotid artery thickening or stiffness and no negative changes in blood vessel health. Over time, the astronauts' cholesterol and blood sugar levels increased, and their predicted risk of developing heart disease also rose slightly. The research team found these changes to be more due to natural aging than exposure to microgravity, pointing to the incredible resilience of the astronauts' cardiovascular systems.

Source: doi.org/10.1152/japplphysiol.00264.2024

Unless otherwise specified, all images: istock

IN BRIEF

The Latest Research from APS Journals

Explore new peer-reviewed findings published across the Society's journals.

Heat stress disrupts mammary epithelial cells in cows, even after the heat subsides. Study provides insight into genes involved with stress and recovery.

doi.org/10.1152/physiolgenomics.00127.2024

Non-invasive skin heating could replace nitric oxide measurement when invasive tests aren't possible, offering a simpler way to assess blood vessel function.

doi.org/10.1152/japplphysiol.00324.2025

Study finds eight days of cold exposure doesn't improve comfort, skin temperature or hand function.

doi.org/10.1152/ajpregu.00076.2025

APS*select*

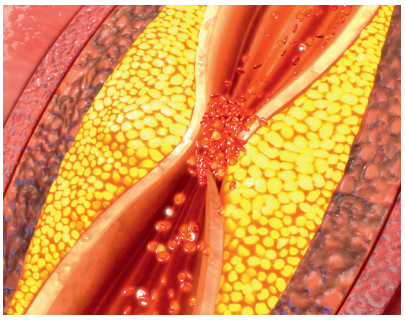
Simple Spritz Eases Heat Stress

Extreme heat poses serious health risks for older adults, especially when air conditioning isn't available. This study in the *Journal of Applied Physiology* tested how simple cooling methods—water spray and electric fans—affect the body's response to very hot, dry conditions. A group of older adults (average age of 75) were exposed to 116-degree F heat with different cooling treatments: water spray, fan use, both combined, or no cooling. Water spray helped reduce core body temperature, skin temperature, sweating, heart rate and cardiac workload, easing heat strain. In contrast, using fans alone actually increased these stress markers, putting additional strain on the heart and body. Combining fans with water spray offered some cooling, but was less effective than water spray alone. These results suggest that for older adults in extreme dry heat, water spray is a simple, effective way to reduce heat stress, while electric fans may do more harm than good under these conditions.

Source: doi.org/10.1152/japplphysiol.00390.2025

Immunometabolism

Metformin Protects Heart Health Beyond Diabetes



Metformin, the well-known—and most prescribed—diabetes drug, is already recognized for protecting cardiovascular health in people with diabetes. New research in mice suggests it may also benefit people who don't have diabetes. In this study, in the *American Journal of Physiology-Endocrinology and Metabolism*, the drug reduced artery plaque size and inflammation even when blood sugar was normal by preventing specialized stem cells in the bone marrow from releasing inflammatory cells that worsen artery damage and contribute to plaque formation. Metformin also helps these cells get rid of excess cholesterol by slowing down cholesterol production in liver cells, which protects the heart. These findings suggest metformin may have heart-protective benefits beyond diabetes and independently of glucose regulation, opening new doors for preventing artery disease.

Source: doi.org/10.1152/ajpendo.00056.2025

Nontraditional medical school students benefit from flexible pacing, mentorship and inclusive teaching strategies that recognize diverse strengths and support equitable success.

doi.org/10.1152/advan.00076.2025

Long-term head-down bedrest alters blood pressure control differently in men and women, with women showing stronger vessel responses during simulated standing.

doi.org/10.1152/japplphysiol.00309.2025

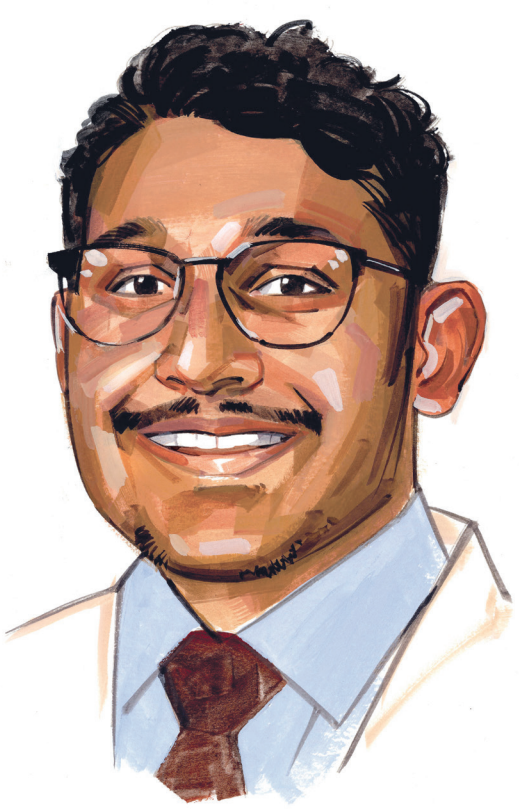
Exercise boosts kidney blood flow, fluid regulation and immune activity in mice. Improved fluid removal occurred only in males.

doi.org/10.1152/ajprenal.00218.2025

Blood flow restriction and light weightlifting cause more muscle fatigue than heavy weights in people with multiple sclerosis, which could enhance training benefits.

doi.org/10.1152/jn.00197.2025

LAB NOTES



Rohit Reddy

Daniel Gagnon, PhD

MENTORING Q&A | MEDICAL SCHOOL

Ignite Your Fire

How to keep your passion for physiology alive.

Each issue, we ask a student or early-career member to pose their career questions to an established investigator and mentor. Here, **Rohit Reddy**, a second-year medical student at the University of Alabama Heersink School of Medicine, asks **Daniel Gagnon, PhD**, an associate professor at the Université de Montréal, Quebec, Canada, how to stay encouraged in a highly competitive field.

Illustrations by Kagan McLeod

Q: You've built a successful research career in an increasingly competitive field. What's the hardest truth about academic science that no one talks about?
A: That competition is fierce. This is generally acknowledged, but perhaps not talked about sufficiently. In my experience, it is important to develop thick skin to not let the many setbacks of academic science stop us from learning and progressing towards the eventual successes, as small or big as they may be.

In my opinion, being able to prioritize research despite multiple competing priorities is essential to favor success in research.

Q: You've seen physiology evolve dramatically over your career. What worries you most about where the field is headed?
A: I honestly cannot say I am worried. My experience has been that the field of physiology is gaining more recognition beyond our discipline. We will always need physiology to understand how the biological functions of living organisms work (or don't work) to continue developing preventive strategies, treatments or enhance performance.

Perhaps what is worrying is my perception that decision-making at the highest levels does not need to be based upon empirical facts anymore. I suppose that is a topic for another conversation.

"In my experience, it is important to develop thick skin to not let the many setbacks of academic science stop us from learning and progressing towards the eventual successes, as small or big as they may be."

Q: When you look at trainees today, what's the biggest misconception they have about what it takes to succeed in research?
A: That to succeed the only thing needed is to focus on research. If only it were that simple! For most of us, research is only one component of our work, and as trainees we may not fully grasp how difficult it can be to deal with multiple priorities, responsibilities and expectations simultaneously.

Q: Every scientist faces moments where they question whether it's worth it. What keeps you from walking away?
A: What keeps me going is that I truly enjoy (almost) all aspects of my work. I feel we are privileged as researchers and academics to drive our own research agenda, which I find very stimulating. But what I enjoy most are interactions with students and colleagues. Working and interacting with great people always makes the harder times seem easier.

Q: What is one piece of advice for someone starting their research career today?
A: To go for it! We often hear how academic research is competitive with relatively limited opportunities and how demanding it is if we make it to an academic position. That said, we need, perhaps more than ever, driven trainees to aspire towards a research career. The next generation will not only ensure our field keeps going but will also push the existing generation to evolve and perform "better" research.

We also need early-career researchers to be vocal ambassadors for research and why it matters, to continue fighting battles we perhaps took for granted.

Got a career question you'd like to submit? Email it to tphysmag@physiology.org. We may use it in an upcoming Mentoring Q&A.

STATS & FACTS

Stress is linked to the six leading causes of death in America: heart disease, cancer, lung ailments, accidents, cirrhosis of the liver and suicide.

Veterans Affairs Mental Health Care

75%–90%

of all medical office visits in the U.S. are for stress-related ailments and complaints.

Veterans Affairs Mental Health Care

"Our brains are designed to seek certainty."

—Aoife O'Donovan, PhD

A meta-analysis found that uncertainty activates the amygdala, anterior cingulate cortex, and insula, brain regions also involved in threat perception and pain.

"Uncertainty and Anticipation in Anxiety: An Integrated Neurobiological and Psychological Perspective," *Nature Reviews Neuroscience*

STREAMING SCIENCE | SOUNDBITES FROM APS JOURNAL PODCASTS

Expanding the Heart Donor Pool

Advances in donor heart preservation may now hinge on ferroptosis—programmed cell death fueled by iron accumulation and lipid peroxidation. In this *American Journal of Physiology-Heart and Circulatory Physiology* podcast episode, experts discuss groundbreaking findings: Prolonged cold storage heightens ferroptosis risk in hearts donated after brain death (DBD), while warm ischemia increases it in hearts from circulatory death (DCD). Researchers propose that tailored interventions—such as inhibiting ferroptosis during cold preservation for DBD hearts, or targeting early warm ischemia in DCD hearts—could improve transplant viability. Tune in to explore how this discovery could help expand the donor pool and optimize care for patients undergoing heart transplantation.

Catch the full episode:

istock

POLICY IQ | RESEARCH

Why Animal Research Still Matters

Despite growing calls for full replacement, animal models remain essential.

The ethical and scientific foundation of animal research has been well-established. But in today's politicized climate, its role is being questioned now more than ever—loudly and often without scientific basis.

At the center of the debate is a fundamental misunderstanding that modern research technology can fully replace animal models. Tools such as organ-on-a-chip, microphysiological systems and artificial intelligence (AI) offer exciting possibilities—but they are not substitutes for the complex living systems required to understand how the body functions. For physiologists and biomedical researchers, there is no viable replacement for animal research, and understanding why is critical to protecting scientific progress.

First introduced in 1959 in "The Principles of Humane Experimental Technique," the principles of the 3Rs—reduction, refinement and replacement—have guided animal use in research for decades. These principles shape how investigators design experiments and write animal use protocols and how institutional animal care and use committees function. The 3Rs are embedded into the "Guide for the Care and Use of Laboratory Animals" and the "U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training." The 3Rs are not aspirational; they are standard. But of the three, replacement is the most frequently misunderstood—and the most politicized. Anti-animal research activists have long focused on replacement, arguing that the existence of alternatives—no matter how limited—makes continued animal use unethical. Recently, this argument has gained traction in policy circles. Proponents of organ-on-a-chip and microphysiological systems often present these technologies as side-by-side replacements for animals in research.

Federal agencies are responding to this momentum. U.S. Health and Human Services Secretary Robert F. Kennedy Jr. said he intends to oversee a "dramatic reduction in animal testing," in part because of the promise of AI to replace animals in research. His statement was followed by an announcement from the U.S. Food and Drug Administration about plans to phase out animal testing requirements for monoclonal antibodies and other drugs.

However, this effort is not limited to clinical research and drug development. The National Institutes of Health (NIH) has announced an initiative to "prioritize human-based research technologies." A new Office of Research Innovation, Validation and Application, will validate alternative models. NIH announced in July that it will no longer issue Notices of Funding Opportunity that exclusively support animal models.

Despite growing enthusiasm for alternatives, there is currently no full replacement for animal models. Studying organ systems or disease states requires approaches that are not limited to animal or non-animal based models.

APS member Caitlin Vonderohe, DVM, PhD, studies diseases primarily affecting infants and children. These conditions are rare, devastating and biologically distinct from disease states in adults. Her research program, like many others, seeks to leverage the strengths of all available models available.

"The physiological differences between preterm infants and healthy adults who would be likely to volunteer for a clinical trial are insurmountable," Vonderohe says. "Therefore, we've developed a research program that leverages the strengths of both animal and non-animal models."

Replacement is the most frequently misunderstood—and the most politicized.

This kind of layered, multi-model design is common in physiology—and what the 3Rs intend to promote. APS remains committed to ensuring researchers have access to the range of resources they need to answer fundamental questions about life and health. This includes alternatives where appropriate and animal models where necessary.

Email questions or comments to **tphysmag@physiology.org**.

UNDER THE MICROSCOPE | A FAMILY DESTINY

All Creatures Great and Small

Researcher veers from the physics surrounding her and becomes a "rebellious" biologist.

Natalya S. Zinkevich, PhD, is an assistant professor at the University of Illinois Springfield. She teaches undergraduate introductory and upper-level human anatomy and physiology, human disease, and comparative vertebrate biology courses. She is passionate about conducting research with students interested in vascular physiology.

A SCIENCE CITY. I grew up in the Russian science city of Dubna in the Moscow region and was surrounded by scientists. My mom and dad worked for the Joint Institute of Nuclear Research, an international research center for nuclear sciences. Math and physics were greatly emphasized in the school I went to. It is not surprising that many of my classmates decided to become physicists to follow in the footsteps of their parents. My rebellion was to become a biologist. As a young child, I read "My Family and Other Animals" by Gerald Durrell and became greatly interested in zoology. Later, I learned about the tragic fate (persecution, imprisonment and execution) of geneticists during the Soviet Union, which inspired me to seek a degree in biology/genetics.

Zinkevich, on the right, with Frankie Molitor, an APS summer undergraduate research fellow.

Courtesy of Natalya S. Zinkevich, PhD

NOBEL INSPIRATION. I would like to meet Christian Nüsslein-Volhard, PhD, who was awarded the Nobel Prize in Physiology or Medicine in 1995. As a graduate student, I was inspired by her groundbreaking research on drosophila homeobox genes and even wrote her a letter. I consider myself lucky to have had a chance to use Nüsslein-Volhard's favorite animal models—fruit flies and zebrafish—for genetic experimentation. I have great admiration for her long and productive career in research and her incredible efforts to promote science literacy and support gender equality in science.

"The favorite part of my work are moments with students when ... all of a sudden their eyes light up."

THAT "AHA!" MOMENT. The favorite part of my work are moments with students when you keep re-explaining difficult concepts and all of a sudden their eyes light up. Or when a student asks a very thoughtful question, demonstrating a deep interest in the concept. Other moments I really cherish involve doing research with students, as I can see them formulating the research hypothesis and testing it in the lab.

PHYSIOLOGY IS FOUNDATIONAL. It impacts everything from medical breakthroughs to our understanding of life across all organisms. I love helping people understand that and making physiological research more accessible and relatable. That's why I contribute to the I Spy Physiology Blog, and I encourage my students to do the same. The blog connects real-world applications of physiology to everyday life.

WIDE WORLD OF SCIENCE. Physiology also extends beyond human biology. Previously, I taught organismal physiology, the study of the physiology of plants and animals. Microbial physiology is another intriguing field. I see the value in exploring how physiological processes operate across species.

Do you know someone we should meet? Email us at **tphysmag@physiology.org** and tell us more.

PUBLISH WITH POLISH | PUBLICATION TOOLS

Better Visuals, Stronger Science

Communicating science takes both clear writing and compelling visuals. Most scientists are trained to write manuscripts and grants. But composing figures and schematics? Not so much. APS Publications aims to fill this gap by supporting authors with figure creation. Through a new pilot program, APS journal authors now have access to BioRender's figure creation tools at no cost. The goal: to help you communicate your science more clearly and effectively.

BioRender is a leading online platform for creating scientific illustrations. Its extensive image library covers everything from molecules and proteins to cells, organs and animals. You can generate your own pathways using BioRender's icons or adapt ready-to-use templates other scientists created. Collaborating is easy—you can also share draft figures with your research team.

If you already have a BioRender account, log in to the APS portal at **app.biorender.com/portal/aps**. From there, select your desired figure size and start creating. APS journal figure sizes, such as single and double column widths and graphical abstracts, are already built into the platform. If you create an illustration outside of APS guidelines, the site will alert you to the error and prompt you to correct it. That way, you can better focus on the science. In addition, when you export your final figures, the APS portal settings ensure that you download a high-resolution file suitable for publication in an APS journal.

The site is intuitive to use, and there are several ways to learn how to improve your illustrations. From within the APS portal, you can access the BioRender Learning Hub. This learning environment offers tutorials on how to begin to create a figure, as well as more in-depth instructions, such as changing the color palette of your selected icons. BioRender also has a library of full-length webinars on topics such as creating graphical abstracts and improving your presentations. Live webinars are also offered.

Strong visuals can elevate science. They can mean the difference between someone quickly skimming an abstract or being drawn to read more about the results depicted in a graphical abstract. We encourage authors to take advantage of the APS BioRender pilot to design and refine their figures.

APS Publications will evaluate the BioRender pilot next year. We'd love to hear your feedback—email us at apsproduction@physiology.org.

FREE ACCESS

Through a new pilot program, APS journal authors now have access to BioRender's figure creation tools at no cost.

Ready to try it out? For step-by-step setup instructions, visit **journals.physiology.org/biorender**.

STATS & FACTS

50%

chance of receiving an electric shock caused higher stress—both physiologically (sweat, pupil dilation) and psychologically—than knowing the outcome with certainty. Participants with the highest stress levels also showed better judgment, suggesting stress offers some survival benefit.

"Computations of Uncertainty Mediate Acute Stress Responses in Humans," ***Nature Communications***

Three broad categories of uncertainty:

1. **Basic threat and reward**
2. **Decision-making**
3. **Associative learning**

"The Uncertain Brain: A Co-ordinate Based Meta-analysis of the Neural Signatures Supporting Uncertainty During Different Contexts," ***Neuroscience & Behavioral Reviews***

3,800+

people are on the national heart transplant waiting list.

Organ Procurement and Transplantation Network

150 million

alveoli are in the human lungs; these are the tiny air sacs that allow for rapid gaseous exchange.

National Heart Blood and Lung Institute

IN DEPTH | CONTROLLED BREATHING

Breathe Easy

Applying a rigorous scientific approach brings surprising insights on the interplay between breathing and mental health.

Alicia E. Meuret, PhD, is a professor of clinical psychology and director of the Anxiety and Depression Research Center at Southern Methodist University. Her research has revealed opportunities to address anxiety and mood disorders with controlled breathing—or "breathwork"—while contending with shifting perceptions of breathwork in science and society.

How is breathwork different from breathing? Breathwork refers to practices that encompass regulating the way one breathes in order to promote a positive mental and physical outcome. Breathing, on the other hand, is spontaneous; we do it without having to think about it.

What is unique about breathing is that it is the only autonomic system that can be brought under complete voluntary control. Say for example, my heart is racing, or I feel my body temperature rising—I can directly go to my breath, influence my breath, and because all these autonomic systems are interconnected, by influencing one system, you influence all the other ones. So eventually, if I alter my breathing in a certain way that promotes relaxation or a parasympathetic function, the other organs will have to follow.

Why is breathwork relevant to mental health issues such as panic disorder? Patients with panic disorder have this sensation as if they're being chased by a lion, and yet there is no apparent threat in the environment. When this happens, patients develop respiratory symptoms—shortness of breath, feeling dizzy, chest pain, the sensation of choking.

What I noticed when I looked at the basic research was, it wasn't that those patients were necessarily breathing extremely fast. Their CO_2 was in an abnormally low range (known as hypocapnia), and that was because they were taking in too much volume. With every inhalation, they had triple or quadruple the amount of air as would be needed.

What's fascinating is that hypocapnia and hypercapnia create the same sensation. So, this person has, in essence, too much air, and that person has too little air, and yet the perception of suffocation is the same. They would get this feeling of 'I cannot breathe' but their oxygen is in a normal range. One can think of this as a biological error, but a very costly one, as

istock

sufferers often end up in the emergency room, where they are told it's all in their head.

Tell me about the intervention you developed.
Exhaled CO_2 is a sensitive indicator of hyperventilation, which O_2 is not. CO_2 can be assessed directly from the nose when a person exhales using a capnometer. Using this device, my colleagues and I devised a training, termed Capnometry-Assisted Respiratory Training (CART), where patients practice breathing very shallowly and more slowly. They would take this device home with them, and it would show them an instant reading of CO_2, respiration rate, heart rate and oxygen.

> "They would get this feeling of 'I cannot breathe' but their oxygen is in a normal range."

This would show them that whatever distressing respiratory symptom they experienced wasn't due to them being hypoxic; it was because of their CO_2 being too low, and [it would] basically give them feedback to increase their CO_2 levels. Over a four-week training with a one-year follow-up, we found very substantial decreases in panic disorder severity, which were comparable to gold-standard cognitive behavioral therapy. We were able to normalize those CO_2 levels, and those levels remained stable after we took away the device, even 12 months later. Therapeutic gains and mechanisms of CART have been independently replicated and also tested in patients with other anxiety disorders and in people with asthma.

Importantly, changing respiration—breathing slower—was not responsible for the improvements. They had to breathe very shallowly in order to get the CO_2 up. It was breathing less air, counter to what people would think.

What are the next steps for this work?
This intervention is still mostly used in academic or medical settings. That is because the key to this treatment is very specific to CO_2, and in order to measure CO_2, you spend $1,000-plus on a reliable device. As I can tell, there hasn't been an alternative in terms of measuring CO_2 reliably that is low in cost. So, I continue to work on finding an index or estimate of CO_2 to come up with a device that would be more cost-friendly. If successful, therapeutic applications could be extended to treating patients with other conditions such as long COVID.

How have scientific and societal perceptions of breathwork affected your approach?
Breathwork has complex historic roots that go all the way back to yoga breathing and Tibetan Buddhism.

For a while, breathing in the context of mental health became kind of a black sheep. It was viewed as a placebo and inhibiting people from getting better. Things have changed now due to the increased focus on mechanistic research and personalized medicine. In clinical psychotherapy, there's a lot of focus toward meditation and mindfulness, and that also includes breathwork. However, the one thing where I still feel the field is lagging behind is to do precision work, taking a careful look at the underlying mechanisms. Without that, we don't know if a change was because of the intervention or a placebo effect.

I came in at a time when we had to prove that this works by doing careful mechanistic work. It's an advantage when you have that pushback because then you work even harder to make your research as objective and mechanistically sound as possible.

Interview conducted by science writer Anne Frances Johnson. Send questions or comments to tphysmag@physiology.org.

STATS & FACTS

45%

of U.S. adults describe research scientists as good communicators.

Pew Research

"Improv helps us connect with each other as humans. It helps enhance people's curiosity about what the other person needs out of the communication."

Laura Lindenfeld, PhD, Alda Center executive director, dean of the School of Communication and Journalism, Stony Brook University

83%

of respondents in a global survey want scientists to invest more effort into communicating about science with the public.

"Trust in Scientists and Their Role in Society Across 68 Countries," *Nature*

50%

of adults could correctly identify a scientific hypothesis.

National Science Board


BCM
Baylor College of Medicine
Texas Children's Hospital
Fong Lam, MD
Critical Care M

Photo courtesy of Texas Children's Hospital

Perseverance in PEDIATRICS

Fong Lam, MD, and his persistent questions may pave the way for a new treatment for infants.

BY MEREDITH SELL

In the middle of the night, Fong Lam, MD, stood over a patient in the intensive care unit at Texas Children's Hospital (TCH) in Houston. The patient had a new diagnosis of infantile leukemia and their white blood cell counts were off the charts, putting them at an extremely high risk for stroke and lung injury. For older patients, Lam and his colleagues would use a centrifuge machine to remove the white blood cells, but this patient was too small for the machine. Lam had to lower the white blood cells by hand.

For four hours, he and a pediatric critical care fellow used a central line that was hooked up to the patient to remove tiny amounts of blood, discard it, reinfuse the infant with red blood cells, platelets and plasma—and repeat the process until the white blood cells were at a safe level.

Left: Lam with colleagues Sergey Shevkoplyas, PhD, professor of biomedical engineering at the University of Houston, and Mubasher Iqbal, PhD, research assistant at the University of Houston; above: Lam with his family Seema, Kirin and Anne.

Lam is an associate professor of pediatrics-critical care at Baylor College of Medicine (BCM) who splits his time between intensive care at TCH, his research lab at the Michael E. DeBakey Veterans Affairs (VA) Medical Center in Houston, and teaching. That day, he had been up since early morning. He had spent the day in his lab before reporting to his nighttime call in the pediatric intensive care unit (ICU). When his call ended the next morning, he returned to his lab to analyze data. By the time he took a seat in a small lecture hall at the VA to hear from Sergey Shevkoplyas, PhD, a bioengineer from the University of Houston, it had been a long day.

The room was dark. Sunlight scarcely made it through the bunker-style slit windows, and the fluorescent lights were lowered for Shevkoplyas's slide presentation. Lam served himself some coffee and took a seat toward the back of the room. As he listened, he kept thinking of the pediatric patient. The new device Shevkoplyas was describing could separate blood cells without centrifuges or other large machines. In some instances, gravity was enough to filter the blood through and separate it. "I could have used that last night," Lam thought.

Shevkoplyas explained that the device could be useful for blood banks—they could receive blood donations and process them right away, separating blood into components such as plasma and other blood cells. Lam had other ideas: "Could you connect it to a person?" he asked. The engineer wasn't sure.

After the presentation, Lam introduced himself to Shevkoplyas. He shared his idea for the device to be used as therapy for infants with leukemia. They exchanged contact information, left, and Lam started campaigning. He reached out to Shevkoplyas repeatedly over the next few months, following up every few weeks to see if they could meet. He was convinced the microfluidic device could help tiny leukemia patients.

PUSHING THROUGH

If there's one word to sum up Lam's career and education, it would be persistence. From his days in Chinese school as a Chinese American student growing up in Texas—where he would copy columns of Chinese characters over and over until he got them right—to his repeated attempts to win National Institutes of Health (NIH)

Photos, this page, courtesy of Fong Lam, MD

funding for his research, he often had to try and try again to achieve what he was after.

Lam's path to science began in his father's lab. A PhD researcher at BCM, his dad took Lam and his sister to his lab on Saturdays. Early on, Lam would entertain himself by playing the pinball game Midnight Magic on his dad's Apple II while his dad attended to the lab animals. His dad was never glum about going to the lab on the weekend. "He loved research, and he made it fun," Lam says.

When Lam was in high school, his dad ran a biotech company, and Lam worked in the company lab. He also worked with his dad's colleague, a neurosurgeon studying stroke in rats. At the time, Lam planned to be a high school biology teacher. "I had a great one in high school, and I just wanted to be like her," he says. His mom told him he should be a doctor, but he didn't take the suggestion seriously until he was in college.

As an undergraduate at The University of Texas at Austin (UT), he volunteered in the pediatric arm of Brackenridge Hospital. Once or twice a week, he served as a clerk at the ICU's front desk. He watched the doctors talk to families, deliver tough news, and explain what was happening with the patients. He hadn't realized how much teaching doctors did or how much detective work was involved in the role. Suddenly, he liked the idea of becoming a doctor.

In 2003, after earning his medical degree from UT Southwestern Medical School in Dallas, he returned to BCM, first as a pediatric resident, then as a pediatric critical care medicine fellow. "When I looked around for fellowships in pediatric critical care, Baylor College of Medicine was the No. 1 spot for me because it had a combination of being a large clinical practice but also a very structured research platform, especially for medical trainees," he says.

His clinical mentor at BCM, M. Michele Mariscalco, MD, MHA, emphasized the importance of research to improve patient outcomes and encouraged her trainees to deepen their knowledge of both human physiology and their individual patients.

"She did not let us talk about plans for patients until we saw every patient and we reviewed their charts, we knew all their labs, and we read all the previous day's notes," he says. "She had very high expectations of us."

These expectations pushed Lam. He did extra reading to avoid embarrassing himself. Once, he brought what he'd learned from a recent paper to the ICU. Mariscalco let him try the technique but challenged

INSIDE STORY

6 Questions with Fong Lam

1 **What's your best piece of career advice?**
Have perseverance or grit. I feel like I'm the poster child of perseverance with the amount of failures I've had.

2 **What's your idea of happiness?**
Loving what you do, in professional and nonprofessional life. I have many hobbies. I love playing board games and running. And family's really important to me.

3 **What do you like about treating kids?**
Kids are super cute. My favorite age patient is a five-year-old because they are so interested in the world, and they're so inquisitive. To have that amount of wonderment is amazing.

4 **What's a skill you've learned from working with biomedical engineers?**
Always keep an open mind and strive to learn new things. Ideas can come from anywhere.

5 **What talent would you most like to have?**
I would love to be a polyglot and know how to speak every language because breakdown in communications is probably 99% of the cause of every problem we have in the world.

6 **What's your favorite thing to teach?**
Physiology, of course!

> "I had a very late start in my NIH career. I don't necessarily regret it because it taught me grit."

him to explain why it didn't work on his patients—and recommended more reading when he couldn't provide an answer. "She had such a deep understanding of physiology that she knew what was safe to do and what was not safe to do," he says, "and that gave me as a trainee … the autonomy to try things."

When Lam decided he wanted to study microcirculation, Mariscalco introduced him to his first research mentor, Rolando Rumbaut, MD, PhD. Initially, Lam investigated capillary leakage, a condition in which fluid leaks from tiny blood vessels. But after a year, he pivoted to examining the role of platelets in neutrophil transendothelial migration, which is part of how the immune system fights infection. He published a paper on the subject, but his grant proposals were turned down.

By this point, his fellowship had ended, and he'd taken a role at BCM as a physician-scientist, where he worked in the ICU and had protected research time with startup funding. He started working with another mentor, hoping he'd land some federal grants, but before Lam gained much momentum, his mentor took a job in Seattle. Lam decided to stay at BCM because there weren't any junior faculty physician-scientist positions where his mentor was going and he was determined to do both medicine and research. It wasn't until 2017, after he started working with Miguel Cruz, PhD, that he finally landed a federal grant.

"I had a very late start in my NIH career," Lam says. "I don't necessarily regret it because it taught me grit. And I was able to show myself I really want to do research."

It also gave him time to sharpen his research questions through his experience in the pediatric ICU.

FOSTERING CONNECTIONS

Lam sees himself as a kid at heart and believes this childlikeness makes for a good scientist. "If you question everything like a 5-year-old … then I think you find the joys in trying to solve the puzzles and trying to understand why things happen," he says.

As BCM faculty, Lam is expected to care for patients and do research and teach, but even if all three weren't a requirement, Lam would embrace them anyway. His clinical work directly relates to his research. It shapes his questions and how he examines microcirculation and interactions between different parts of blood. His research, in turn, shapes his approach to clinical work, and his teaching brings it all together.

Since 2015, Lam has taught a flipped-classroom course called "Core and Applied Physiology" to residents and fellows at BCM, where instead of Lam lecturing, the students engage with material through assignments and in which more advanced students teach the more junior students. Over the course of a year, the biweekly sessions bring first-, second- and third-year residents together to learn from one another about different physiological concepts. The goal is to help them understand physiological processes so they will be better doctors and know how to navigate novel patient situations.

Lam's favorite moments are when he sees fresh understanding dawn on his students. "Every couple of sessions—especially in the bigger or more complex ones—there will be at least one fellow or resident that sits there and says, 'Oh! That's why we do X, Y or Z,'" he says.

He wants to foster in his students the same curiosity that has driven his success. The same curiosity that led him to attend a lecture after a long day and make a new connection that might change patient treatments in the long run.

EXPLORING NEW IDEAS

It took Lam a few months to persuade Shevkoplyas to meet with him, but his persistence paid off. Once they met, he convinced Shevkoplyas his idea was worth exploring. That was in 2017. Since then, they've investigated the efficacy of the device for removing white blood cells from both human blood and rats. Earlier this year, they published a paper in *Nature Communications* showing that the devices are safe in animals and can operate for at least three hours without losing function. The devices, which use tiny channels roughly the width of a human hair to separate blood cells, are now being tested on pigs. Lam is hopeful the trials will go well and pave the way for a new, less-invasive therapy for pediatric patients with dangerously high white blood cell counts.

Will it work? Too soon to say. But one thing's for sure: Lam won't be sleeping on the possibilities.

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THE BRAIN IN A CHAOTIC WORLD

Uncertainty is unsettling, and that ambiguity can have a profound effect on our physiology.

BY LAUREN ARCURI

Humans today have access to more information than ever. We might think this fire hose of data helps us be less fearful, but more often, it stokes anxiety and contributes to our feeling of uncertainty. It can be a real challenge to make sense of the deluge of details we receive from multiple sources daily, much of it contradictory.

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"Our brains are designed to seek certainty," says Aoife O'Donovan, PhD, professor in the Department of Psychiatry and Behavioral Sciences at the University of California San Francisco (UCSF) and director of the UCSF Trauma and Health Research on Immunity, Vitality and Emotions (THRIVE) Laboratory. "But uncertainty is inevitable in life."

It makes sense that our hunter-gatherer ancestors, dependent on foraging for food and navigating unpredictable dangers while traveling through difficult terrain, preferred certainty. In our modern world, we face different kinds of threats but still have to cope with a great deal of uncertainty in our lives. But our nervous systems still prefer the known to the unknown. "We're living in a time when we have so much information, it's hard to find some certainty in the midst of all that," O'Donovan says.

All that uncertainty has a profound effect on our physiology. How our systems react to uncertainty—and our tolerance for stress and our resilience to it—are shaped by our life experiences.

A PHYSIOLOGICAL CHALLENGE

There are two main kinds of uncertainty from a neuroeconomic perspective, says Paul Glimcher, PhD, chair and professor in the Department of Neuroscience, professor in the Department of Psychiatry and director of the Institute for Translational Neuroscience at NYU Langone Health in New York. "Donald Rumsfeld famously called these 'known unknowns' and 'unknown unknowns,'" he says. "'Known unknowns' is a kind of uncertainty we often refer to as facing risk in a technical sense," when you know what the chances are of a given outcome. "In 'unknown unknowns,' or ambiguous uncertainty, we have no idea how likely it is that a given outcome will happen," Glimcher says. "Of course, in most cases, with time and experience, ambiguous uncertainty turns into risky uncertainty."

People are generally risk-averse overall, but they "tend to treat ambiguous situations as roughly two times as bad as risky situations," Glimcher says.

When we face ambiguity, but not risk, the amygdala, an almond-shaped brain structure that regulates decision-making and emotional responses, activates. In experiments, participants may be offered a lottery ticket with a known chance of paying off, or one where the chance is unknown, or ambiguous. "You might view that ambiguous lottery ticket as worth very little," Glimcher says. On functional MRI, researchers see activation in the amygdala of participants in the unknown situation, but much less in the one where they know their chance of winning.

In both risky and ambiguous situations, Glimcher says, they see activation in the ventromedial prefrontal cortex and ventral striatum. The degree of activation correlates with how much the subject wants the lottery ticket. "There are indications subjects want the ticket less when it is ambiguous, compared to when it's risky," he says.

Diving deeper, Glimcher and his colleagues have found that while overall, people tend to prefer risk to ambiguity, "different people have different aversions to each. There is a lot of interindividual variation," he says. Risk attitudes tend to correlate with thickness of the parietal cortex, among other things. "People who have a lot more gray matter there are more tolerant of risks, and people with less are less," Glimcher says. And as we age, we tend to become less tolerant of risk and ambiguity. "Significant elders, people in their 80s and 90s, are generally very averse to taking risks."

BEYOND THE LAB

4 Ways to Limit Uncertainty's Effects

When we are forced to live with uncertainty for an extended period, stress responses may accumulate and negatively affect our health. How can we break this cycle? Aoife O'Donovan, PhD, at the University of California San Francisco, offers these suggestions:

1. **Recognize your limits.** There's a limit to the amount of information you can use to reduce uncertainty. Realize that simply seeking more information is unlikely to make you feel more certain about your decision. "There's a sweet spot that will help us make the best decision without causing us excess stress," O'Donovan says. Seek that balance as you make your choice.
2. **Decide and move forward.** Accept that you've made a decision and commit to moving forward, rather than continuously considering other options. "Put yourself in a state of certainty as soon as you can," she says.
3. **Limit your preoccupation with stressors.** Consider postponing your worry about a stressful decision or event until closer to the actual time. "In an uncertain situation things might change. You might never have to deal with the threat you're imagining."
4. **Bolster your resilience.** A lifestyle that promotes overall health can also enhance our resilience and help buffer the negative effects of uncertainty on our well-being.

Ambiguous circumstances, or uncertainty, means that our imagination can run away with us—we can conjure every possible bad thing that might happen, even very unlikely things. Many people experienced this in the early days of the COVID-19 pandemic, when we knew very little about the disease and how it spread.

To make matters worse, our physiology doesn't distinguish between actual and imagined stressors. "We activate our biological stress response in anticipation of upcoming stressors," O'Donovan says.

An impending threat or stressor has an impact on every bodily system, says Scott Russo, PhD, endowed chair in affective neuroscience, director of the Center for Affective Neuroscience and director of the Brain Body Research Institute at the Icahn School of Medicine at Mount Sinai in New York. Our body primes our systems to respond. Part of that response is immune system activation, including inflammation. Russo's research focuses on how and why resilient people are able to switch off the acute immune response to stress after the immediate threat is gone, before it causes long-term damage to their own tissues.

RESILIENCE AS AN ACTIVE PROCESS

Researchers have long viewed stress as a trigger of disease or illness, but "our studies of resilience have shown us that most of us don't respond to chronic, even very traumatic, stressors in a maladaptive way," Russo says. "Most of us are quite adaptable."

It turns out, resilience isn't merely the absence of a physiological stress response. It seems to be an active process of adaptation, Russo explains. "Resilient individuals adapt [to stress] in a way that actively alters circuits in the brain that control reward perception, preventing some of the most negative impacts of stress," he says.

Janice Urban, PhD, professor of physiology and biophysics and director of the Center for Neurobiology of Stress Resilience and Psychiatric Disorders at Rosalind Franklin University of Medicine and Science in Illinois, also studies the physiology of resilience. In one of her experiments, rats who were exposed to a stressful stimulus showed an increase in a chemical called neuropeptide Y (NPY) that acts in the amygdala. At the same time, another research team found that injecting NPY into the same region of the brain increased the rats' social interaction and blunted the behavioral effects of stress. Data from humans also suggested that lower NPY was associated with post-traumatic stress disorder and social anxiety.

The evidence suggested that NPY might be a molecule that enhances resilience to stress. Urban's research focuses on what activates the NPY-producing neurons and how the receptor mechanisms work. "If there was something unique we could target, we could increase these resilience-promoting mechanisms," she says.

Thus far, Urban's research team has discovered that NPY, when delivered to an area called the basolateral amygdala, inhibits specific stress-sensitive pathways that project to the bed nucleus of the stria terminalis (BNST). "That part of the BNST is important for anxiety and fear discrimination," Urban says. It is also very sensitive to repeated stress; rats subjected to repeated stressors develop hyperactivity in these areas.

"This hyperactivity is caused, in part, by long-term structural changes that make the animals more anxious

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over time," Urban says. "But we have found that NPY can buffer these long-term changes, particularly by antagonizing one of the neurotransmitters that causes these changes in the amygdala: corticotropin-releasing factor." Current research in Urban's lab focuses on further mapping the neural circuitry of the NPY-responsive amygdala neurons.

THE IMMUNE SYSTEM'S ROLE

Russo's research on the immune system has led him to conclude that in resilient individuals, the system dampens the fight-or-flight immune response once the acute threat is over, before it does longer-term damage to the body itself.

"We don't yet fully understand how they do that," he says. "It's thought to be some combination of brain-to-immune pathways that allow resilient individuals to suppress inflammation." Vulnerable individuals don't seem to have this same dampening mechanism.

Heightened inflammation, the consequence of an unchecked stress response, is suspected to underlie at least a portion of cases of major depressive disorder. Russo's lab found that people with depression also have lower levels of a molecular marker called claudin-5, a protein that sits in the junction between cells in the first layer of the blood-brain barrier, suggesting they may have a compromised blood-brain barrier.

In a mouse model of stress vulnerability, Russo has found that the blood-brain barrier becomes leakier in response to stress, allowing in large proteins that normally would not be able to cross into the brain. "They bypass the barrier and directly infiltrate the brain parenchyma, where they can act on neurons and change behavior directly," he says. Specifically, his team found a cytokine called interleukin-6 in the brain and discovered that it caused depressive behavior in the mice.

ENHANCING RESILIENCE

Living through chronic stress or traumatic experiences may make someone more prone to the negative effects of uncertainty. "People who have been exposed to a lot of stressors may be more likely to perceive threat in new uncertain situations," O'Donovan says.

Glimcher and his colleagues administered the STRAIN, a lifetime stress inventory, to a group of adults who also completed a series of questions about lotteries with varying levels of risk and ambiguity. This measures how averse someone is to ambiguity and risk.

"What we've found is that this lifetime stressor scale correlated very strongly with people's aversion to ambiguity," Glimcher says. "So this led us to believe that ambiguity aversion emerges as a function of the bad stuff that's happened to you over your lifetime, particularly bad stuff that happens to you in childhood."

If some individuals possess an innate ability to be resilient—to weather the storms of uncertainty and stress without lasting damage—can scientists learn what drives that resilience to help those of us who wind up inflamed, depressed and sick?

Recent trials have attempted to use monoclonal antibodies to develop targeted anti-cytokine treatments that neutralize specific inflammatory molecules, a type of biologic drug that has been highly effective for certain autoimmune conditions, such as rheumatoid arthritis. "But their utility in depression and other stress conditions has been less clear," Russo says.

"What we need is to be able to train the immune system, rather than block or enhance it," he says. "What we want it to do is turn on when appropriate and turn off when appropriate, like in a resilient individual."

Treatment might involve introducing the resilience factors, rather than attacking a disease mechanism. Human trials of potential therapeutics are underway after resilience factors were identified in mice models.

O'Donovan says managing uncertainty's effects on physiology and health requires thinking about it like any other stressor and remembering that the same things that enhance our health will also increase our resilience to psychological stress. "Lifestyle factors like getting enough physical activity; eating a good diet; avoiding smoking, alcohol and other substances that harm the body; having social support—these are all factors that can make us more resilient to stress," she says.

Prioritizing these behaviors can be difficult when you're already dealing with uncertainty, so trying to build these healthy habits during the lower-stress times is ideal, she says. "We can do our best to build our stress resilience during these times, knowing this is what is going to get us through the inevitable stressors of life."

A CLOSER LOOK

How the Brain, Body and Biology Shape Stress Response

Learn more about the mechanisms of resilience when it comes to trauma, stress and adversity from this *Physiological Reviews* podcast episode, "Neurobiology and Systems Biology of Stress Resilience."

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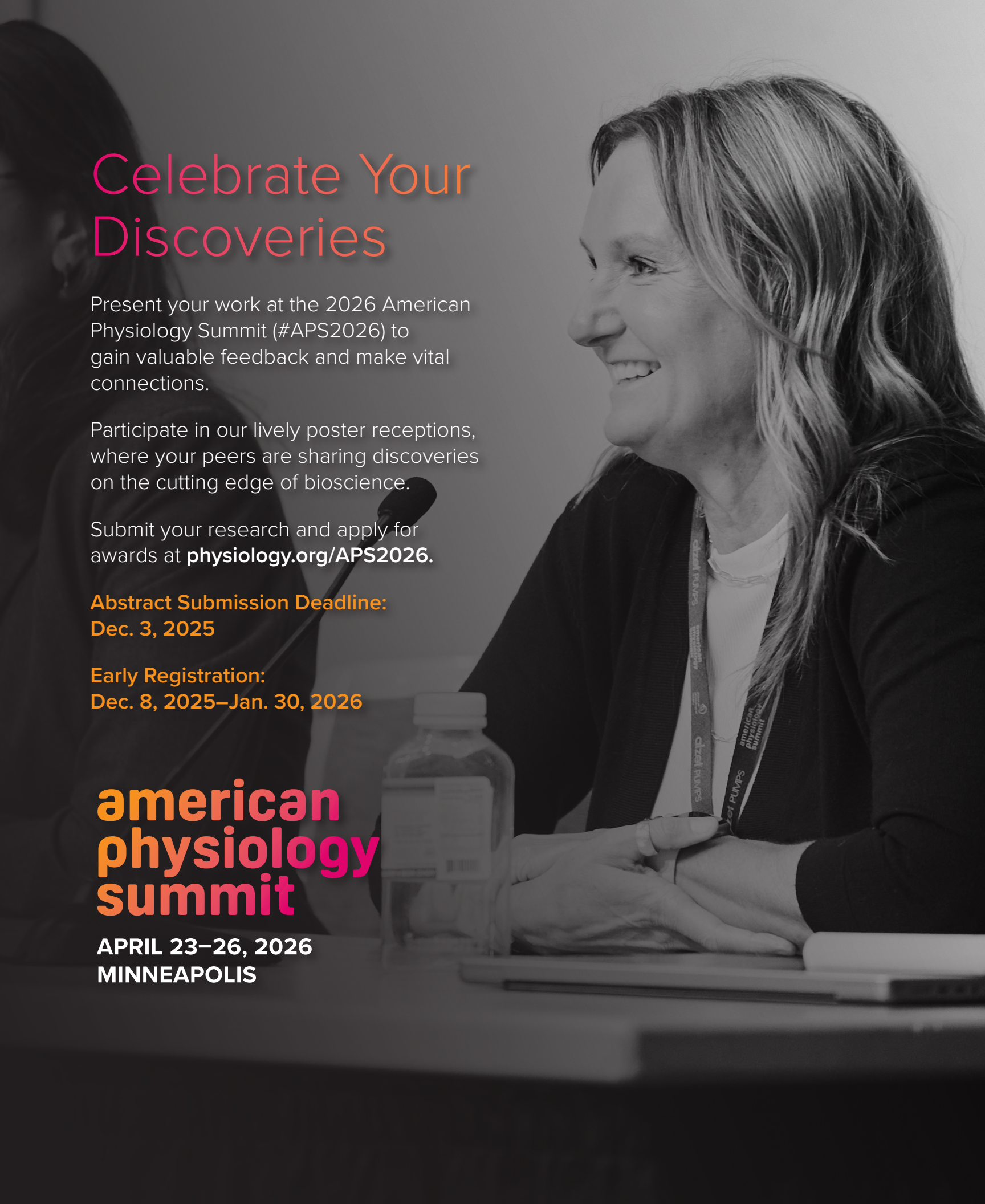

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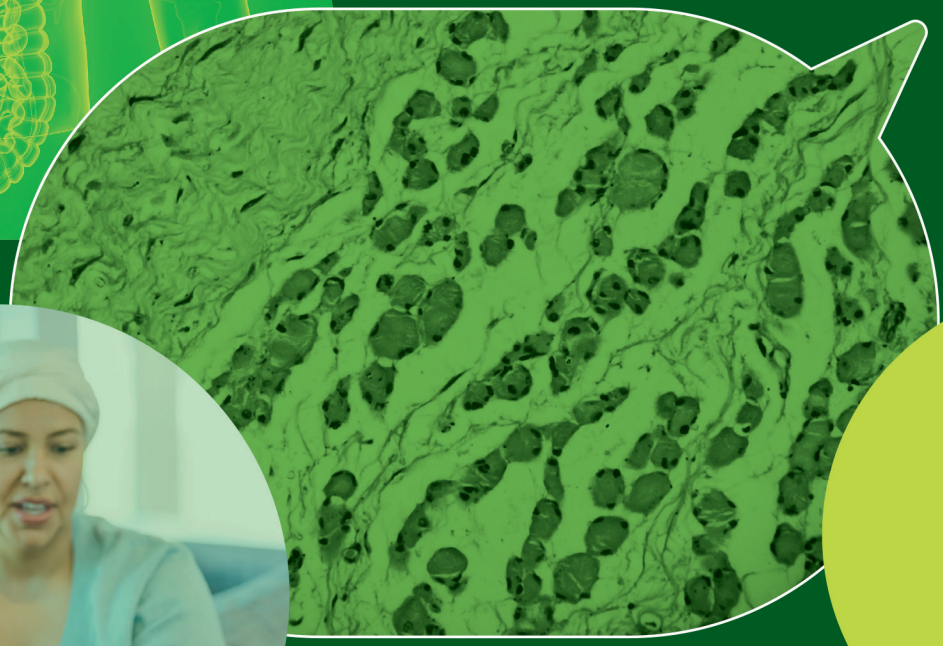
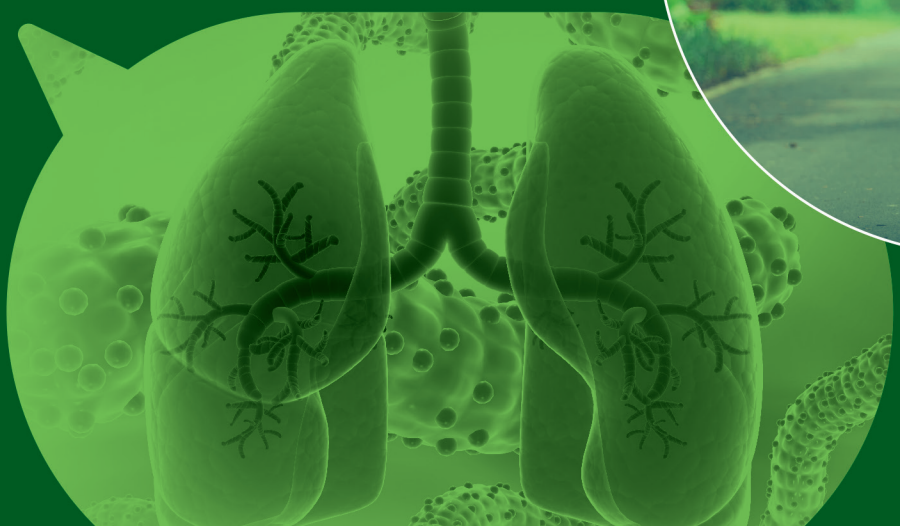
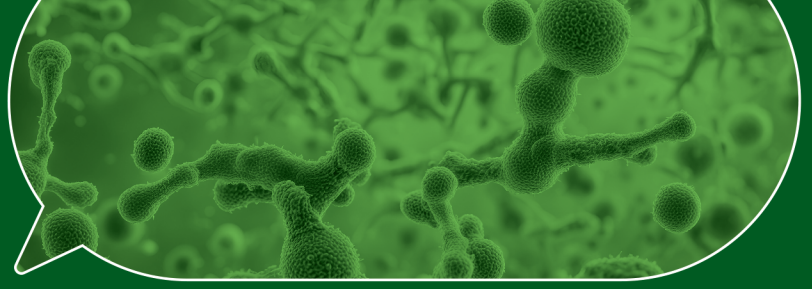






TALK SCIENCE TO ME

Learn how to slay the jargon and turn your research into stories that resonate beyond the lab.

BY BRIAN BUSENBARK

As an undergraduate student at Virginia Tech, Morgan Zumbaugh took a job cleaning glassware in a laboratory on campus for some extra cash. Eight years later, she left with her PhD.

Though she initially had no interest or background in scientific research, Zumbaugh was inquisitive. She began attending staff meetings and peppering others in the lab with questions about their work and the nature of the research. Those interactions helped lay the foundation for her future.

"They really piqued my interest and opened up opportunities for me," says Zumbaugh, PhD, an assistant professor in the Animal Sciences and Industry Department at Kansas State University and a member of the APS Science Policy Committee. "But I really just fell into it, honestly."

FINDING COMMUNICATION RESOURCES

Of course, it doesn't always work out this way. Complicated scientific concepts and research work can be difficult for lay audiences to grasp. Informing—much less inspiring—those less experienced with science calls for advanced communication skills. Traditionally, research institutions don't require any formalized curriculum or training to aid scientists in this endeavor.

"I wish there was a course on this; this is a gap in our field at most universities," says Jason Carter, PhD, dean of the Robbins College of Health and Human Sciences at Baylor University. "There are often scientific and technical communication programs in humanities departments, but a physiologist typically doesn't take these courses."

There are some exceptions: The University of Chicago and the Institute for Translational Medicine offer a nine-month certificate program in science communication, aimed at empowering researchers to write and speak more dynamically about their work. They also present three-day seminars covering these topics. Elsewhere, professors may steer their students toward communication courses offered on campus; Zumbaugh encourages her graduate students to take an agricultural communication class offered at Kansas State.

And while researchers have traditionally been able to share their findings in policymaker meetings on Capitol Hill or poster presentations at academic conferences, they can increasingly find novel opportunities to help them further hone their communication skills. For example, the University of Florida sponsors "Talk Science with Me," a public outreach program that encourages casual conversations between the school's scientists and members of the public. Usually held in bars, coffee shops and libraries, these sessions offer researchers opportunities to discuss their work with small groups of people in an informal setting.

"People just sit down next to you and ask what you do," says Erica Dale, PhD, an assistant professor in the Department of Physiology and Aging at the University of Florida and a faculty member with the university's Breathing Research and Therapeutics (BREATHE) Center. "I've spoken with people from all education levels and have learned a lot just about meeting people where they are."

A prominent resource in this realm is the Alan Alda Center for Communicating Science, a collaboration between the renowned actor and Stony Brook University, with support from Brookhaven National Laboratory and Cold Spring Harbor Laboratory. Its aim is to train STEM and health care professionals to communicate more effectively using a blend of improvisational theater concepts and messaging strategies. Since its founding in 2009, more than 30,000 scientific experts have participated in the Alda Center's graduate and professional development programs.

"Improv works because it helps us connect with each other as humans," says Laura Lindenfeld, PhD, Alda Center executive director and dean of the School of Communication and Journalism at Stony Brook University. "It helps enhance people's curiosity about what the other person needs out of the communication."

FROM THE EXPERTS

Pitfalls to Avoid

Even experienced communicators are prone to lapses in judgment. Be sure to focus on sidestepping these common traps:

Curse of knowledge. Mastery of the subject matter may be your superpower, but it can be kryptonite for your communication skills. Excessive use of jargon and needlessly technical content can alienate an audience and may even come off as arrogant.

Making assumptions. Regardless of your audience, it's a mistake to presume their knowledge base—even other scientists may not be well-versed in your specialized research area. Don't be afraid to level-set your approach with the audience. "It doesn't matter if I'm speaking with little kids or a senator, I always ask if they're familiar with my subject," Erica Dale, PhD, says.

Crowded slides. Known as "death by PowerPoint," boring, text-heavy slides are hard for people to digest and can tempt you to simply read them aloud, rather than engaging your audience. "If I'm in the audience, I lose attention if there are too many words on a slide versus images," Morgan Zumbaugh, PhD, says.

Closed-mindedness. It can be easy to get stuck in an echo chamber of ideas and become too entrenched in your own perspective. It's important to think of your communications as conversations with the audience and respect constructive criticism and alternate viewpoints.

5 KEYS TO EFFECTIVE COMMUNICATION

For most researchers and scientific lecturers, mastery of the content is the easy part. But how do you impart your message in a clear and compelling manner? Our experts say following these five guidelines will make any communication more effective:

1 Know your audience.

First and foremost, understanding your audience is key to successful communication. Who are they? Why are they listening (or reading), and what do they hope to learn from you? Being able to craft your message with an appreciation of your audience's vantage point is crucial. Even if the communication's format is one-way, try to think of it as a conversation.

"Communication is not like a spray paint can, where you can just shower someone with information and they automatically get it—that only leaves them with a paint-covered face," Lindenfeld says. "Whenever possible, imagine communication as an opportunity to connect and bridge a gap."

2 Lean on your network.

Resist the urge to go it alone. Instead, leverage those around you. Colleagues, mentors, students—even friends and family—can provide you with multiple vantage points to help you refine your message and approach. "Don't be a lone wolf," Carter says.

3 Align your message.

Finding a common link between your work and the audience's priorities will capture their interest. The Alda Center uses a fun exercise it calls "Hobby Speed Dating." Here's how it works: Scientists pair up and take turns role-playing as a hobbyist. For example, one may say their hobby is knitting, and it's their partner's job to figure out how to relate their research to knitting to make it matter to their audience. "It's kind of silly and funny, but it's really important and helps move the conversation forward," Lindenfeld says.

4 Don't sweat it.

The fear of making a mistake while speaking in public can be paralyzing for some. As a result, they avoid those situations and never improve. No matter your level of preparation, verbal flubs or technical glitches will occur—don't let it derail or discourage you.

"Think about whenever someone has an awkward pause while giving a talk. You don't immediately think that it's really weird—rather, you have empathy for them," Dale says. "Just remember that everybody listening to you likely wants to hear what you're saying and is interested in your message."

5 Practice (and then practice some more).

There's no substitute for putting in the time rehearsing your communication. Whether it's getting live repetitions by talking with family and friends, smaller engagements like the "Talk Science with Me" sessions, or delivering in front of the mirror, practice is invaluable. Be sure to practice delivering your message for diverse types of audiences. One caveat: Don't just memorize your lines—you want to sound conversational, not scripted.

ADDRESSING IDEOLOGICAL CHALLENGES

Disseminating complicated scientific concepts to lay audiences effectively is an evergreen dilemma. An issue that has gained traction in recent years, however, is communicating with audiences who have strongly held beliefs around science and academic research.

"One of our biggest challenges right now is the hyperpolarized political state we're in," Carter says. "In many ways, we've lost our ability to agree to disagree, and my hope is that we never give up on that—it's what defines humanity."

Carter adds that he prepares his students not to become discouraged in the face of disagreements. Fortunately, many of the same principles used to communicate complex scientific concepts also apply to addressing opposing viewpoints: understanding and empathizing where someone is coming from, finding common ground, remaining calm and practicing your delivery.

For Dale, this approach has resulted in fruitful conversations with congressional staffers who had originally advocated for cutting funding for scientific research. In Zumbaugh's case, it's led to common ground with vegetarians around her work researching how the metabolism of skeletal muscle affects livestock production efficiency.

"If you choose not to eat meat for environmental reasons, then we could talk about how my research is ultimately trying to figure out how to make meat for other people with less of an environmental impact," Zumbaugh says.

The most important piece, the experts agree, is to not shut down or avoid potentially difficult conversations altogether for fear of encountering disagreement. "At the core of all of this is building trust. You can disagree with someone, but if you trust them, you'll still listen to them," Lindenfeld says. "The solution is not to avoid communicating, but to communicate well."

ADVOCACY

Rallying for Research

APS sponsored and participated in the Rally for Medical Research Hill Day in Washington, D.C., along with more than 350 national organizations, patient groups and research advocates in September. The annual event united the biomedical community to urge Congress to prioritize robust, sustained funding for the National Institutes of Health (NIH). APS members met with congressional offices to share how federally funded physiological research drives medical breakthroughs and improves lives. The Society's presence reinforced the message that continued NIH investment is critical to advancing science and public health. Now in its 13th year, the rally brought scientists, survivors, clinicians and students to Capitol Hill with a unified message: More Progress. More Hope. More Lives Saved. The Society's participation underscored its commitment to supporting science policy that empowers discovery and promotes equitable health outcomes.

EVENTS

Future Summit Site Selections Announced

APS has confirmed the upcoming locations for the next several American Physiology Summits. Stay tuned as we share more details on these exciting destinations—and continue building on the energy and success of the Society's flagship meeting. The sites are:

- 2026 Minneapolis, Minnesota
- 2027 Denver, Colorado
- 2028 Pittsburgh, Pennsylvania
- 2029 Louisville, Kentucky
- 2030 Tampa, Florida
- 2031 Long Beach, California

RESEARCH

APS Joins Women's Health Innovation Network

APS has been invited to join the Milken Institute's newly launched Women's Health Innovation Network, a global initiative aimed at accelerating research, infrastructure and investment in women's health. The network is chaired by former First Lady Jill Biden, PhD, and led by a 13-member steering committee representing academia, health systems, industry, finance, technology and advocacy.

The Milken Institute is a nonprofit, nonpartisan think tank focused on accelerating measurable progress toward a meaningful life. With an emphasis on financial, physical, mental and environmental health, the Institute brings together leading ideas and resources to address urgent global challenges and anticipate those on the horizon. The Women's Health Innovation Network will focus on building a digital platform to support data sharing and institutional knowledge exchange, creating a pooled investment fund, and launching proof-of-concept projects that target longstanding gaps in women's health research and innovation. As one of the few scientific associations in the network, APS will contribute its scientific expertise and established platforms for research dissemination, including 13 peer-reviewed journals and specialty scientific conferences, to help drive the network's mission forward.

MEMBER NEWS

Michael Welsh, MD, FAPS, has been awarded the prestigious **Lasker-DeBakey Clinical Medical Research Award** for his work developing lifesaving drug treatment for cystic fibrosis (CF). Welsh and colleagues Jesús González, PhD, and Paul Negulescu, PhD, uncovered how the protein behind CF normally functions—and what goes wrong in people with the disease. Their insights led their research into finding small molecules that could fix the faulty protein. Welsh is a professor at the University of Iowa. In addition to researching CF, Welsh's lab explores how to develop treatments to prevent or delay the progressive neuron loss in neurodegenerative conditions, including Alzheimer's and Parkinson's diseases.

Ryan King, PhD, has been appointed **executive director for administration and chief of staff** in the President's Office at Roanoke College. King was formerly an assistant professor of medicine at Virginia Tech Carilion School of Medicine. His research interests include cardiology, leadership education, and entrepreneurship and innovation policy. He is an active member of the Science Policy Committee and currently serves as the APS representative on the FASEB Training and Career Opportunities Subcommittee.

Apply for Society Awards

american physiological society®

Access awards and fellowships designed to move your work and career forward. Apply for APS awards to gain recognition in your field and access new and meaningful opportunities.

Learn more about all award opportunities and apply for the awards highlighted below at physiology.org/awards.

A. Clifford Barger Mentorship Award	$1,000	Honors a member who has demonstrated leadership, guidance and mentorship of underrepresented students in the physiological sciences	Nov. 17
Bodil M. Schmidt-Nielsen Distinguished Mentor and Scientist Award	$1,000	Honors a member who has made outstanding contributions to physiological research and demonstrated dedication to the training of young physiologists	Nov. 17
Annual Marion J. Siegman Lectureship Award	$1,000	Recognizes an established investigator who has made outstanding contributions to our understanding of muscle contraction and motility and has generated new avenues of investigation in the field	Nov. 17
Early-career Advocacy Fellowship	up to $1,500	Engages early-career investigators in advocacy activities and provides them with skills to become long-term advocates for scientific research	Dec. 15
International Early-career Physiologist Travel Awards	12 awards of $1,000 each	Assists with travel expenses international early-career physiologists incur while attending the American Physiology Summit to present their work	Dec. 15

DATES & DEADLINES

AWARDS APPLICATION DEADLINES

*Award deadlines vary and may be subject to change. For the latest information, including award descriptions, amounts, eligibility requirements and to apply, visit **physiology.org/awards**.*

NOV. 17

A. Clifford Barger Mentorship Award

Bodil M. Schmidt-Nielsen Distinguished Mentor and Scientist Award

Annual Marion J. Siegman Lectureship Award

DEC. 1

Robert W. Berliner Award for Excellence in Renal Physiology

DEC. 2

APS Presidential Service Award

NEURAL CONTROL & AUTONOMIC REGULATION SECTION

Carl Ludwig Distinguished Lecture

Lifetime Achievement Lecture

DEC. 15

ADInstruments Macknight Innovative Educator Award

Arthur C. Guyton Awards for Excellence in Integrative Physiology

Beverly Petterson Bishop Award for Excellence in Neuroscience

Dean Franklin Young Investigator Award

Early-career Advocacy Fellowship

Giles F. Filley Memorial Awards for Excellence in Respiratory Physiology & Medicine

International Early-career Physiologist Travel Awards

Lazaro J. Mandel Young Investigator Award

Martin Frank Travel Award

Shih-Chun Wang Young Investigator Award

JAN. 6, 2026

Cardiovascular Section New Investigator Award

Cell & Molecular Physiology Section New Investigator Award

Central Nervous System Section New Investigator Award

Comparative & Evolutionary Physiology Section New Investigator Award

Linda F. Hayward Achievement Award of the APS Neural Control & Autonomic Regulation Section

Neural Control & Autonomic Regulation Section New Investigator Award

Renal Section New Investigator Award

Respiration Section New Investigator Award

The Charlie Bates Research Award

ENDOCRINOLOGY & METABOLISM SECTION

New Investigator Award

CANTROL Environmental Systems New Investigator Research Award

ENVIRONMENTAL AND EXERCISE PHYSIOLOGY SECTION

Early Career Research Award

New Investigator Award

TEACHING OF PHYSIOLOGY SECTION

Arthur C. Guyton Distinguished Educator Award

New Investigator Award

Research Recognition Awards

Travel Fellowships

William Galey Scholarship Award

WATER & ELECTROLYTE HOMEOSTASIS SECTION

Jane Reckelhoff Mid-career Achievement Award

Leonard Share Award

New Investigator Award

JAN. 15, 2026

Dale J. Benos Early Career Professional Service Award

Dependent Support Travel Awards

Gastrointestinal & Liver Physiology Section New Investigator Award

Horace W. Davenport Distinguished Lectureship

John S. Fordtran Distinguished Research Award

Raj and Prem Goyal Lectureship in Pathophysiology of the Gastrointestinal and Liver Diseases

Teaching of Physiology Section Labfront Mid-career Educator Award

CALLS FOR PAPERS

CROSS-JOURNAL CALLS FOR PAPERS

Opioids and Respiratory Depression

Cardiorenal Physiology

Plus: Explore our ongoing cross-journal calls for papers on key women's health research topics:

- Alzheimer's disease
- Autoimmune diseases
- Breast cancer
- Cardiovascular disease
- Hormone replacement therapy and menopause
- Migraines
- Novel perspectives on sex as an investigative variable
- Pregnancy and postnatal conditions:
  - Endometriosis
  - Gestational diabetes
  - Preeclampsia
  - Polycystic ovary syndrome

Join APS in advancing our mission to improve health care outcomes and promote greater scientific understanding of women's health. Learn more about this special call for papers at journals: **physiology.org/womens-health-research-initiative**.

American Journal of Physiology-Cell Physiology

Jan. 4, 2026
- Exploring Autonomic Signaling and Cell Physiology
- Cellular Dysfunction in Cardiovascular Diseases
- Myogenic Stem Cells: From Single Cell Biology to Muscle Physiology
- The Extracellular Matrix in Exercise Physiology
- Decoding Fibrosis
- Ketones in Cellular Physiology: Metabolic, Signaling and Therapeutic Advances
- Mechanisms Underlying Diversity in Cancer Cachexia
- Exploring the Multifaceted Roles of Non-Coding RNAs in Human Diseases

Jan. 9, 2026
- Revising Platelet Signals, Function and Therapies

American Journal of Physiology-Endocrinology and Metabolism

Jan. 4, 2026
- Immunometabolism
- Clinical Metabolism
- Exercise Metabolism
- Liver Metabolism

American Journal of Physiology-Gastrointestinal and Liver Physiology

Jan. 16, 2026
- Cell and Animal Models of Gastrointestinal Disease
- Epithelial Cell Metabolism
- Immunometabolism and Novel Gut-neural-cardiorenal Pathophysiological Mechanisms of Disease
- The Microbiota-Gut-Brain Axis

American Journal of Physiology-Renal Physiology

Jan. 4, 2026
- The Impact of Obesity and Hypertension on Kidney Disease

Feb. 2, 2026
- Mechanism of Renal Ion Transport and Sensing in Health and Disease in Honor of Steven Hebert, MD

Comprehensive Physiology

Dec. 31
- Gut-brain Communication in Metabolic and Cognitive Control
- Heart-lung Interactions in Pulmonary Vascular Disease

Journal of Applied Physiology

Dec. 15
- Physiological Responses to Psychosocial Stress

Jan. 5, 2026
- Context-dependent Mechanisms of Striated Muscle Dysfunction

Anytime
- Cerebrovascular Control in Health and Disease: From Modeling to Translational Research
- Experiments of Nature

Journal of Neurophysiology

Nov. 30
- Now and Then

Dec. 31
- Neuroimaging Meets Neurophysiology

Jan. 15, 2026
- Integrative Research on the Functional Logic of Neural Circuits

Feb. 15, 2026
- Neurophysiology of Exposure to Extreme Environments—Pressure, Temperature and Microgravity

Physiological Genomics

Dec. 1
- Nutrigenomics

Physiological Reports

Dec. 31
- Tissue Fibrosis Through the Life Course and in Transplanted Organs

MEETINGS & EVENTS

SAVE THE DATE: 2026 CONFERENCES

American Physiology Summit
April 23–26
Minneapolis

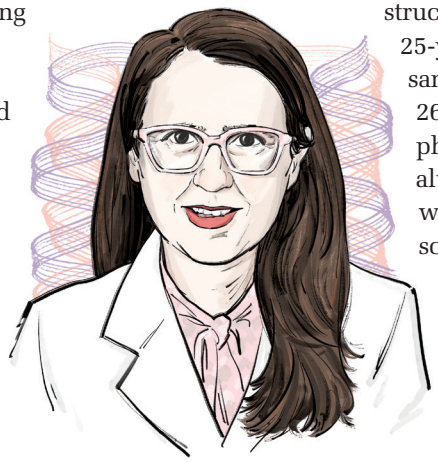
Control of Renal Function in Health and Disease
June

Comparative Physiology Conference
September

The Impact of a Scientific Conference

BY LICY L. YANES CARDOZO, MD

When I was a first-year internal medicine resident in Paraguay, I attended the International Internal Medicine Conference in Buenos Aires, Argentina. At the time, my research focused on a quality improvement project examining whether patients who had suffered a myocardial infarction received standard care in a timely manner. I still remember walking through the entrance of that building and into the meeting room—feeling both amazed and energized. It was a defining moment in my professional life, one that revealed with crystal clarity the transformative power of a great scientific meeting. After that meeting, I fell in love with research and its power to reveal the truth. I found my purpose.



A truly impactful meeting can open the door to a new area of research, spark collaborations, foster friendships or inspire us to revisit old data from a new perspective. Most importantly, it can create a sense of belonging—to a place, to a community. That is why it felt like such an honor to serve as a chair alongside Heddwen Brooks, PhD, and Stella Goulopoulou, PhD, of the New Trends in Sex Differences and Women's Health Research conference, sponsored by APS at Tulane University in October. Even years after attending that first scientific meeting, nothing inspires me more as a researcher than the energy of a scientific conference. My hope for the event was that it sparked those same moments of wonder and connection—interactions that not only shape the trajectory of research but also the people who carry it forward.

"If I submitted a manuscript treating male and female rodents of different weights with identical drug doses, it would almost certainly be rejected—so why do we still accept this practice in the clinic?"

Since the 1993 National Institutes of Health mandate to include women in clinical research, we have seen a rise in manuscripts incorporating sex as a biological variable. Yet, despite these advances in preclinical and clinical data, translation into medical practice remains limited. As a practicing endocrinologist, I am continually struck by the fact that we treat a 25-year-old 130-lb woman in the same way we treat a 70-year-old 260-lb man. In basic research, pharmacological agents are always adjusted according to body weight. If I submitted a manuscript treating male and female rodents of different weights with identical drug doses, it would almost certainly be rejected—so why do we still accept this practice in the clinic? The field of sex differences and women's health still has a long way to go; we need to move from the data-gathering phase to the implementation phase.

I was especially delighted that this year's conference was hosted so close to home in my neighboring state of Louisiana. Women's health in the southern U.S. is deeply influenced by social determinants of health, which have profound biological consequences. In an ideal world, no injustices or inequities would exist. Until then, studying the biological systems most profoundly shaped by society may be the best way forward.

As physiologists, we are uniquely positioned to advance the field and bring clarity to areas of uncertainty—to shed light into the darkness, to show the truth. That, after all, is what research does best.

Licy L. Yanes Cardozo, MD, is a professor in the departments of Pharmacology and of Medicine/Endocrinology at the University of Mississippi Medical Center. She is a physician-scientist and practicing endocrinologist. Her research focuses on the role and mechanisms by which androgen excess mediates cardiovascular disease in women.

Illustration by Brett Affrunti

Share Your Story

Has the American Physiological Society impacted your life and career?

Share your story and inspire the next generation of physiologists to build a rewarding and impactful career through Society membership, volunteerism, events, publishing, advocacy and more. Tell us:

- An APS experience that changed the trajectory of your career
- How APS connections led to lifelong partnerships or discoveries
- Ways that APS supported you on your professional journey

We can't wait to hear from you!

physiology.org/testimonial

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Every APS member plays an important role in shaping the future of physiology—by sharing knowledge, supporting colleagues, advancing transformative discoveries and advocating for science.

Together, we create a network of strength, resilience and inspiration.

Renewing your APS membership isn't just about maintaining benefits. It's about standing united with peers who understand your journey, amplify your voice and work with you to push science further.

Because in times of uncertainty and progress alike, our greatest strength is in our shared commitment to advancing physiology.

Renew your APS membership and help keep our community strong.

physiology.org/renew