THE Physiologist MAGAZINE
NOVEMBER 2026



The Taste Signal

Could tinkering with taste fine-tune our health?

PLUS: ANITA LAYTON USES 'MESSY MATH' TO STUDY THE KIDNEY 16 | THE FIGHT FOR RESEARCH INTEGRITY 22

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The Taste Signal

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BY TOMAS WEBER

Cover illustration: iStock

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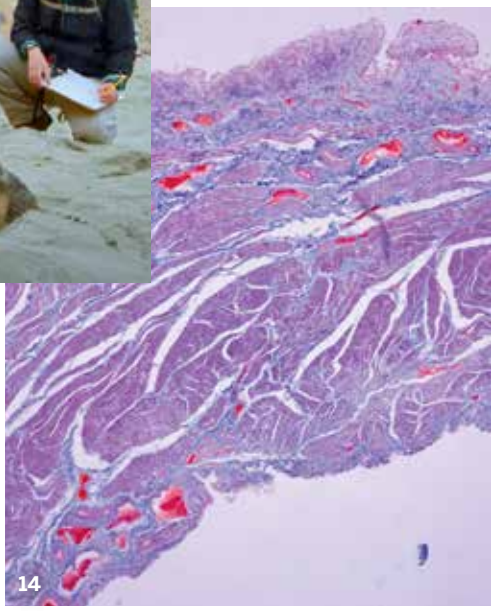

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A Taste of What's to Come

BY AMANDA BERTHOLF, MA



This comes to you from the airport, where I wait to board my flight to New York. Tomorrow, at the Ragan Nonprofit Communications Awards luncheon, we'll learn whether *The Physiologist Magazine (TPM)*, a finalist for best publication, takes home the top prize. Ragan Communications honors some of the best work in the industry. (Spoiler alert: We took home the honorable mention trophy.)

We're proud of what this magazine has accomplished since its relaunch in 2019. And this has been a banner year. In July, *TPM* won the Content Marketing Institute's (CMI) award for Best Nonprofit Publication for our November 2025 issue. The CMI awards recognize the best of the best in content development, communications and marketing, and we were honored to beat out some impressive organizations, including the Muscular Dystrophy Association and University of Chicago Medicine.

"The scientific enterprise depends not only on new discoveries but also on trust in the research itself."

My home airport is Kansas City International, and there are plenty of opportunities to grab some barbecue before boarding a flight. Personally, I've never been tempted to fill up on burnt ends before takeoff, but plenty of travelers are. What I do love is the smell. The moment you step into the main concourse, the aroma from the smokers working overtime hits you. Even at 5 a.m.

It turns out some people are perfectly happy to start their day with brisket. And every day, whether we're eating airport barbecue at dawn or grabbing a quick granola bar for breakfast, our taste receptors are hard at work. Most of us learned about the five tastes: sweet, salty, sour, bitter and umami. But how we taste is far more complex than simply deciding what's for breakfast.

Physiologists are studying the mechanisms of taste, including one of nutrition's biggest balancing acts: salt. We need it to survive, but too much can be harmful. In our cover story, "The Taste Signal" on page 28, you'll learn more about the physiology of taste, the history behind the tongue map and the search for healthier ways to satisfy our cravings.

The scientific enterprise depends not only on new discoveries but also on trust in the research itself. That trust is under threat from paper mills, which produce fraudulent manuscripts designed to game the publication system. APS Publications and Ethics teams, along with the Society's journal editors, are helping lead the effort to identify and stop fraudulent research before it reaches publication. Read more on page 22.

In this issue you'll also meet computational physiologist Anita Layton, PhD, FAPS, whose path to physiology blended mathematics, computer science and biology. Today, she applies those skills to some of the most complex questions in kidney disease. Her story begins on page 16.

Like the brisket cooking low and slow back in Kansas City, each issue of *TPM* is made with care. It takes the time and the efforts of many talented people. We're proud of the result, and we're grateful that you continue to read it.

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

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Research from the APS Comparative Physiology Conference

CONFERENCE ABSTRACT

A Hot Start Can Sting Later

While short exposures to high temperatures may not be lethal to the prepupa of alfalfa leafcutting bees, longer exposure to extreme heat quickly increases the risk of mortality. Researchers found an hour-long exposure to 113 degrees F in bees showed delays in their development. Preliminary findings showed that females had signs of stress, including tissue damage in the gut and ovaries. As the insects reached adulthood, males had a shorter lifespan than nonexposed bees. Unlike other species, the heat-exposed bees' telomere length did not show the typical age-related pattern, suggesting that telomeres may not be a reliable indicator of aging in the alfalfa leafcutting bee. The findings highlight how environmental stressors can have delayed effects as a short, nonlethal heat event can leave lasting damage much later in a bee's life. As extreme heat events become more frequent, understanding how developing pollinators respond to heat may help reveal the longer-term effects of a warming climate.

Source: Andre Szejner-Sigal, PhD, et al. "A Hot Start? Developmental Heat Stress and Biological Aging in a Solitary Bee."



All images: iStock

IN BRIEF

Spotlight on Science

Highlights from research presented at the APS Comparative Physiology Conference.



Obesity affects metabolism, endurance and muscle health differently by sex, with males showing greater impairments that may reflect evolutionary adaptation.

Source: Alexandra Genualdi et al. "Comparative Analysis of Muscle (Dys)function Between Sexes in a Young Adulthood Model of Obesity."



Stress can have widespread effects throughout the body, with even short-term exposure causing weight loss and increased markers of inflammation in rats.

Source: Diogo Benchimol de Souza, DVM, PhD, et al. "Acute Stress Alters Body Weight and Systemic Inflammation in Adult Wistar Rats."



Ketone bodies may be more than an energy source, with new research suggesting they also influence nerve cell communication and neuroplasticity.

Source: Fahimeh Taheri et al. "Beta-hydroxybutyrate Induces Long-term Synaptic Plasticity in Vertebrate Motor Circuits Independent of Metabolism."

CONFERENCE ABSTRACT

Fish Breathe More Air When Waters Warm Up



For some freshwater fish, surviving a heat wave means coming up for air more often. When waters warm, it holds less oxygen, creating a double challenge. Bronze corydoras catfish use their gut to breathe air. When water temperatures rise and oxygen levels fall, the fish gulp air at the surface with increased frequency to supplement oxygen from their gills. Researchers are investigating whether prolonged heat waves alter this response and the development of air breathing in young fish. Bristlenose plecos suckerfish also breathe air when conditions become stressful. Researchers exposed the fish to fluctuating temperatures ranging from 68 to 89 degrees F and tracked changes in air-breathing behavior. Filling knowledge gaps in these areas may help scientists understand if wild fish populations can acclimate to environmental stressors, particularly during the warmer months, or if they should be more carefully monitored for population decline.

Sources: Infinity Alvarez et al. "Developmental Temperature Conditions Affect Air-breathing Plasticity in a Facultative Air-breathing Fish, Ancistrus Cirrhosis"; Jessica Rippamonti, PhD, et al. "Effects of Prolonged Heatwaves on Facultative Air-breathing, Metabolism and Hypoxia Tolerance in Adult Corydoras Aeneus."

CONFERENCE ABSTRACT



The Physiological Toll of Wildfire

Wildfires don't end when the flames go out. With increased frequency and severity due to global climate change, their effects can linger, with rain washing ash, sediment, nutrients and debris into the water. For freshwater fish, this can mean rapidly changing and challenging conditions. Researchers explored how native Australian fish species responded to environmentally relevant levels of wildfire ash. They looked beyond survival to physiological traits that help aquatic creatures thrive: metabolism, swimming performance, heat tolerance and the ability to handle low-oxygen environments. The study found striking differences among species. Some showed substantial declines in performance, while others seemed able to partially acclimate. These findings highlight how a terrestrial disturbance can ripple through freshwater ecosystems. By affecting species differently, wildfire may reshape aquatic communities and biodiversity, with effects that continue long after the smoke has cleared.

Source: Craig Franklin, PhD, et al. "Fire and Flood: Assessing the Physiological Impacts of Wildfire and Associated Runoff on Aquatic Fauna."



Adult northern elephant seals seem to limit ketone production during times of prolonged starvation, challenging the idea that ketones are essential for survival.

Source: Sarah Huen, MD, PhD, et al. "Limiting hepatic ketogenesis to promote survival during starvation."



Reactive sulfur species may be a potential link between psychological stress and sex-specific changes in cardiovascular function.

Source: Analilia Cardenas-Garza et al. "Mental Stress and Reactive Sulfur Species: Implications for Cardiovascular Function."



Study of flonicamid's effect on solitary alfalfa leafcutting bees highlights the need for continued pesticide research on nontraditional pollinators.

Source: Ella Rush et al. "Beleaf It or Not: Investigating the Effects of Flonicamid on the Pollinator Megachile Rotundata."



Burmese pythons' extreme feeding response reveals molecular changes that could deepen understanding of vertebrate metabolism, tissue growth and interorgan communication.

Source: Marcus Mullen et al. "Multi-omics Atlas of Burmese Python (Python Bivittatus) Postprandial Biology Reveals Coordinated Anabolic Programs."

LAB NOTES

MENTORING Q&A YOUR QUESTIONS ANSWERED
STREAMING SCIENCE APS JOURNAL PODCASTS
POLICY IQ PHYSIOLOGY ON THE HILL AND IN THE HALLS
UNDER THE MICROSCOPE OUR MEMBERS, UP CLOSE
PUBLISH WITH POLISH BUILD A BETTER RESEARCH PAPER
IN DEPTH DIVING DEEP INTO SCIENCE
STATS & FACTS PHYSIOLOGY BY THE NUMBERS



Natasha G. Boyes, PhD



Johnathan D. Tune, PhD

MENTORING Q&A | NEW PROFESSORS

Collaboration over Competition

How to motivate trainees—and yourself—after transitioning to the professorship track.

Each issue, we ask a student or early-career member to pose their career questions to an established investigator and mentor. Here, **Natasha G. Boyes, PhD**, a new assistant professor in the Department of Physical Therapy at Marquette University in Milwaukee, Wisconsin, asks **Johnathan D. Tune, PhD**, about the transition to professorship. Tune is professor, chair and assistant dean of research in the Department of Physiology and Anatomy at UNT Health Fort Worth in Texas.

Illustrations by Kagan McLeod

Q: What are some common mistakes you see trainees make that can impair their growth and career trajectory?
A: The most common mistake I see is a reluctance to ask questions and seek feedback, especially from senior faculty. My perspective is that trainees feel that seeking advice will be perceived as a weakness when nothing could be further from the truth. Another common mistake is taking on too many projects such that the end products are several partially done investigations instead of one or two thorough and complete projects. Try not to focus on immediate results; the academic journey is an undulating marathon, not a series of sprints. Also, resist comparing yourself to others and spreading yourself too thin. Instead, focus on developing depth in your specific areas of interest.

"Try not to focus on immediate results; the academic journey is an undulating marathon, not a series of sprints."

Habits and characteristics I often see in successful trainees are that they tend to be intellectually curious, reliable and resilient. They develop strong relationships with mentors and colleagues, take ownership of their work, communicate well, and consistently follow through. Most importantly, they view setbacks as opportunities to learn rather than as evidence of failure.

Q: The competition in academia can feel intense. How do you help trainees manage this pressure?
A: I do my best to help trainees identify their strengths and to focus on producing high-quality and meaningful work. I also emphasize that collaboration is essential and often more powerful than the pressure of the competition. Building a network of mentors and colleagues who complement your expertise can create opportunities that competition alone cannot. In the end, opportunities tend to follow consistent quality work that contributes positively to the field. Collaboration serves to expand not only the depth but the reach of research.

Q: How do you keep yourself and your trainees motivated during setbacks?
A: I was advised early in my career to develop thick skin, as the academic process can often be quite harsh. While experience has indeed produced a degree of hyperkeratosis, it has also taught me that a rejected grant or manuscript is rarely a judgment on the overall value of the scientist or their career. With that, I encourage trainees to put setbacks into perspective and to extract useful information from the reviews that will help improve the quality and clarity of the overall product. I also emphasize that there will undoubtedly be successes and failures throughout everyone's career. Maintaining curiosity, celebrating achievements, and remembering why you became a scientist in the first place are critical for sustaining motivation.

Q: In your transition to independence, how did you decide which opportunities to say yes to?
A: Early in a career, saying yes to opportunities helps to provide experience, establish your reputation as a team player and build relationships that expand your overall network. As responsibilities increase, however, learning to say no strategically is essential. I have always tried to prioritize opportunities that best align with my areas of interest and experience and to avoid activities that I am less interested in or I felt were likely to be a distraction.

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

Humans have 10,000 taste buds that get replaced every two weeks.

WebMD

19%

of Americans over the age of 40 report some alteration in their sense of taste.

National Institutes of Health

As we age, some taste buds stop growing, so older people have closer to 5,000 working taste buds.

WebMD

50–150

taste receptor cells are in every taste bud.

Cleveland Clinic

1 in 20

Americans reports experiencing dysgeusia, a disorder characterized by distorted taste.

National Institutes of Health

STREAMING SCIENCE | SOUNDBITE FROM APS JOURNAL PODCASTS

A Gut Connection to Hypertension

What can gut microbes reveal about hypertension in middle-aged women? In this episode of the *American Journal of Physiology-Heart and Circulatory Physiology* podcast, Associate Editor Keith Brunt, PhD, talks with lead author Shrushti Shah, PhD, and expert Jasenka Zubcevic, PhD, about research linking high blood pressure to changes in tryptophan metabolism and the gut microbiome. They explore how diet, immune signaling and hormonal transitions may shape these relationships—and why women-specific research matters. The observational findings don't establish causation, but they offer intriguing directions for understanding cardiovascular risk and investigating more personalized approaches to prevention.

Listen to the podcast and explore the article behind the discussion at bit.ly/hypertensivewomen or scan the QR code.

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POLICY IQ | FEDERAL FUNDING

How Science Policy Influences Research Integrity

Federal agencies have been introducing several new and updated policies.

Researchers with federal funding spend nearly half of their time on pre- and post-award activities, according to the Federal Demonstration Partnership. While this work also includes writing grant proposals, managing budgets and lab personnel, compliance with an expanding array of federal research requirements represents a significant investment of time and resources.

Large research institutions employ specialists to help investigators navigate evolving federal regulations and guidance. Scientists at institutions with fewer resources, however, may have less access to that support, creating barriers to pursuing federal funding opportunities.

At the same time, these policies serve an important purpose. Federal requirements governing research misconduct, data sharing, public access and research security are designed to protect research integrity, promote transparency and ensure responsible stewardship of taxpayer investment in science.

Over the past few years, federal agencies have introduced new and updated policies related to data sharing and management, research misconduct, access to scientific publications, and research security. Here's a look at each.

Data sharing and management. In 2023, both the National Science Foundation (NSF) and the National Institutes of Health (NIH) implemented policies requiring data-sharing and management plans for all awards that generate scientific data. While the policies don't specify a required location or format for data sharing, the goal is to ensure long-term preservation and access to federally funded research data.

Research misconduct. Longstanding regulations detailing procedures for investigations into research misconduct were updated in 2024. The regulations are intended to ensure a workable process exists to address fabrication, fraud and plagiarism in federally funded research while protecting the integrity of the scientific record.

Public access. Beginning in 2025, federal research agencies began requiring immediate public access to all scientific publications reporting results from federally funded research. The policy aims to accelerate scientific progress, increase collaboration and support responsible stewardship of federal resources.

Research security. Few areas of research policy have evolved as quickly as research security. In response to concerns about foreign influence in research, federal science agencies have implemented new requirements for research security training, rules about collaborating with scientists in foreign countries, and safeguards for sharing certain sensitive types of data. These policies are intended to reduce the risks related to intellectual property theft and inappropriate sharing of sensitive data.

WHAT THIS MEANS FOR PHYSIOLOGISTS

Physiologists conducting federally funded research must navigate an increasingly complex set of compliance requirements. Those who work with human or animal subjects must also comply with regulations that ensure the research is conducted with appropriate safeguards.

Meeting these requirements takes time, resources and institutional support. The APS Science Policy and the Animal Care and Experimentation committees monitor federal policies and regulations that affect research and provide input when opportunities arise. APS advocates for policies that are workable for scientists, allowing them to carry out their work in an ethical and safe manner while avoiding unnecessary or duplicative compliance requirements.

Send questions or comments to tphysmag@physiology.org.

APS members can share feedback on policy issues by emailing **sciencepolicy@physiology.org**.

UNDER THE MICROSCOPE | COMPARATIVE PHYSIOLOGY

Beyond the Textbook

This researcher's curiosity and persistence take her to unexpected places.

Kaitlin Allen, PhD, is a Life Sciences Research Foundation postdoctoral fellow at the University of Maryland Center for Environmental Science in Baltimore. She studies how marine mammals manage oxygen, energy and iron while facing physiological extremes such as diving, fasting and lactation.





SEALING THE DEAL. I've always liked biology, but I didn't really understand that it was something you could do—and not just read about in a textbook—until I went to college. I worked as a lab tech in a vascular physiology lab to buy myself some time career-wise. And they sent me to Antarctica for two months of fieldwork! I'd had no idea that something like that was even an option for a scientist, and I've been sold on it ever since.

FIRE IN THE FIELD. A few years ago, I was struggling with a bit of imposter syndrome and was second-guessing myself a lot. We were driving in the field one day, and I felt like my vehicle was operating strangely and maybe even smelled a little off. I almost convinced myself it was all in my head, but I stopped to check it out and the engine was on fire! We got the fire put out quickly and nothing more serious happened, but it was a good lesson in trusting your gut.

CHARTING HER COURSE. Marie Tharp was a geologist and cartographer who used existing ship sounding data (depth measurements) to construct maps and profiles of the sea floor. As a woman, Tharp was barred from shipborne fieldwork in the 1940s and 1950s, yet she found a way to produce new visualizations of the sea floor and provide evidence for plate tectonics. She was detailed, creative and persistent—three traits critical for scientists.

CREATIVITY AND COLLABORATION. My favorite part of my job is working in the field. It forces me to be creative and use parts of my brain that don't always get exercise in a controlled lab setting, and it really emphasizes the value of working collaboratively as a team.

NOT JUST FOR PEOPLE. One misconception is that physiology is limited to human health or to measurements made in a laboratory. Physiology is really the study of how all living organisms function, from molecules and cells to entire animals in their natural environments. In my work, that means connecting what happens inside seals' cells with how the animal manages extreme environmental challenges such as deep diving or prolonged fasting.

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

Photos courtesy of Kaitlin Allen, PhD

PUBLISH WITH POLISH | ARTIFICIAL INTELLIGENCE

How to Use AI Responsibly

Adopting artificial intelligence into your daily work can be done ethically.

For scientists, artificial intelligence (AI) has the potential to improve efficiency, streamline tasks and polish communications. The payoff is more time for creative thinking, critical analysis and scientific judgment that only humans can provide. Researchers are embracing these tools. A survey of 6,000 German researchers found that more than 50% are using AI in their daily work. When it comes to publishing, how can researchers use AI effectively and ethically?

Many AI tools can accelerate the processing of large data sets and support statistical modeling. By comparing multiple variables and conditions quickly, these tools can yield faster results and suggest new areas of investigation. If you're designing a custom AI tool specific to your lab, testing and validation are essential. Researchers must understand how the model was trained and where its limitations lie. Authors are responsible for scrutinizing and verifying all data outputs and disclosing them in the methods section of the manuscript. Ethical standards still apply to AI data processes and outputs, so rigor and reproducibility remain essential standards.

A paper's figures are another area where caution is key. Visuals often provide the first impression of a study's findings, making accuracy critical. Graphs should be based on real source data, rather than from generative image software. APS journals allow the use of AI to create schematics and conceptual illustrations, but the authors should verify the accuracy of any resulting images.



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Authors should also be mindful of copyright. Copyrighted images should not be used as AI inputs without permission from the copyright holder. Regardless of how a figure is created, authors are responsible for its accuracy and appropriate use. Any use of AI-generated images should be disclosed in the acknowledgments and figure legends.

For many researchers, writing and revising manuscripts is a significant time investment. AI can be useful as a second set of eyes, helping improve organization, clarity and flow of content. APS journals permit the use of AI tools for this use if it is disclosed.

However, drafting a manuscript completely with generative AI presents risks. These tools can produce inaccurate information, fabricated statements and made-up references. Researchers should carefully review AI-generated suggestions before incorporating them into a manuscript. Any use of AI writing assistance should be disclosed in the acknowledgments.

The role of AI in the peer review process is complicated. At the heart of peer review is a commitment to confidentiality. Reviewers and editors are entrusted with unpublished work, and uploading manuscripts to external AI systems that may store, retain or redistribute material breaks this trust.

Peer review also depends on the expertise and experience of scientists. AI cannot replace the critical evaluation that peer review requires. APS journals allow AI for language-support functions only when confidential manuscript content is not disclosed to external AI systems.

AI is becoming a routine part of research and publishing. The uses of AI are constantly evolving, and APS Publications continues to evaluate its policies. For the latest guidance on using AI responsibly in APS journals, visit **journals.physiology.org/editorial-policies#ai-policy**.

STATS & FACTS

Among 138,897 COVID-19-positive patients, 39% reported taste dysfunction.

National Institutes of Health

Cats have nearly 500 taste buds and cannot taste sweets.

Scientific American

Some neurologic conditions such as Alzheimer's disease, multiple sclerosis and Parkinson's disease are linked to loss of smell and taste.

WebMD

"Swimming tongues"

is the nickname for catfish, which have over 100,000 (and in some cases up to 175,000) taste buds.

National Library of Medicine

Butterflies taste with their feet and can taste anything they land on.

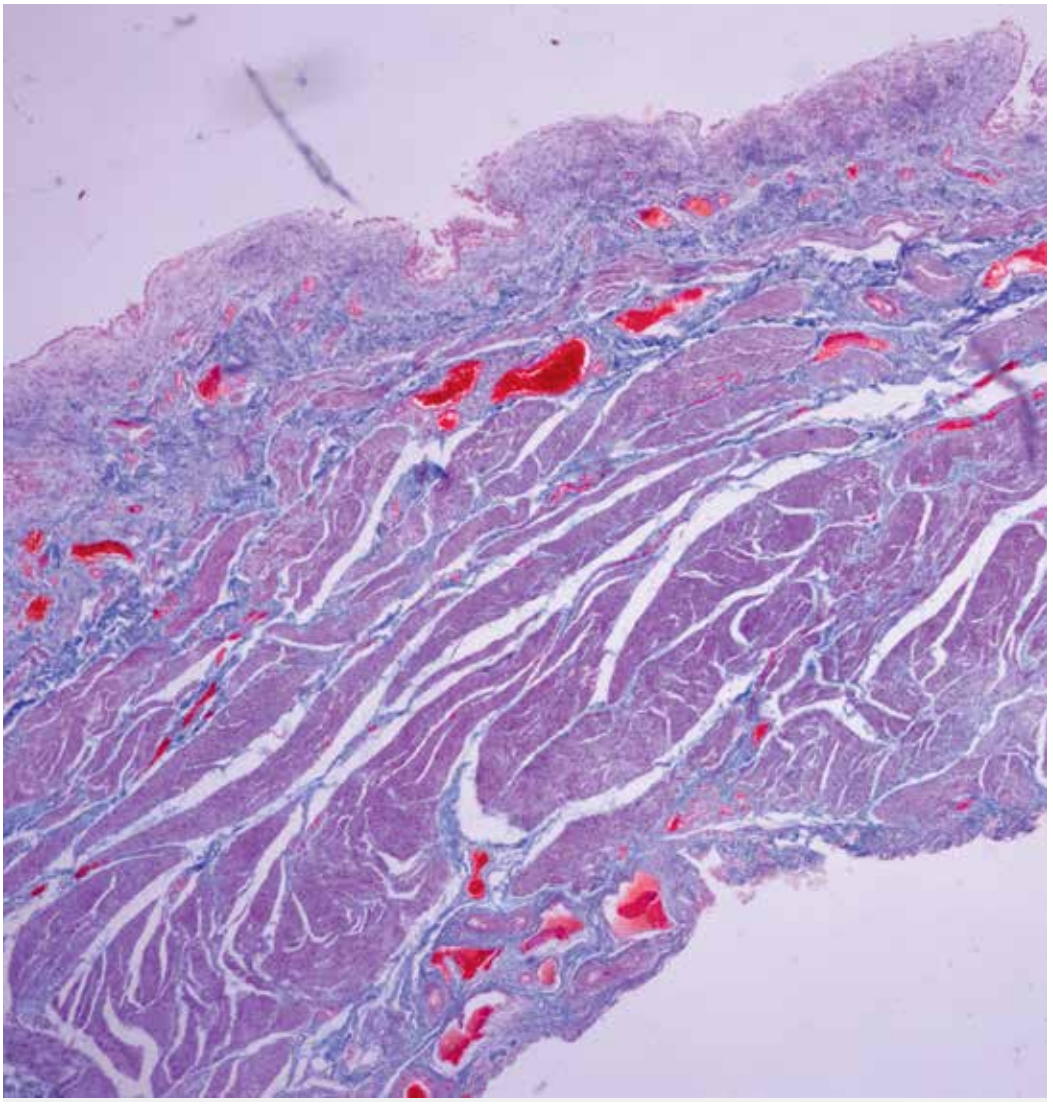
Scientific American

IN DEPTH | UTERINE-PLACENTAL INTERFACE

Placentas and Perseverance

Studying the path from fertilization to fetus comes with challenges and rewards.

Michael J. Soares, PhD, directs the Institute for Reproductive and Developmental Sciences at the University of Kansas. His research focuses on the earliest stages of development—the formation of the placenta—and how this critical step influences health and disease. Soares was a speaker at the 2026 American Physiology Summit.



iStock

What core questions motivate your research?
We are very interested in stem cells and what makes this undifferentiated cell become specialized. During embryonic development, trophoblast cells are the first type of cell to specialize, and they go on to form an essential part of the placenta. There are different types of specialized trophoblast cells. We focus on the ones that migrate into the uterus. These invasive trophoblast cells restructure uterine spiral arteries, allowing the redirection of maternal nutrients to the placenta. Another specialized trophoblast cell then facilitates the transfer of nutrients to the fetus. Much of our work has been targeted at better understanding how the invasive trophoblast cell population arises.

How have you approached this work?
Approximately two decades ago, we observed that trophoblast cells migrate deep into the uterus of the rat. In this way, the rat exhibits striking similarities with the human uterine-placental interface but differs from the shallow intrauterine trophoblast cell invasion characteristic of the mouse, which had been a more common model. This observation set us on a path to establish the rat as a model for investigating conserved

mechanisms controlling deep placentation.

However, connecting these research efforts to early events in human placental development was problematic due to ethical considerations and the absence of valid in vitro models for investigating human trophoblast cells. A critical scientific advance occurred in 2018 when a group from Tohoku University in Japan led by Hiroaki Okae and Takahiro Arima isolated trophoblast stem cells from the human placenta. They characterized these cells in the stem state and established methods for their differentiation into specialized trophoblast cells that invade and transform the uterus and into cells that facilitate the transfer of nutrients to the fetus.

"We are elucidating gene networks that are essential for early decision-making in the establishment of the placentation site."

This advance provided our group with the ability to effectively translate our research. Using these cell lines, we could evaluate potential conserved mechanisms controlling invasive trophoblast cell development using human trophoblast stem cells and test their efficacy in vivo in a rat model.

How can your work help us understand what makes for a healthy pregnancy and fetus?

Our research efforts are focused on identifying conserved regulators that direct the development of the uterine-placental interface. We are elucidating gene networks that are essential for early decision-making in the establishment of the placentation site. These same gene networks are susceptible to dysregulation in pregnancy-associated diseases, such as early pregnancy loss, preeclampsia, intrauterine growth restriction and pre-term birth. It is our expectation that the basic knowledge generated from our research will lead to the development of strategies for the early diagnosis and treatment of pregnancy disorders caused by failures in the process of placentation.

Through our research efforts we have also determined that a healthy placenta exhibits plasticity and, most importantly, can adapt to environmental challenges. Adaptation is especially important during the early phases of placentation. This is when the trophoblast stem cell population can expand, if needed, or can differentiate into more specialized cells to transform the uterine environment or deliver nutrients to the developing fetus. The maternal physiologic state dictates this process. Problems arise when trophoblast stem cells cannot meet challenges within the maternal environment, especially when the challenges arise after the foundation of the placentation site has been established.

What are you eager to learn next?

Numerous questions remain regarding the gene regulatory networks that govern the differentiation of stem cells into invasive phenotypes. Characterizing these complex mechanisms is a primary objective of our research. We would like to extend our work to look at how those differentiated trophoblast cells actually engage and interact with the cells that they encounter in the uterus, like vasculature and immune cells.

What lessons have you learned about being a scientist?

You have to work hard, be focused and have confidence in what you are doing. As scientists, we get challenged and criticized regularly—manuscripts are scrutinized, and we encounter significant obstacles in competing for research support. Individuals who are successful develop skills in perseverance and possess intrinsic confidence in their abilities as a scientist.

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

STATS & FACTS

400,000

paper mill articles have been estimated to have infiltrated scientific literature over the past two decades.

Nature

A team of researchers found that nearly 10% of the cancer research literature screened with a machine learning tool could have originated in paper mills.

"Machine Learning Based Screening of Potential Paper Mill Publications in Cancer Research: Methodological and Cross Sectional Study." doi.org/10.1136/bmj-2025-087581

"You can see a scenario in a decade or less where you could have more than half of [studies being published] each year being fraudulent."

Reese Richardson, PhD, Northwestern University, "Uncovering the Fraudsters and Their Schemes Responsible for Polluting the Scientific Literature," *Chemistry World*

An analysis found suspected paper-milled articles are growing exponentially, doubling every 1.5 years. In comparison, the total number of all publications is only doubling every 15 years.

"Uncovering the Fraudsters and Their Schemes Responsible for Polluting the Scientific Literature," *Chemistry World*



Seeking ORDER

Computational physiologist Anita Layton uses 'messy math' to uncover mysteries of the kidney.

BY KAREN BLUM

When Anita Layton, PhD, FAPS, was a child in Hong Kong, her father led the high school math department at the K-12 school she attended. His colleagues would often pat her on the head and tell her, "You're so smart. You'll grow up to be a math teacher just like your dad." Layton would smile and say, "OK," but internally she was thinking, "There's no way I'm doing math."

Today, Layton is a successful computational physiologist. She combines mathematics, computer science and physiology to tackle some of the most complex questions in kidney disease. She is a named University Professor at the University of Waterloo in Canada, with appointments in applied mathematics, computer science, pharmacy and biology, and she serves as associate dean for research in the Faculty of Mathematics.

Photos courtesy of Anita Layton, PhD, FAPS



Layton with members of her department at their holiday party (left) and at the 2025 annual meeting of the Society for Industrial and Applied Mathematics, where she presented the CAIMS Research Prize Lecture (right).

While Layton was gifted in math as a kid, it took her a while to embrace it. Instead, she wanted to forge her own path in science. There was only one issue: She struggled with hands-on experiments, often breaking something or landing on solutions far from those expected. So, she turned to computer science, where she says, "If something is wrong, there is no smoke, there is no explosion, and no one has to know." Eventually though, her career trajectory led her back to mathematics.

Over the past year, Layton became a fellow of APS and received the Ernest H. Starling Distinguished Lecture—the most prestigious award from the APS Water & Electrolyte Homeostasis Section—for her research in mathematical models of kidney function and her career-long dedication to water and electrolyte homeostasis research.

The award signifies more than 20 years of designing computational models of kidneys in rodents and humans to simulate the effect of different drugs on the organs, as well as modeling sex differences in kidney function and treatment response.

Layton—who has been named one of Canada's most powerful women by the Women's Executive Network—has published over 200 research papers in leading mathematics and physiology journals and co-authored the textbook "Mathematical Modeling in Renal Physiology."

DRAWN TO THE COMPLEX

Simple projects don't excite Layton. If it were a narrow question, it would have been solved 50 years ago, she says. "My kind of math is the messy type. I'm drawn to questions with many interacting parts," she says. "I like being able to step back, see the complexity, and then decide which piece to zoom in on."

In one project, her team used simulations to investigate how a diabetes drug that increases urinary glucose excretion can lower both blood sugar and blood pressure. In another, they developed separate blood pressure models for men and women, using model simulations to demonstrate how and why certain blood pressure medications are more effective for each sex. They have also modeled the combined effects of diuretics, renin-angiotensin system inhibitors and ibuprofen, helping to identify physiological factors that can increase the risk of acute kidney injury.

"I am excited about the findings we have uncovered in sex differences, like what kinds of anti-hypertensive drugs work best for the two different sexes and under what circumstances and why."

Layton enjoys collaborating with other faculty, providing resources and knowledge to help them improve their research in math or science. "Their research may be far outside my own area, but I can still help them sharpen their ideas, build connections and pursue the resources they need. I love science, and I love contributing to science from all kinds of different angles."

AN EARLY INTEREST IN MATH AND SCIENCE

When she was a child, Layton's family stressed the importance of education and earning a PhD. Her father had wanted to go abroad for his doctorate studies but lacked the funding,



Layton with her eldest daughter, Laura, at her 2026 University of Waterloo graduation (left) and presenting her Ernest H. Starling Distinguished Lecture at the 2026 American Physiology Summit (right).

so he took a teaching job after earning his undergraduate degree.

Math and science came to Layton easily, and her father would tutor her on lessons several grades ahead. When it came time to attend university, Layton went to Duke University in North Carolina, where she pursued physics, which she loved. But hands-on experiments proved problematic.

"I love physiology. I love science. I just cannot touch anything without breaking it," Layton says. In high school biology, when her classmates presented a beautifully dissected frog, hers "was like a bloody mess," she recalls. It was the same with physics, even with simple experiments. "You measure gravitational constant, which should be 9.81 m/s2, and mine would be 3. I had no clue what I did wrong."

To survive, she found lab partners to conduct the experiments, while she offered to analyze the data and write the findings. She thought to herself, "This is not gonna last. I need a backup plan." That's when she added computer science as a second major. "I love writing code. I like debugging, figuring out what is wrong," Layton says.

Layton went on to earn a PhD in computer science from the University of Toronto. By then, her parents had relocated to Canada, and she had gotten married. Her dissertation concentrated on numerical weather prediction. "When you predict weather you are looking at the flow of air," including pollutants or other particles, she explains.

Upon taking a position at Duke as an assistant research professor of mathematics, Layton began applying her expertise in fluid dynamics and scientific computing to the kidney. Her husband, Harold, a Duke mathematics professor whose research also involved renal physiology, helped introduce her to the field. "The kidney deals with fluid, blood—clearly not the same as air, but mathematically, they're not very different."

Kidneys are complicated, Layton says. They regulate fluid and electrolyte balance through an intricate network of interacting transport processes. Cells are constantly pumping and transporting. For Layton, the kidney offered exactly the kind of "messy" scientific challenge she enjoys.

To get up to speed on renal physiology, Layton threw herself into studying the kidneys: reading journal articles about renal research and attending relevant physiology and kidney conferences, where she spoke with poster authors and hung out at social events at bars, even though she doesn't drink.

"If you're approachable and bring something valuable to the table, people are willing to start a conversation," she says. While some initially were skeptical about mathematical modeling as a means to study the kidney, she says, "I like to think I've won over quite a few skeptics by showing how modeling can generate insights that are difficult to obtain by intuition or experiment alone."

BUILDING TEAMS

As she built her research program at Duke, she added joint appointments in the departments of medicine and biomedical engineering. Then in 2018, looking to move closer to her

parents, Layton was recruited by the University of Waterloo and awarded the Canada 150 Research Chair in Mathematical Biology and Medicine, as part of a grant program honoring the country's 150th anniversary.

While conducting studies, she enjoys collaborating with clinicians from different backgrounds to probe problems from many angles. "My best quality is to make a lot of friends, so when I need an expert in this area, I know who to call and they will talk to me," she said during an episode of "Living Proof," a podcast from the University of Cambridge in England. She noted that working with others is the best way to make progress. "Big problems that are worth tackling, spending a decade or two of your life on … they are difficult, and you really have to be super arrogant to think that you can do it on your own."

Layton brings that same multidisciplinary mindset to her workplace and her students. She served as inaugural chair of the University of Waterloo's Research Equity, Diversity and Inclusion Council, which works to build research teams that bring together people with varied disciplinary, educational and cultural perspectives.

"I think people learn better and learn more when they interact with people who are not like them," she says. "My clone does not stimulate new thoughts in me or inspire new ideas. I learn a lot more when I work with people whose backgrounds and perspectives differ from mine."

Her computational lab features a large room where, at any given time, a dozen or so students from Canada, the U.S., Europe, Africa, Asia and the Middle East, with backgrounds in disciplines such as math, computer science, philosophy and electrical engineering, collaborate and teach each other.

She values the role of mentor. "I meet with my students rather frequently, answer their questions and help provide direction, but I want them to take intellectual ownership of their projects. That is an important part of my role as an educator."

She encourages her students to apply for awards, sit in on lectures on different topics they might pull from one day, and present findings at conferences. She also encourages them to not be intimidated by disciplinary boundaries. "Some of the most exciting discoveries happen at the interface of mathematics, physiology, medicine and data science," she says. "Be curious, be willing to learn from other fields, and let biology guide the mathematics, not the other way around."

Layton is also shaping the next generation of STEM majors at home, through her two young adult daughters. Her 23-year-old, with a double degree in applied math and statistics, is pursuing a PhD in statistics, while her 19-year-old is enrolled in a joint program in computation arts and computer science, which provides a foundation for the integration of these two subjects as hybrid digital media arts and multimedia productions.

Back in her own lab, Layton's new research goal is to build a multiscale model that can use genetic information to predict cellular function, organ function and a whole-host response, she says.

"That's very difficult to do. You may know what a certain substance does to one gene regulatory pathway," she says, "but how do you translate that information into predictions about cells, organs and ultimately the whole body? I want to connect those scales in a meaningful way. I don't know how to do that yet, but I intend to find out."

A CLOSER LOOK

5 Questions with Anita Layton

What do you do for fun?
I work out. I play squash with my partner. I run on a treadmill. In the summer, Mississauga, where we live, has festivals for different cultures: Italian, Japanese, African, etc. I like going to those on the weekends. I love reading. "The Murderbot Diaries" is my current obsession.

What math fact do you like to share with people?
Math can actually be used to help answer biological and medical questions. That is mind-blowing to them. I would like people to know that better.

What do you like to do on vacation?
My partner and I love to travel and eat. I'm less interested in spending three hours in a formal restaurant than in walking through a street market and trying a dozen unusual things. Osaka absolutely deserves its reputation as the kitchen of Japan, and Taipei was wonderful too.

What is a fun fact about you that people might not know?
I break things all the time. When you first meet me, you may not know that you should not let me in your lab because I will break something there. But if you had a few dinners with me, I might have spilled your glass of wine and you would have found out.

What three traits do you value most in a colleague?
Curiosity, insight and generosity. I value people who ask good questions, see connections others may miss, and approach collaboration as a genuine exchange.

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The *Fight* for Research Integrity

Authorship for sale is undermining science, but editors and scientists are pushing back against the incoming wave.

BY ISOBEL WHITCOMB



Illustration by Sara Gironi Carnevale

In 2021, Larissa Shimoda, PhD, started noticing a strange pattern in some of the papers she reviewed as deputy editor of the *American Journal of Physiology-Lung Cellular and Molecular Physiology (AJP-Lung)*. The experimental design, data and figures would look uncannily similar. Two papers might feature nearly identical Western blots, with just a single protein distinguishing the figures. Even the syntax of the study titles would mirror one another. *AJP-Lung* would see four or five of these doppelgangers in a week, Shimoda says.



It would be one thing to receive these studies from a single lab or university, but they were coming from all over. "The data all looked so very similar, there's no way different universities studying different proteins would get results that looked interchangeable," says Shimoda, who is now editor-in-chief of *AJP-Lung* and director of research in the Pulmonary and Critical Care Medicine Division at the Johns Hopkins School of Medicine. "That's when we began to realize, 'Oh, these might be coming from a paper mill.'"

For about 20 years, paper mills—commercial enterprises that write and sell authorship to academic manuscripts—have been helping bad actors pad their CVs. For a while, the trickle of sham research in the scientific literature went largely undetected. But around a decade ago, that trickle turned into a flood that was impossible to ignore. A 2022 analysis published in *BMJ* found that in 2021, nearly 22% of retracted papers were found to come from paper mills. In 2023, Hindawi journals retracted more than 8,000 paper mill papers.

Amid growing public distrust of science, paper mills pose a risk to scientific integrity and credibility. Fortunately, awareness of the crisis has allowed academic organizations to begin cracking down on systematic fraud. Within the field of physiology, editors and ethics teams are using an arsenal of screening tools to prevent the output of paper mills from infiltrating the academic literature. But preventing the spread of fraudulent research is also up to scientists themselves.

INSIDE THE PAPER MILL INDUSTRY

Paper mills are hidden in plain sight. In 2021, *Retraction Watch*, an online publication investigating research misconduct, published screenshots of a Russian website promising authorship of published papers—for a price: "We sell publication of ready-made articles in Scopus and Web of Science journals," a translation of the homepage reads. "We are NOT CHEAP because WE GUARANTEE publication and indexing by 100%."

These entities don't originate in just one country. From China to India, academics and fraudsters peddle papers over websites, WhatsApp groups and Facebook. They sell for as little as $50 or as much as $15,000 for a co-first author position in a prestigious journal. Sometimes, these papers are based on legitimate science, written by academics who auction authorship positions to unaffiliated researchers for a profit. They might plagiarize existing research, with subtle tweaks to figures and text. Other times, they are simply fabricated. Fake data are inserted into manuscript templates—a cookie-cutter appearance that editors like Shimoda saw in many papers.

Christopher England, PhD, APS director of publishing, program development, policy and ethics, first noticed an unusual number of papers on microRNA. "Their titles

often followed a similar formula: X does Y via this pathway," England says. The data often looked too perfect or would be presented in duplicate figures, and the papers typically lacked a credible funding statement.

The paper mill industry is more than just the entities producing the papers themselves. Research suggests that it may also involve a network of editors and peer reviewers who collude to get fraudulent research accepted into the literature. A 2025 analysis published in *PNAS* found that 45 *PLOS ONE* editors had accepted nearly one-third of all articles that were later retracted, despite handling only 1.3% of articles overall. When they repeated the analysis with Hindawi journals and IEEE conference proceedings, they found a similar concentration of retractions among a few editors. The study authors noted instances in which agents for paper mills attempted to bribe journal editors.

The result is an influx of slop into the academic literature that "tears down the integrity of all scientific knowledge," England says.

In 2022, Clear Skies, a company that developed an AI tool for flagging suspicious papers, estimated that the output of paper mills accounted for 1.5% of scientific literature. That number is likely growing.

The immediate effect of this output is the erosion of trust in data and science, says Wolfgang Kuebler, MD, FAPS, chair of the Institute of Physiology at the Charité-University Medical Center Berlin and recent chair of the APS Publications Committee. But it goes much further than that, he adds. Imagine a graduate student who reads an intriguing study, builds a hypothesis, and starts a five-year project, only to discover that the basis of their work was the output of a paper mill. "You could put in years of your life into something that is just an invention," Kuebler says.

On a much larger scale, a company might put millions of dollars into a clinical trial for a new drug based on fake data. "It could cause not only psychological damage, but real economic damage to the scientific system," Kuebler says.

DEVELOPING A PLAN

When Shimoda and her colleagues first noticed the influx of submissions from paper mills, it was all hands on deck. *AJP-Lung's* editors would work together to come to a consensus on whether suspicious papers warranted action. "It would take hours to go through each paper," Shimoda says. When they rejected a paper on suspicion it was fraudulent, they also provided other reasons for the decision, in case the research was legitimate. "We would take the time to review it and give feedback," Shimoda says. Not only did that take time, but it gave the paper mills data to improve submissions, making them harder to detect.

The workload quickly became unmanageable, so the editors went to the APS Ethics Department for help. The department developed a strategy and suite of tools to help screen for paper mills. This strategy combined human assessment with digital platforms that screen for various possible paper mill indicators, such as irregularities in citations, authorship and figures.

Journal editors don't rely solely on these tools. Sometimes, a suspicious

INSIDE THE STORY

5 Red Flags to Watch for When Evaluating Studies

When fraudulent research accumulates citations, it erodes the foundation of science, says Larissa Shimoda, PhD, editor-in-chief of *AJP-Lung*. Next time you're participating in peer review, writing a review article or just staying up to date on literature, here are some warning signs to look for.

- **Implausible collaborations.** Look at the title and affiliations of the co-authors. Does it make sense that these researchers would collaborate, and does the study's topic fit within their respective disciplines?
- **Irrelevant citations.** Check the study's references. Do these papers exist, and are they relevant to the context in which they are cited?
- **Tortured phrases.** Paper mills will often substitute bizarre synonyms into a text to hide plagiarism. Real-world examples include "colossal information" for big data and "motor vitality" for kinetic energy.
- **Familiar text.** Does a title or abstract give you deja vu? Paper mills appear to use manuscript templates that can give their output a cookie-cutter appearance.
- **Duplicated images.** In fraudulent research, identical images occasionally appear as different figures within the same article, cropped, flipped or manipulated to appear as though they represent different experiments or samples.

paper will evade the initial screening process. When that happens, Shimoda and her team consult with the APS Ethics Department to determine the appropriate next step. When a digital tool flags a paper as high risk of coming from a paper mill, the APS Publications team doesn't automatically throw it out. "It just means we have to step back and assess whether there is truly a problem," England says.

"This system isn't 100% effective," England says, acknowledging that the screening process may occasionally result in legitimate research being rejected. "We make the best judgments we can based on the information available to us, always with positive intent. Ultimately, that intent is to protect the integrity of the scientific literature."

APS journal editors and staff did not share the details of their screening methods because doing so only helps paper mills evade detection tools. These commercial entities are constantly evolving. "This is something we do not discuss publicly because that teaches these people how we detect their papers and helps them develop better algorithms," Kuebler says.

The advent of generative artificial intelligence (AI) presents a new challenge to editors. "It has made generating fraudulent data that much easier," Shimoda says. For example, paper mills can now use AI models to produce a convincing Western blot with specified band sizes.

Shimoda has also seen an increasing number of AI-generated review articles. "These models will put something together that reads fairly well and has citations. But when you look closer at them, some of those citations are fraudulent," she says.

The fight against paper mills will involve more than just screening tools and diligent editors. It also requires the participation of the larger scientific community.

A COMMUNITY-WIDE EFFORT

The fight against paper mills will involve more than just screening tools and diligent editors. It also requires the participation of the larger scientific community. Whether crafting a hypothesis or writing a review article, all scientists should be on the lookout for research produced by paper mills. A good starting point, Shimoda says, is to check the track record of the journal where a study is published. An unusual number of retractions and a fast publication timeline—just days between submission and acceptance—are signals that the journal isn't giving submissions the level of scrutiny that a reputable journal would devote to research.

England encourages scientists to be skeptical when peer reviewing research. "If the data looks too good, it might be too good to be true." When scientists do encounter a suspicious paper, they should contact the publisher or editor-in-chief, he adds. "They're the experts in that field. They likely have an understanding of what looks right and what doesn't look right."

Keeping fraudulent research out of scientific literature will also require a culture change, Shimoda says. Paper mills have thrived in an environment where scientists face enormous pressure to produce large volumes of research with limited time and resources. Authors of papers produced by paper mills also tend to be based in countries where scientists are rewarded for publishing, whether through promotions or monetary compensation. "Many of us go into science because we're looking for truth," Shimoda says. "But there are cases where a lot of competitive interests may come into play."

When it comes to promotions and tenureship, institutions should focus more on the quality of the work scientists produce—its rigor, reproducibility, how the data are generated, and the overall value to science—rather than impact factor or publication counts. "That makes for a much better landscape for everyone involved," England says.

Despite the continued prevalence of paper mills, Shimoda is hopeful that scientists will be able to keep the flood of fraudulent research at bay. With greater awareness of the issue, more publishers are developing policies to identify submissions generated by paper mills. Digital tools that detect fraudulent research are growing more sophisticated.

"Looking back over the last five years at the strides that we've made, we've come a long way," Shimoda says. "And I'm hopeful we can continue to make progress."

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THE TASTE SIGNAL

Researchers are lifting the hood on the mechanisms of taste. Could tinkering with it help fine-tune our health?

BY TOMAS WEBER

Here are three words people are probably tired of hearing: "Eat less salt." It's well-worn advice that physicians and public health authorities have been repeating for decades. Meanwhile, the global health crisis resulting from excessive sodium consumption remains as stubborn as ever.

In 2013, all 194 World Health Organization member states committed to cutting their populations' salt intake by 30% within a decade. Progress, though, has been sluggish. Only a handful of countries have reduced their intake, and in 2019 the deadline was pushed back to 2030. By 2021, global mean consumption stood at 4,278 mg a day, more than twice the recommended limit. Across the world, 1.7 million cardiovascular deaths a year result from consuming too much salt.

Illustration: iStock

"If you could reduce the amount of salt people eat by half, that would have a huge impact on cardiovascular disease, kidney disease and high blood pressure," says physiologist Vijay Lyall, PhD, associate professor emeritus in the department of cellular, molecular and genetic medicine at Virginia Commonwealth University. Lyall has spent more than three decades studying salt taste.

Dietary guidelines, as well as salt substitutes such as potassium chloride, are part of the solution. But Lyall believes that changing the way salt tastes could be an even more effective way of reducing salt intake. After all, if you could supercharge the taste of sodium—make saltier salt—maybe people would want to eat less of it.

"The idea is to make a flavor enhancer so strong that you would only want to use a very small concentration of salt," Lyall says.

But engineering such a compound requires understanding how the taste system works, and until recently, much of it was a mystery. Over the past several years, though, researchers have been making impressive progress in uncovering the physiology that turns a compound on the tongue into a signal read by the brain—and now they are getting closer to making healthier food taste better.

"The more we know about how the system works, the more potential there is for us to go in there and manipulate it," says taste physiologist Alan Spector, PhD.

So what would it take to fool the tongue?

THE TONGUE ON GUARD

It's a hard problem. For our own protection, our tongues have evolved to be difficult to trick. "The taste buds stand guard over the rest of the alimentary tract," says Spector, who is distinguished research professor of psychology and neuroscience at Florida State University. "Nothing gets through without passing their scrutiny."

Like the skin, the tongue is covered with layers of scale-like cells that defend the body from whatever lands on it. (These cells are constantly being renewed and sloughed off.) Taste happens only where that armour is interrupted, at thousands of tiny pores scattered across the tongue, palate and throat, each leading to a taste bud, which is a bundle of 50 to 100 cells.

Forget the tongue map you may have learned in school. Every region can detect every taste, and the system is a shrewd security guard: There are around 25 different receptors for bitter tastes, which warn us of potential toxins. Hacking this defensive apparatus is a tall order.

Taste cells detect compounds in two broad ways. Sweet, bitter and umami compounds activate receptors that trigger signals inside the cell. Other stimuli—including the ions that produce sour and salty tastes—pass directly through ion channels in the cell membrane, changing its electrical state. Either way, the result is a signal sent to a nerve fiber, which travels to the brain. There, a decision is made: Swallow or spit, take more or take less.

With sodium, these are high-stakes decisions. Too much salt can cause hypertension, kidney disease and stroke. But too little also poses serious problems. "There's nothing like sodium," Spector says. "In fact, it gets a bit of a bad rap. Too much is bad. But with no sodium, you're going to die."

For decades, researchers hunting salt enhancers focused on a single sensor in a subset of taste cells. The epithelial sodium channel (ENaC) is a narrow pore that admits sodium ions and almost nothing else. It seemed ideal. "Seventy to 80% of the salt response in the anterior tongue in rats, mice and hamsters is due to ENaC," Lyall says.

Holding the channel open longer should let more sodium through, making the same pinch of salt taste saltier. Senomyx, a San Diego biotech company, spent years looking for ways to do just that. By 2006, it had identified compounds that worked in the lab and began taste-testing them. PepsiCo funded the program, hoping to cut the salt in Lay's potato chips without affecting flavor. But no ingredient ever reached the market.

The problem, Lyall says, was that salt taste works differently in humans and rodents. ENaC carries most of the salt response in rats and mice. In humans it accounts for only a small part of it. Blocking ENaC with amiloride produced a tiny effect in only about one person in five. "It did show an effect in a minority of people," Lyall says, "but it still wasn't enough to change their salt taste."

Something else had to be sensing the sodium.

SALT ALTERNATIVES

Beyond ENaC, and the bitter and sour pathways that kick in at unpleasantly high salt concentrations, there must be other ways we taste salt. One of Lyall's possible candidates is TRPV1, known as the receptor that makes chili peppers taste hot. Whether TRPV1 is the salt sensor itself or helps modulate one, its involvement in salt taste is increasingly clear. And unlike ENaC, this pathway has produced a flavor intensifier that works.

Lyall's group collaborated with a food company to develop Maillard peptides, which are compounds formed when sugars and amino acids react under heat—this is the chemistry behind browned toast and roasted meat. In low-sodium solutions, a small amount of the right peptide increased the nerve

A CLOSER LOOK

How Taste Works

The tongue is a fascinating and complex muscular organ. It plays several critical roles in taste, chewing, swallowing and more, but researchers are still trying to solve its many mysteries.

First contact

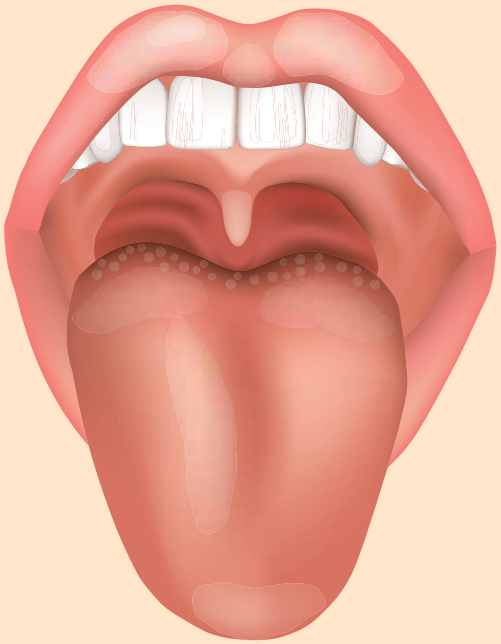
Most of the tongue can't taste. Its lining is covered in protective cells, interrupted only at thousands of pores, each home to a bundle of 50 to 100 taste cells that form a taste bud.

Detection

Sweet, bitter and umami compounds bind G protein-coupled receptors on type II taste cells, triggering a cascade inside. Other stimuli that cause sour and salty tastes are ions and pass straight through channels in the membrane, changing the cell's electrical state directly.

Release

The taste cell fires and passes a message to a nearby nerve. Type II cells have no vesicles. Instead, they open a channel, and adenosine triphosphate flows straight out. The type III sour-detecting cells beside them release the same molecule the conventional way, using vesicles. Why a single taste bud contains two mechanisms is a mystery.



Arrival

Three cranial nerves carry the signal to the brainstem, to a region also receiving information from the stomach and gut. From there it splits: One route works out what the taste is, another whether it's good or bad, though the two interact more than researchers once thought.

Renewal

Taste cells are replaced every few weeks. Because they're constantly dividing, they're vulnerable to chemotherapy and radiation, which is why cancer patients often lose their sense of taste and why it usually comes back when treatment ends.

response to salt in rodents and made the solution taste saltier to human testers than its sodium content would have predicted.

The company then took the peptides into food. "They have tested these peptides in low-sodium soups," Lyall says. "If they add these peptides in the soup, the soup tastes saltier."

But there was a problem. The channels involved in salt taste are not confined to the tongue.

Similar pathways in the kidney help the body retain sodium, and if you activate them there, then you could end up with raised blood pressure—the exact opposite of the goal. The ideal molecule, then, would work in the mouth and then vanish, obliterated by the stomach acid before it can enter the bloodstream.

There is also another route that may only work at the back of the tongue. Unlike ENaC and TRPV1, which both handle sodium, a channel called TMC4 admits chloride—the other half of the salt molecule. TMC4 responds to high levels of salt, perhaps because allowing chloride into the cell appears to speed up the signaling cycle. Compounds that activate TMC4, including several peptides, have also been shown to make salt taste stronger to human tasters.

"This is an active field of research," Lyall says. "Identifying naturally occurring peptides that modulate amiloride-insensitive salt responses may be key to finding the elusive salt-taste enhancers that can reduce salt intake in humans."

TASTE CELL SIGNALS

The enhancer problem is one piece of a larger puzzle, which also includes the machinery that taste cells use to pass signals to the brain.

Taste cells are not neurons, but they behave like them. They detect a compound, generate an electrical signal, and pass a message to a nerve fiber. Usually, that final step involves loading a neurotransmitter into vesicles, which travel to the cell's edge and release their contents.

But type II taste cells that detect sweet, bitter and umami have no such packets. The messenger had been identified as adenosine triphosphate (ATP), but how it got out of the cell was unknown. Then the answer came from a lab working on a problem that initially seemed to have nothing to do with taste.

In the late 2000s, Kevin Foskett, PhD, chair of physiology at the University of Pennsylvania, had been brought into a collaboration on Alzheimer's disease for his lab's expertise in electrophysiology. The protein they were studying was an ion channel called CALHM1, which is also found in taste cells. When Foskett measured its pore, he found it was enormous, wide enough to let whole molecules pass through. CALHM1's size made Foskett wonder if it was also the channel through which certain taste cells release ATP.

In 2013, Foskett's group bred mice with a deleted CALHM1 gene and watched what they drank. The mice had lost their preference for sweet water over plain water and lost their aversion to bitterness.

"That was an aha moment for us," Foskett says. "We knew immediately that this must be the mechanism for neurotransmitter release from type II taste cells."

It was a key piece of the machinery of taste, found almost by accident. "It's a nice example of curiosity-driven basic science research," Foskett says, "leading to fundamental discoveries about how the body works."

ONGOING MYSTERIES

Understanding how the signal leaves the cell is one thing, but knowing what happens once it reaches the brain is another. There, the picture gets more complicated, making it harder to predict how a flavor intensifier will change what we taste, and ultimately, what we choose to eat.

Recent research suggests that taste cells send the brain more than a simple signal of salty or sweet. Before food is swallowed, taste cells provide information that helps the brain make guesses about a food's caloric value and how quickly that energy can be used by the body. These predictions give the digestive system a head start, triggering physiological responses, such as insulin release, in anticipation of what's coming down the hatch.

But there was a puzzle. Sweet taste cells respond to glucose, fructose and artificial sweeteners alike. They all taste sweet. To the body, though, these are all very different. Glucose can be used for energy almost immediately; fructose must first be converted. Non-caloric sweeteners, meanwhile, carry no energy at all. Somehow, the body knows the difference before the food is even swallowed.

In 2022, Lindsey Schier, PhD, associate professor of biological sciences at the University of Southern California, found one way the body does this. Her lab discovered that taste cells carry a dedicated glucose sensor, separate from the sweet receptor and built around an enzyme called glucokinase. The tongue makes a quick guess about what kind of sugar it's encountering and how quickly the body will be able to use it.

The brain then checks that prediction against the real energy that the food delivers. Signals from nutrient sensors in the gut travel along the gut-brain axis, allowing the brain to evaluate its prediction. This helps the brain learn and change its estimations over time. At first, animals given both sugar and a noncaloric sweetener respond similarly to both because they both taste sweet. Over time, however, the brain learns that only sugar reliably provides energy and the reward signals diverge. You might still enjoy the taste of the sweetener, but it no longer produces the same reward.

"Even if something is more intense or initially palatable, if it doesn't ultimately provide the energy that's expected, it starts to become devalued over time," Schier says.

This has uncomfortable implications for sodium. A salt intensifier would make food taste saltier than it should be. Might the body attempt to close the gap over time?

"In theory, finding a salt taste intensifier has a lot of appeal," Schier says. "But at the same time, we just don't know what would happen over the long term. Would you just adapt to it? Then it almost becomes meaningless that it's this intense because it's not actually providing what the brain is looking for."

Still, that uncertainty hasn't slowed down the search. Lyall, who retired this year, believes a game-changing peptide that makes salt saltier but doesn't pass into the bloodstream is just around the corner. "I'm sure," he says, "that we are going to find it soon."

WHEN THE LANDSCAPE CHANGES,

COMMUNITY MATTERS MORE THAN EVER

Connection. Advocacy. Resources.



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AWARDS

New Award Supports Training in Central Autonomic Neurophysiology

Applications are open for the new Susan M. Barman Professional Opportunity Award for Research in Central Autonomic Neurophysiology. The award supports a promising early-career physiologist seeking additional training in technologies used to investigate how the central nervous system controls autonomic target organs.

The recipient will receive a $10,000 unrestricted research grant to their institution, complimentary early registration for the American Physiology Summit, and up to $2,000 for travel expenses. Applicants must have been APS members for at least two consecutive years and hold an academic rank no higher than assistant professor or equivalent.

"The central autonomic nervous system has been the center of my research program," says Susan M. Barman, PhD, FAPS. "I hope all the award winners share my passion and know that they are forever a part of my physiology family."

Barman established the award to support the next generation of researchers in her field. A distinguished professor in the Department of Pharmacology and Toxicology at Michigan State University, she studies the neural control of cardiorespiratory function, including the origins and patterns of sympathetic and phrenic nerve activity. Barman is a past APS president and a recipient of the Carl Ludwig Distinguished Lectureship Award and the Bodil M. Schmidt-Nielsen Distinguished Mentor and Researcher Award.

Learn more about the award at **physiology.org/barman**.

EDUCATION

Online Program Explores Sex as a Biological Variable

A new Coursera specialization aims to help researchers address one of biomedical science's persistent challenges: understanding how sex influences physiology, health and disease. The online program, Sex as a Biological Variable (SABV) in the Conduct of Research, is offered by the University of Colorado Anschutz Ludeman Family Center for Women's Health Research. The course launched on Sept. 2.

The three-course specialization examines the scientific, methodological and statistical considerations involved in studying sex differences and incorporating sex as a biological variable into research. The coursework covers topics ranging from recruitment challenges in human studies and animal research design to genetics, lifespan health outcomes, biostatistics and artificial intelligence.

The training arrives as journals and research institutions continue emphasizing more rigorous approaches to SABV. The National Institutes of Health, as well as many leading journals, expects researchers to consider SABV in the design, analysis and reporting of vertebrate animal and human studies.

Designed primarily for early-career investigators, the self-paced specialization may also appeal to established researchers seeking practical guidance on integrating SABV into experimental design and data interpretation. The training reflects a growing recognition that accounting for biological sex can improve research rigor and strengthen the relevance of findings.

To learn more, visit **coursera.org/specializations/sex-as-a-biological-variable-conduct-of-research**.

APS COMMUNITY

Summit Registration Opens Early

It's not too early to start planning for the 2027 American Physiology Summit in Denver. Registration opened weeks earlier than in previous years, giving you more opportunities to save by securing discounted registration rates and reserving hotel accommodations. Researchers can submit abstracts through Dec. 2, and many APS sections offer travel awards to help offset meeting expenses. Some awards also cover registration costs, making now a good time to explore the opportunities available through your section and apply. See the listing of awards deadlines on p. 37 and learn more at **physiology.org/summit**.



ADVOCACY

APS Advocates on Capitol Hill Throughout the Fall

APS sponsored and participated in the Rally for Medical Research Hill Day in Washington, DC, in September, along with more than 350 national organizations, patient groups and research advocates. The annual event brought the biomedical community together to urge Congress to prioritize sustained funding for the National Institutes of Health (NIH).

Now in its 14th year, the rally brought scientists, survivors, clinicians and students to Capitol Hill with a unified message. APS President Sue Bodine, PhD, FAPS; Past President Robert Hester, PhD,



APS President-elect Lacy Alexander, PhD, FAPS, and Past President Robert Hester, PhD, FAPS, at the Rally for Medical Research in September.

FAPS; and President-elect Lacy Alexander, PhD, FAPS, met with their 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. "Physiology is the science life depends on," Bodine says. "By revealing how the body functions in health and disease, physiology provides the foundation for virtually every medical breakthrough. Sustained federal funding for biomedical research ensures scientists can continue pursuing the discoveries that improve lives, drive innovation and build a healthier future."

APS continued its advocacy work throughout the fall. In September, the Society joined other organizations in the People for Effective and Ethical Research Coalition Hill Day, helping educate congressional offices about the role of animal research in biomedical discovery, the complementary use of new-approach methodologies, and the rigorous standards that govern animal welfare in research. The next day, APS supported a congressional briefing that brought together scientific leaders and patient advocates to discuss how animal research has contributed to advances in areas such as aging, cancer and addiction. In October, APS members also participated in a virtual Hill Day focused on research funding and federal policy issues affecting the biomedical research enterprise.

APS COMMUNITY

New Scientific Excellence Committee Convened

APS has seated its new Committee for Scientific Excellence, which was approved by the Board of Directors last spring. The committee will advise the Board and APS staff on issues affecting the scientific quality, vitality and reputation of both the Society and the discipline of physiology. Its charge includes helping ensure that APS programs, publications and meetings uphold high standards of scientific rigor and innovation while supporting the continued advancement of physiology.

CHAIR:
Michael Caplan, MD, PhD, Yale University

COMMITTEE MEMBERS:
Dennis Brown, PhD, FAPS, Harvard Medical School
Nisha Charkoudian, PhD, FAPS, U.S. Army Research Institute of Environmental Medicine
Holger Gerhardt, PhD, Max Delbrück Center for Molecular Medicine
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Rory Morty, PhD, Heidelberg University Hospital
Linda Samuelson, PhD, FAPS, University of Michigan Medical School
Erika Shugart, PhD, FAAAS, APS
Juleen Zierath, PhD, Karolinska Institute

APS JOURNALS

New *Journal of Neurophysiology* Editor-in-Chief Named

Carlos Mantilla, MD, PhD, has been named editor-in-chief of the *Journal of Neurophysiology*. Mantilla is a professor of anesthesiology and physiology at Mayo Clinic College of Medicine and Science and a consultant and former chair in Mayo Clinic's Department of Anesthesiology and Perioperative Medicine. He also holds a joint appointment in the Department of Physiology and Biomedical Engineering.



Mantilla's research examines the neural control of breathing, with the goal of preventing complications and improving quality of life for people across the lifespan, including those with spinal cord injuries and neuromuscular disorders.

An experienced journal editor and reviewer, Mantilla has served as an associate editor of *Physiology*, *Frontiers in Respiratory Physiology* and *Regional Anesthesia and Pain Medicine*. He is also active in education and mentorship and previously directed Mayo Clinic's doctoral program in biomedical engineering and physiology. Learn more about Mantilla and the *Journal of Neurophysiology* at **journals.physiology.org/journal/jn**.

MEMBER NEWS

Jessica Meir, PhD, NASA astronaut and spacecraft commander of the SpaceX Crew-12 mission, assumed command of the International Space Station in July. Prior to becoming an astronaut, Meir studied comparative physiology, focusing on the physiology of animals in extreme environments.



Lindsey Ramirez, PhD, a postdoctoral fellow at the University of Illinois Chicago, is a 2026 winner of the Albert and Mary Lasker Foundation video contest. The contest challenged early-career scientists and health professionals to describe a research question they are studying or want to explore and explain how it could benefit science and patients. Ramirez's video discusses the effects of alcohol consumption on behavior and the individual differences in these behaviors.



Alexander Staruschenko, PhD, FAPS, a professor and director of the Hypertension and Kidney Research Center at the University of South Florida Morsani College of Medicine, is the 2026 recipient of the American Heart Association's Council on the Kidney in Cardiovascular Disease Donald Seldin Lectureship Award. Staruschenko presented "SGLT2 Inhibition in Salt-sensitive Hypertension: From Kidney Metabolism to Cardiovascular Protection," at the Hypertension Scientific Sessions in October.



Cormac Taylor, PhD, a professor at University College Dublin School of Medicine in Ireland, is the 2027 recipient of The Physiological Society's Widening Participation Physiology Prize Lecture. This honor "celebrates impactful work in increasing the number and diversity of people studying and conducting research in physiology." Taylor advocates for diversity, equity and inclusion in science, focusing on improving opportunities for LGBTQIA+ scientists.



Send your updates to **tphysmag@physiology.org**.



DATES & DEADLINES

AWARDS APPLICATION DEADLINES

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

Society Awards

DEC. 2

Presidential Service Award

DEC. 9

Arthur C. Guyton Awards for Excellence in Integrative Physiology

Beverly Petterson Bishop Award for Excellence in Neuroscience

Charlie Bates Research Award

Early-career Advocacy Fellowship

International Early-career Physiologist Travel Awards

Lazaro J. Mandel Young Investigator Award

Martin Frank Travel Awards

Shih-Chun Wang Young Investigator Award

DEC. 11

Barbara A. Horwitz and John M. Horowitz Undergraduate Research Awards

JAN. 8

Dale J. Benos Early Career Professional Service Award

Dependent Support Travel Awards

Section Awards

DEC. 2

NEURAL CONTROL & AUTONOMIC REGULATION SECTION

Carl Ludwig Distinguished Lectureship

Lifetime Achievement Lecture

Linda F. Hayward Achievement Award

DEC. 3

RENAL SECTION

New Investigator Award

Robert W. Berliner Award for Excellence in Renal Physiology

Research Recognition Award

Predoctoral Excellence in Renal Research Award

Postdoctoral Excellence in Renal Research Award

DEC. 9

CARDIOVASCULAR SECTION

New Investigator Award

Mid-career Investigator Award

Outstanding Postdoctoral Trainee Award

Outstanding Graduate Student Trainee Award

Research Recognition Award

CELL & MOLECULAR PHYSIOLOGY SECTION

New Investigator Award

Research Recognition Award

Robert Gunn Student Award

CENTRAL NERVOUS SYSTEM SECTION

New Investigator Award

Research Recognition Award

Van Harreveld Memorial Award

COMPARATIVE & EVOLUTIONARY PHYSIOLOGY SECTION

New Investigator Award

Research Recognition Award

Travel Award sponsored by Novo Nordisk Foundation

ENDOCRINOLOGY & METABOLISM SECTION

Mid-career Achievement Award

New Investigator Award

Research Recognition Award

Virendra B. Mahesh Award of Excellence in Endocrinology

ENVIRONMENTAL & EXERCISE PHYSIOLOGY SECTION

Early-career Research Award

New Investigator Award

Postdoctoral Research Awards

Predoctoral Research Awards

Partnership for Clean Competition Anti-doping Predoctoral Award and Postdoctoral Award

Research Recognition Award

GASTROINTESTINAL & LIVER PHYSIOLOGY SECTION

Horace W. Davenport Distinguished Lectureship

John S. Fordtran Distinguished Research Award

New Investigator Award

Raj and Prem Goyal Lectureship in Pathophysiology of Gastrointestinal and Liver Disease

Research Recognition Award

Trainee Poster Award

NEURAL CONTROL & AUTONOMIC REGULATION SECTION

Janet and Robert Speth Undergraduate Researcher Award

Michael J. Brody Young Investigator Award

NCARnation Trainee Presentation Award

New Investigator Award

Outstanding Graduate Student Award

Research Recognition Award

Summit Trainee Travel Award

RESPIRATION SECTION

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

New Investigator Awards

Outstanding Trainee Award

Research Recognition Award

Trainee Poster Presentation Award

Usha Award

TEACHING OF PHYSIOLOGY SECTION

Mid-career Educator Award

New Investigator Award

Research Recognition Award

Travel Fellowship

William Galey Scholarship Award

WATER & ELECTROLYTE HOMEOSTASIS SECTION

Jane Reckelhoff Mid-career Achievement Award

Juan Carlos Romero Postdoctoral Research Award

Leonard Share Award

Leonard Share Predoctoral Research Award

New Investigator Award

Research Recognition Award

CALLS FOR PAPERS

ONGOING CROSS-JOURNAL CALLS FOR PAPERS

Cardio-renal physiology

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**.

Advances in Physiology Education

Jan. 15, 2027

- Using the Power of Comparative Physiology to Improve Physiology Teaching

American Journal of Physiology-Cell Physiology

Jan. 4, 2027

- Cellular Dysfunction in Cardiovascular Diseases
- Decoding Fibrosis
- Exploring Autonomic Signaling and Cell Physiology
- Mechanisms Underlying Diversity in Cancer Cachexia
- Mitochondrial Channels/Transporters: From Physiology to Pathophysiology
- Myogenic Stem Cells: From Single Cell Biology to Muscle

Jan. 5, 2027

- Crosstalk of ECM and Cellular Metabolism in Development, Aging and Disease
- Metabolic Syndrome and Cancer

American Journal of Physiology-Endocrinology and Metabolism

Jan. 4, 2027

- Clinical Metabolism
- Exercise Metabolism
- Immunometabolism
- Liver Metabolism

Feb. 2, 2027

- Muscle Physiology

American Journal of Physiology-Heart and Circulatory Physiology

Feb. 2, 2027

- Unraveling Cellular and Subcellular Mechanisms, Diagnostic and Therapeutic Innovations in Heart Failure Across the Ejection Fraction Spectrum
- Interorgan Communication in Cardiovascular Disease
- Core Skills in Cardiovascular Research
- Emerging Technologies in Cardiovascular Physiology
- Stress, Exercise and Cardiovascular Disease
- Role of Leukocytes in Cardiovascular Disease
- Spotlight on Cardiovascular Health Disparities
- Transformative Cardiometabolic Advancements

American Journal of Physiology-Lung Cellular and Molecular Physiology

Dec. 4

- Exploring Macrophages and Environmental Exposures in the Lung

Jan. 15, 2027

- Cystic Fibrosis and Other Lung Diseases in the CFTR Modulator Era
- Artificial Intelligence and Machine Learning Approaches in Respiratory Research

Dec. 3, 2027

- Chemoreception and Breathing Regulation Across Scales

American Journal of Physiology-Renal Physiology

Dec. 31

- The Impact of Obesity and Hypertension on Kidney Disease

June 30, 2027

- Environmental and Dietary Factors in Kidney Health and Disease
- New Mechanisms in the Juxtaglomerular Apparatus and PKD Development

Comparative Physiology

Dec. 15

- Interoception in Physiology and Disease

Feb. 12, 2027

- Physiology of Aging: Integrative Mechanisms

Comprehensive Physiology

Jan. 6, 2027

- Kidney-Heart-Lung Axis Communication in Health and Disease
- Gut-Brain Communication in Metabolic and Cognitive Control
- Heart-Lung Interactions in Pulmonary Vascular Disease
- Liver-Lung Interactions in Health and Disease
- Microbiome: A Critical Modulator of Multiple Organ Cross-talk in Health and Disease
- Organ Cross-talk in Glucose Homeostasis and Diabetes Pathogenesis

Journal of Applied Physiology

Jan. 15, 2027

- Physiological Impacts of Modern Environmental Exposures

Jan. 29, 2027

- The Physiology of Exercise Limitation in Chronic Obstructive Pulmonary Disease

Journal of Neurophysiology

Jan. 29, 2027

- Neurophysiology of Exposure to Extreme Environments—Pressure, Temperature and Microgravity

Physiological Genomics

Nov. 6

- Single Cell Analysis

Dec. 4

- Gene Therapy and Multi -Omics Approaches for Precision Medicine
- Environmental Effects on Physiological -Omics
- Spatial -Omics

June 4, 2027

- Convergence Physiology and the Artificial Intelligence Era of Physiological -Omics

Physiological Reports

Dec. 31

- Aging, Health Span and Lifespan: Physiological Aspects

June 30, 2027

- Metabolism and Metabolic Disorders: Metabolism in Health and Disease

Dec. 31, 2027

- Women's Health Research in Basic and Translational Physiology



MEETINGS & EVENTS

American Physiology Summit
April 1–3, 2027
Denver

Signals and Systems: Interorgan Communication in Health and Disease Conference
September 17–19, 2027
Chicago

Science Doesn't Speak for Itself

BY SACHIN ARYAL, PHD

I still remember a time during graduate school when I had to present a paper in the journal club. The paper was complex, and I was not familiar with many techniques used in the study. When I started to prepare slides, I included nearly every detail from the paper to make it comprehensive and ended up with 40 slides. I forgot that I only had 15 minutes to present.

I began my talk, and by the time I reached slide 25, my time was over. I panicked, and I rushed through the rest. As I spoke faster, I could see that the audience was losing track of the study. My peers later gave me feedback that I needed fewer slides, a slower pace, and clearer transitions between the slides and ideas.



After that, I struggled to craft presentations on complex studies. I feared that excluding information would make my presentation incomplete. I reached out to my mentor, who suggested I break down the information into smaller parts and include only the details that contribute to the central message of the study. She also advised me to pause between points, interact with the audience, and bring enthusiasm to my delivery.

"Data may be extensive, and findings could be important, but their effect may become limited if not communicated properly."

I began applying those suggestions, and by my next presentation, I could feel the difference. My peers also saw an improvement.

Handling audience questions is another important communication skill to master. I used to believe that admitting I did not know the answer would make me appear unprepared. During a presentation at a national conference, I guessed an answer to a question from the audience. Afterward, I discovered that my answer was wrong. That moment taught me that saying "I do not know the answer" is more credible than improvising an uncertain response. It demonstrates honesty rather than weakness.

Graduate research training taught me how to conduct rigorous research, while participation in seminars, journal clubs and advocacy opportunities surrounding that training gradually taught me how to communicate with audiences from different backgrounds. Beyond that, writing blog posts and newspaper articles helped me communicate science to the public. And that skill later helped me discuss my research and the importance of biomedical research funding to policymakers as an APS Early-career Advocacy Fellow.

It is important to understand that science doesn't speak for itself. Data may be extensive, and findings could be important, but their effect may become limited if not communicated properly. Slides crowded with figure panels may not necessarily demonstrate expertise. They may instead fail to highlight the important part of the research story.

To improve scientific communication, students and researchers can practice in everyday settings. They can start by describing their research to their family, then explaining to them why their study is important. That communication can help identify the use of jargon and places where contexts are missing.

Focus on one core idea and then build a presentation around that central idea. Additionally, thoughtfully designed, clear visuals, such as graphical abstracts and flowcharts, which are easier to follow than extended details, can be prioritized during talks.

It is crucial to understand that scientific communication is a part of the research process itself, rather than something that is needed after the research is complete.

Sachin Aryal, PhD, is a T-32 postdoctoral fellow in the Department of Cardiology at the Children's Hospital of Philadelphia. Send questions or comments to tphysmag@physiology.org.

Illustration by Brett Affrunti

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

Presidential Service Award	$1,000	Awarded to an APS member for extended and outstanding volunteer service to the Society and the broader physiology community	Dec. 2
ADInstruments Macknight Innovative Educator Award	$1,500	Honors an early to mid-career APS member who demonstrates innovative teaching techniques in engaging students in physiology education	Dec. 9
Arthur C. Guyton Awards for Excellence in Integrative Physiology	$10,000	Recognizes investigators who conduct research using quantitative and integrative approaches	Dec. 9
Beverly Petterson Bishop Award for Excellence in Neuroscience	$20,000	Honors an investigator who demonstrates outstanding promise in neuroscience or neurophysiology research	Dec. 9
Barbara A. Horwitz and John M. Horowitz Undergraduate Research Awards	$100 abstract, $400 research	Presented to undergraduate students presenting their research at the American Physiology Summit	Dec. 11



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Present your work at the 2027 American Physiology Summit (#APS2027) to gain valuable feedback and make vital connections.

Participate in our lively poster receptions, where your peers are sharing discoveries on the cutting edge of bioscience.

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Abstract submissions now open!
Deadline: Dec. 2, 2026

Early Registration:
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