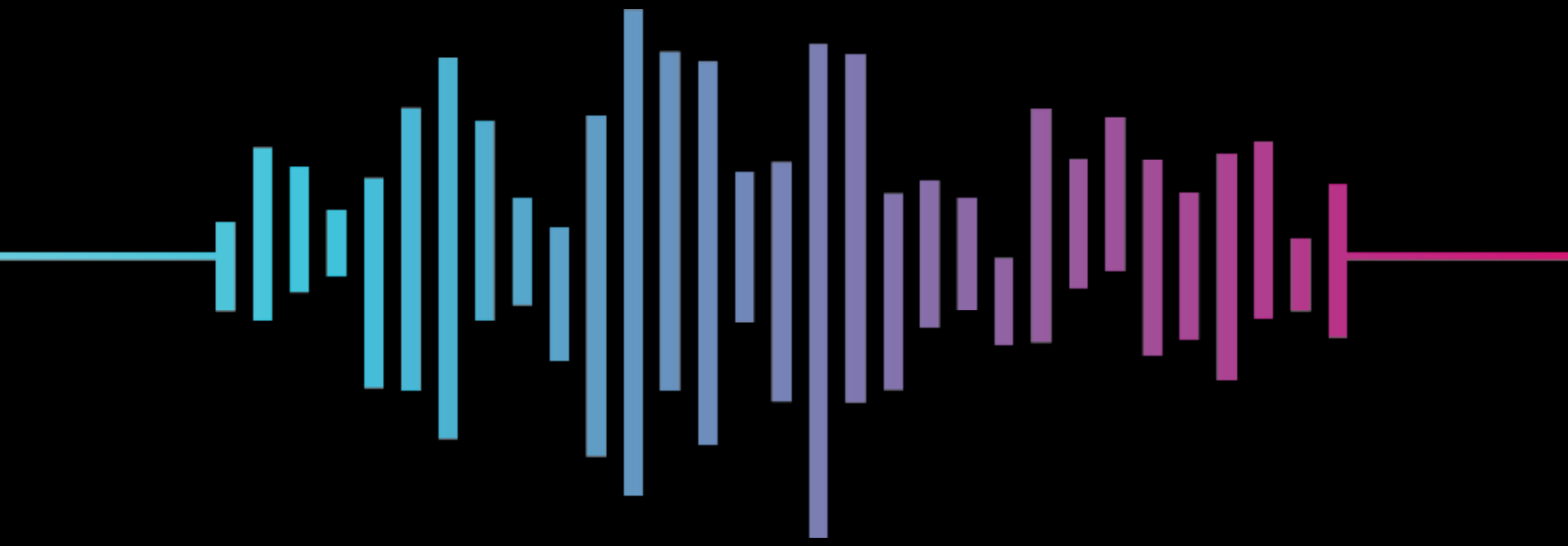
THE Physiologist MAGAZINE

MARCH 2024

BEAUTY IN THE SIMPLICITY

Renal physiologist Jan Michael Williams, PhD, is intrigued by seemingly simple research questions that are full of possibility.



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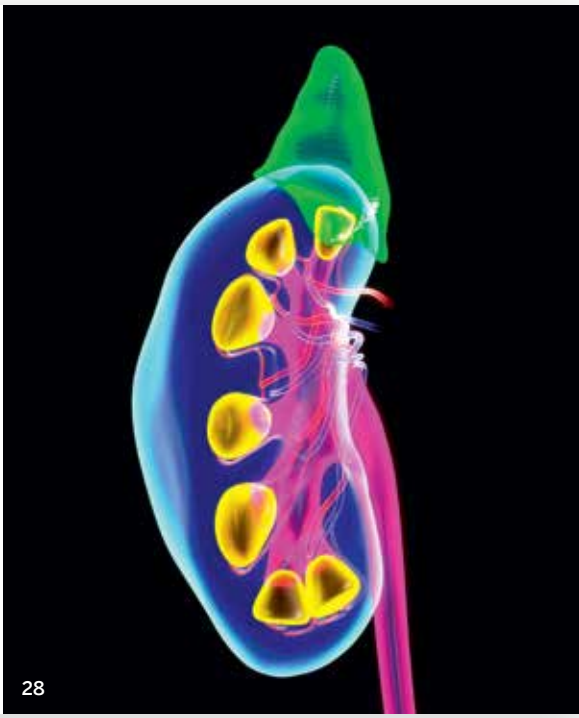
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Cover photo by Bryan Tarnowski

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CORRECTION: In the January 2024 issue, we included an incorrect definition on page 32 in the article "On the Frontlines." In describing the work of John Harrell, PhD, the writer mentioned that Harrell studies "dehydration and mild hypobaria (low blood pressure)." The definition in parentheses should have read "low pressure." We apologize for the error.

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How to Plan Your Summit

BY MEEGHAN DE CAGNA, MSC, CAE

Dear reader:

As we count down the days to the American Physiology Summit, I can feel the excitement surrounding this event. There was so much energy and enthusiasm for our Summit launch last year, and it has carried straight into 2024. We can see it in the numbers:

- More than 3,100 attendees
- Two keynote lecturers: a Nobel Laureate and an astronaut!
- Eight Game-changer Sessions—Have you checked out those great topics yet?
- Two receptions featuring 1,900-plus posters in the PhysioHub
- 350 speakers
- 174 scientific presentations
- One Welcome Festival featuring fun games, great food and entertainment

With so much going on at the Summit, how can you make sure you get the most out of your experience? The best place to start is by finding what excites you and building your Summit schedule around those events. There will be a lot to see and do, but planning ahead and being flexible on-site can help you make the most of it.

While you won't be able to make it to every event, the APS mobile app, which launches in early March, can help you plan and create your schedule. Talk with your adviser or mentor beforehand to get advice about which sessions or networking events to attend. And if you're attending with colleagues, plan to divide and conquer and share your key takeaways with each other afterward. And don't forget to wear comfortable shoes!

THIS MONTH'S FEATURES

This issue's cover article features Jan Michael Williams, PhD, a renal physiologist—but his career didn't start out studying the physiology of kidney disease. He always loved math and science and was planning to become a pharmacist or chemist. But an injury changed those plans and set him on a new course. Read his story on page 18.

Ever made a reference or joke in your lab or classroom about a song or TV show pivotal to your childhood or young adult years only to be met with blank stares? You instantly realize: They have no idea what I'm referring to. This can happen no matter what age you are, whether you're talking with older or younger generations than you.

In today's workplace, there are often four—and sometimes five—generations represented. We all grew up in different circumstances, technological ages and environments. So, how can we begin to comprehend each other and work well as a team? On page 22, our feature "Generational Power" shows the benefits of understanding and leveraging age diversity in the workplace. The article explains the various generational traits and how to understand them so you can build a stronger and more cohesive team.

For our science-focused articles, our editorial team sometimes chooses to cover a disease or condition or dive into a broad topic like pain or sleep. But in this issue, we decided to focus on one organ that we kept hearing cool things about and were amazed by: the kidney. From a science perspective, the kidney is one of our most complex organs. But it's also complex from a health care perspective: More than 1 in 7 adults in the U.S. have chronic kidney disease, and there is no cure. What are physiologists learning about the kidneys? Find out in "The Amazing Kidney" on page 28.

WE WANT TO HEAR FROM YOU

Members, you are what makes *The Physiologist Magazine* happen. We couldn't do it without you, so please share any feedback, suggestions or story ideas with us at **tphysmag@physiology.org**.

Meeghan De Cagna, MSc, CAE, is APS chief community and learning officer and associate publisher and editor-in-chief of *The Physiologist Magazine*. You can reach her at mdecagna@physiology.org.

center for physiology education

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physiology.org/CPE

THE Physiologist MAGAZINE

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NEUROSCIENCE

Sit All Day? Taking Time to Squat Will Help

We know sedentary behavior is bad for our health, especially for those of us who sit at a desk all day or in front of the TV each night. It has even been linked to mild cognitive impairment. Previous research has suggested that executive function—the processes in the brain that enable people to plan, focus, remember and multitask—may suffer when we sit for long periods without moving our bodies.

But a new study published in the *Journal of Applied Physiology* found that doing just one minute of squatting exercises while sitting for long periods (every 20 minutes during a three-hour sedentary session) improved blood flow to the brain and helped young adult volunteers perform tasks related to executive function and concentration more quickly and accurately. The volunteers also reported less mental fatigue than when they sat without exercising. This could be an ideal way for people who have sedentary jobs to preserve brain function during long workdays.

Source: **journals.physiology.org/doi/full/10.1152/japplphysiol.00437.2023**

APPLIED PHYSIOLOGY

'Regular' Athletes Can Be Elite

A case study finds that recreationally trained athletes—"regular" people, as compared to elite athletes—may be able to achieve the extremely high levels of energy expenditure needed to complete high-endurance athletic events. The study, the first to show that extreme endurance is possible for mere mortals, is published in the *Journal of Applied Physiology*. Cyclists who complete the Tour de France must not only sustain high levels of energy and power throughout the active periods, but they also need to consume roughly 7,000 to 8,000 calories each day to avoid losing weight during the race. The case study compares a 58-year-old male recreational athlete (who started training about a year before the study) with a 27-year-old male professional elite cyclist, both of whom completed the 21 stages of the 2023 Tour de France.

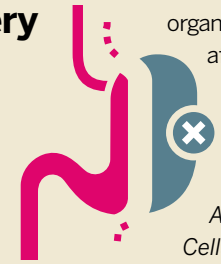
Source: **journals.physiology.org/doi/full/10.1152/japplphysiol.00798.2023**

All photos: iStockphoto

RESPIRATORY

Weight Loss Surgery Improves Obesity-related Asthma

Obesity is not only a risk factor for developing asthma, it's also a contributing factor for the worsening of preexisting asthma symptoms in people who are overweight. Visceral fat—the type that surrounds the organs—has been found to negatively affect lung function. Studies show weight loss often improves asthma symptoms significantly, partially because weight loss shrinks adipose tissue. Research published in the *American Journal of Physiology-Lung Cellular and Molecular Physiology* studied the responses of airway epithelial and bronchial smooth muscle cells when exposed to visceral fat tissue from people who had undergone bariatric surgery. The findings suggest that bariatric surgery and its associated weight loss improved the inflammatory response by increasing the epithelial cells' cytokine (proteins that control inflammation) production.



Source: **doi.org/10.1152/ajplung.00205.2023**

Farah Sheikh
@FarahSheikhLab

So this happened in Times Square yesterday! Moving from bench to bedside to Wallstreet. Grateful to LEXEO in moving cardiac (ARVC) precision based gene therapies forward.

Patricia A. Halpin, Ph.D.
linkedin.com/in/patricia-a-halpin-ph-d-15376732

Our workshop on using dramatization in teaching was well received. #PanAm2023 #UNHResearch American Physiological Society

Black in Physiology
@annetkiraboc1

#BlackinPhysiology has been awarded for outstanding leadership & service by UNCF and the Ernest E. Just Life Sciences Society. Congrats to the #BiP Executive Board for their hard work & dedication in supporting & amplifying the voices of Black scientists in physiology & beyond!

Upendra Chalise, PhD
@Uppenn

Got a 'paper accepted' email from *AJP-Heart & Circulatory Physiology* while hiking at this location! Feels good!

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NEW!

LAB NOTES

MENTORING Q&A | LESSONS LEARNED

Time Travel

Reflecting back to the most difficult days of graduate school.

Each issue, we ask a student or early-career member to pose their career questions to an established investigator and mentor. Here, Dain W. Jacob, a graduate research assistant in exercise physiology at the University of Missouri, asks Steven J. Elmer, PhD, to reflect on what he has learned since grad school. Elmer is interim chair, graduate program director and associate professor in the Department of Kinesiology and Integrative Physiology at Michigan Technological University.

Illustrations by Kagan McLeod

Q: If "present you" could talk to "past you," what would you tell yourself during your hardest year of graduate school?
A: Here are a couple of things I would tell my younger self: First, watch the video on YouTube of President John F. Kennedy delivering the commencement address to Rice University in 1962. During his speech, Kennedy said, "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard." Remember, if completing a graduate degree was easy, then everyone would do it. Don't lose sight of your end goal. You will get to the moon!

"If completing a graduate degree was easy, then everyone would do it. Don't lose sight of your end goal."

Start to get comfortable with the element of "surprise" and learn to deal with the unexpected. Sometimes no matter how well you prepare, things do not go according to plan. In your thesis proposal and future grant applications include a section titled "potential problems and alternative solutions" that describes challenges that could arise and strategies for how to circumvent them.

As a scientist, be confident in your ability to adapt, problem-solve and find ways to keep moving forward. Also, there will come a time when two key pieces of laboratory equipment fail spectacularly during the first day of your thesis data collection. Rest assured you will overcome this setback! Your adviser will also remind you for years to come that they still occasionally find tiny ball bearings on the floor from that morning.

Q: Do you have any tips for managing a healthy, yet realistic, work-life balance?
A: Prioritize your overall health and well-being and find something that helps take your mind off work to relax and reduce stress. Try something like meditation or mindfulness or movements such as yoga, qigong or tai chi. Set aside a block of time each week where you unplug and take a break from screens. Protect your time by saying "no" sometimes. With coursework, research and teaching responsibilities you already have a lot going on and it's easy to say "yes" to extra things. Stay focused on your research, prioritize things, and when in doubt seek input from your adviser on whether to commit or not.

And stay socially connected with others. As we get immersed in our work, we can become isolated and socially disconnected. Lastly, don't hesitate to use the resources available through your campus center for student mental health and well-being.

Q: If you had not become a physiologist, what do you think you'd be doing?
A: My initial interest was in becoming an athletic trainer and then later a physician. So, I would like to think I would be working in the field of sports medicine. On a related note, I would encourage graduate students to attend a few professional development sessions, such as a webinar or symposium, that highlight atypical career paths and careers outside academia. Identifying other potential career options might open doors you didn't know existed.

Q: What is your favorite scientific technique or methodology?
A: Hands down it would be the equipment and procedures for measuring maximal oxygen consumption (VO2max) during exercise. When I was a first-year exercise science undergraduate student I had the opportunity to complete a running VO2max test and loved it. Since then, I have administered this test in teaching and research settings with a wide variety of healthy, athletic and clinical populations. It never gets old!

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

31.5

The average age of a PhD recipient in the U.S.

National Science Foundation

The genetic modifications were effective enough that [the recipient primates] needed only about as much medicine as a human could tolerate.

An outcome of a recent pig-to-primate xenotransplantation study, *Nature*, October 2023. CNN

19.1

An individual's life expectancy at age 65.

U.S. Census Bureau

15%

The portion of surveyed high school students in 2022 who planned on careers in biology or biotechnology.

National Society of High School Scholars

In a single day, a person's kidneys filter about 150 quarts of blood.

National Institutes of Health

FROM EXPERIENCE | MENTORSHIP

In the Driver's Seat

Mentees also have a role to play in mentoring relationships.

Sometimes mentees feel like they don't have anything to offer in a mentoring relationship. But it is a two-way street, and mentees bring their own value to the experience, says Mitchell D. Feldman, MD, professor of medicine, associate provost for faculty mentoring at the University of California San Francisco. "In addition to learning and getting guidance from your mentor, you're in a position of power and influence and can expand your mentor's network," he says. "You bring them knowledge that you have in research or a content area, and you can teach them how to be a better mentor. You bring a lot to the relationship, so it's important to remember that."

Learn more about being a successful mentor or mentee at physiology.org/DEIvideos. Share your best advice, leadership tip or productivity hack by emailing tphysmag@physiology.org.

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POLICY IQ | RESEARCH FUNDING

Supporting Equitable Research

Two programs provide significant funding.

The U.S. invests federal dollars in scientific research through agencies such as the National Institutes of Health (NIH) and the National Science Foundation (NSF). These and other research agencies allocate funding through a merit review process that identifies and supports research priorities.

While some states have many research-intensive institutions with the resources and infrastructure to secure significant federal funding for research, others are building that capacity to compete for research dollars. Both NIH and NSF have longstanding programs to increase geographic diversity by building research capacity in states and territories with historically low levels of federal research funding.

These programs provide significant benefits by building infrastructure, fostering the development of a skilled and diverse workforce, and addressing local and regional issues. Here's more about two of these programs.

ENHANCING RESEARCH

At 2% of the NSF's annual budget, the Established Program to Stimulate Competitive Research (EPSCoR) aims to help institutions and investigators be more successful in competing for NSF's general budget dollars.

States and territories are eligible for EPSCoR programs if they have been awarded 0.75% or less of the NSF budget over the past five years. Currently, 25 states and three territories qualify. Each state must have a science and technology plan updated every five years so that the EPSCoR programs can focus on research priorities specific to jurisdiction.

The program at NSF uses three investment strategies: research infrastructure improvement (RII); co-funding support, which combines EPSCoR resources with funding from a directorate to support meritorious research; and outreach and engagement.

Within the RII programs, there are three tracks: The first addresses infrastructure based on the jurisdiction's science and technology plan; the second focuses on collaborations among jurisdictions; and the third supports EPSCoR research fellows to stimulate cross-sector collaboration.

Currently, all 28 jurisdictions combined receive about 13% of NSF research funding. With passage of the CHIPS and Science Act in 2022, Congress sought to address this imbalance by increasing the share of the NSF budget that goes to EPSCoR jurisdictions. The amount of research and scholarship money designated will gradually increase until it reaches 20% in fiscal year 2029.

BUILDING CAPACITY

The Institutional Development Awards (IDeA) are administered by the National Institutes for General Medical Sciences. The goal is to enhance the research competitiveness of institutions and individuals in qualifying states that have historically received low levels of NIH funding. Currently, 23 states and Puerto Rico qualify.

Learn about the program at **bit.ly/IDeA**.

Determining the effectiveness of the EPSCoR and IDeA programs has been challenging given the diversity of factors at play in each jurisdiction. Evaluations have found that the programs successfully build research infrastructure, promote faculty retention and increase productivity but that there has not been a significant geographic shift in the distribution of federal research funding.

Recommendations for maximizing the impact of these programs have focused on continuing to build resources and infrastructure, supporting development of a diverse and skilled workforce, and strengthening collaborations.

Expand Your Science Policy Knowledge

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APRIL 4–7, 2024
LONG BEACH

If you are looking to expand your science advocacy toolkit, or just curious about how to get started, check out the Science Policy Symposium, a pre-conference event of the American Physiology Summit. "How to get started in science advocacy (and why you should)" will take place on April 4, 12–1:30 p.m. Organized by members of the APS Science Policy Committee, the symposium will feature speakers with science backgrounds who have transitioned into government and policy careers. They will describe the experience of a scientist working in policy and discuss strategies and skills to become effective advocates for science, as well as how to transition into science policy as a full-time career. A panel discussion will follow.

UNDER THE MICROSCOPE | BREATHING BEHAVIOR

Equine Inspiration

This researcher shares how riding horses as a child led to a career in physiology.

Ann Revill, PhD, is associate professor of physiology in the Department of Physiology at Midwestern University in Glendale, Arizona. Revill's research interest focuses on understanding the cellular and synaptic properties that contribute to airway patency during sleep and wakefulness.

HORSE SENSE. I've always been fascinated by movement and motor control. Growing up, I rode horses regularly and was always intrigued by how we could change our movement pattern or the horse's depending on the task at hand. However, I grew up in rural Ontario, Canada, and did not have a university nearby, so I didn't know about research until I got to university. There, I was lucky enough to start working in a lab that researched equine biomechanics, and that's what I thought I wanted to do for my graduate degree. However, my fourth-year work physiology professor, Dr. Barclay, with whom I would spend just about every available office hour, speculated that my research interest might not be satiated by biomechanics. After spending some time soul-searching, I realized that neurophysiology might be a good fit for my research interests. During grad school and my postdoc, I came to the conclusion that I really enjoyed the mix of skills needed as an academic and that it would be a great fit as a career.

A WELL-STOCKED LAB. When I first started at Midwestern University, I knew I needed to order some of the basic supplies for running a lab. I expected that Midwestern University operated similarly to my postdoc institution, which meant that, among other things, I ordered a giant box of paper towels. However, I discovered that Midwestern kindly supplies items like paper towels! So, it took us years, but I think we've finally run through that giant box. That has inspired me to start a "what I wish I'd known" document to share with new faculty. I think the moral of that story is to ask as many questions as possible of other faculty when you're starting out.

PLUSSES AND PITFALLS OF TECHNOLOGY. I often mull over with friends and colleagues about how earlier scientists have been able to deduce so much about the world around them with far less technology than we have today. I often wonder what these scientists would be able to accomplish if they had today's tools, or whether we're hampered by technology and don't give ourselves enough time to think and observe what's right in front of us.

STANDOUT STUDENTS. I really value the energy that students bring to the lab and thrive on their enthusiasm for their research and the creativity they bring. I also thoroughly enjoy supporting each student's development as a scientist and am very excited to celebrate their successes with them along the way. A favorite memory is the PowerPoint presentation created by a student regarding the similarities of cats and muscular hydrostats (the tongue is a muscular hydrostat, which means that the muscles provide structure, as well as generate force, all while maintaining a constant volume).

"I really value the energy that students bring to the lab and thrive on their enthusiasm for their research and the creativity they bring."

DOING WHAT NEEDS TO BE DONE. My least favorite part of my job is lab administration. I just cannot seem to get excited about making sure that all the packing slips are uploaded in a timely manner. I know that all jobs have some degree of administrative work and that this is the backbone that allows us to keep doing science. However, I'd rather spend that time reading papers, talking science or doing experiments.

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

Photo courtesy of Ann Revill, PhD

PUBLISH WITH POLISH | RESEARCH DISSEMINATION

The Layers of Open Science

More than a buzzword, open science removes barriers and increases equity.

Open science. Open data. Open methods. By now, most researchers have heard these terms. Federal agencies and funding agencies such as the Office of Science and Technology Policy and National Institutes of Health are implementing related policies. The requirements for data management and sharing plans in new grants are already in effect. But what does this mean for researchers and authors?

Open science may sound like a buzzword, but it supports the foundations of scientific discovery and dissemination. The Center for Open Science, founded in 2013, encourages open research practices to "increase openness, integrity and reproducibility of research." Rendering science more open removes barriers and increases equity among the world's research community. Open access to content fits under this umbrella, as we've discussed in a recent column at **physiology.org/publish**. By keeping science open, discoveries are evaluated and corrected as needed, fostering the continued evolution of knowledge.

OPEN DATA

Open data resides a layer below open science. It's one thing to see the results of experiments, but it's another to be able to access and scrutinize the raw data from those studies. The FAIR Guiding Principles were first published in 2016, providing best practices for sharing scientific data. Specifically, FAIR requires that data are findable, accessible, interoperable and reusable. For this reason, APS journals support supplemental data repositories that follow the FAIR guidelines. Approved generalist—or not field-specific—data repositories allowed by APS journals include Figshare, GitHub and Zenodo, among others. More details can be found at **journals.physiology.org/data.**

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OPEN METHODS

Diving yet another layer deeper, we find open methods. To some researchers, open methods is a newer concept. Journal methods are known to be fraught with missing details and nuance that hinder reproducibility. But an initiative to improve methodological clarity in life sciences publications aims to change this.

Promoting Reusable and Open Methods and Protocols (PRO-MaP) offers recommendations for increasing and improving the reporting of detailed, reusable and open methods and reusable step-by-step protocols. The draft recommendations are directed at specific stakeholders: researchers, research institutions, publishers and funders. In this way, the guidelines endeavor to enact change by targeting those involved in the creation and utilization of methods.

As a publisher, APS supports the inclusion of links to step-by-step protocol repositories, such as Protocols.io. In 2023, the APS journals also expanded article types to Methods and Resources to encourage publication of more methodology content.

The international community is working hard to promote open science education. Most recently, the inaugural international Love Methods Week was held January 29–February 2 and featured workshops, webinars and activities designed to help researchers share open, reusable methods to help others use data responsibly. This was followed by Love Data Week, February 12–16, which highlighted the importance of data equity and inclusion.

APS journals want to support authors in reaching their open science objectives and requirements. For more information, email publications@phsyiology.org.

STATS & FACTS

758 days

The longest survival time of a nonhuman primate recipient of a genetically modified pig kidney.

Nature

The share of millennial women with a bachelor's degree is now higher than that of men—a reversal from the Silent Generation and boomers.

Pew Research Center

~1 in 16

The number of hospitalizations in 2020 that were due to acute kidney injury.

National Institute of Diabetes and Digestive and Kidney Diseases

72.1 million

The number of millennials in 2019, surpassing the 71.6 million baby boomers. Generation X, at 65.2 million, is not expected to outnumber boomers until 2028.

Pew Research Center

The Bear Necessities

Understanding the functional genomics involved in bear hibernation could enhance human health.

Joanna Kelley, PhD, is an associate professor in the Department of Ecology and Evolutionary Biology at the University of California, Santa Cruz. Her evolutionary genomics laboratory is using the latest genome sequencing and computational approaches to better understand the genomic basis of adaptation, with a special emphasis on extreme environments.

What motivated you to focus on functional genomics and hibernation in brown bears?
I was trained in human population genetics, and I'm really interested in the evolutionary process and differences between different populations at a genetic level. When I was getting my PhD, I realized that extreme environments are a phenomenal place to ask questions about phenotypes, genetics and physiology because we know more about what selective pressures are at work.

When I started my faculty position at Washington State University (WSU), I would often stop by and see the bears at the WSU Bear Center. This got me thinking more and more about hibernation. Charlie Robbins, who started the Bear Center, noticed that I was interested in the bears and brought me into his team working on understanding bear hibernation.

Hibernation is a fascinating adaptation. Bears bulk up and then use that fat all through the winter, and then they do that again every year without negative consequences. We're trying to find out what changes are happening on an annual basis to facilitate hibernation and then coming out of hibernation.

Could your studies of bears one day help people?
Bears become insulin resistant during hibernation and insulin sensitive outside of hibernation, and this happens over and over again without detrimental effects to their health. Insulin resistance is also a hallmark of Type 2 diabetes. While in bears this insulin resistance is adaptive, it is clearly maladaptive in humans. Also, during hibernation, bears are barely moving, and yet there's very little loss of muscle tone, whereas if one of us is on bedrest for even a short amount of time, it can become a huge issue. Muscle atrophy is especially problematic during hospitalization and in geriatric patients.

If we can identify the factors in the bears that restore insulin sensitivity or reduce muscle atrophy, we can use that information to develop therapeutics for humans. Although it may seem kind of wild, bears and humans share a lot of genes, so it's not so far-fetched to think we might learn something from bears that could be applied in people.

What innovative approaches are you using to carry out this research?
We're taking a functional genomics approach by looking at how gene expression changes throughout

iStockphoto

Exploring Species Diversity

See Joanna Kelley, PhD, at the American Physiology Summit on April 6, where she will participate in a Game-changer Session, "Physiology in Nontraditional Model Systems: Exploring Species Diversity to Reveal Adaptations with Translational Potential."

the seasons and the year in the bears. More recently, we've been trying to examine whether there are specific regulatory regions of the genome that drive some of the large-scale patterns that we see.

One of our earliest findings showed that in the bears' adipose tissue thousands of genes change in terms of expression levels throughout the year. To better understand how that regulation happens, my colleague Heiko Jansen at WSU developed an adipose cell culture system based on cells from the bears. Using this cell culture system to complement our organismal studies allows us to ask more specific questions in a controlled environment. It also speeds up our research because we don't have to wait a year until hibernation occurs again to perform a study.

We're also working to conduct single-cell RNA sequencing on adipose biopsies to better understand whether the large differences in gene expression we see in adipose are due to changes in cell type composition changes or changes in expression within the same cell type. This is an ongoing project in the lab that I'm quite excited about.

Have you found any surprising or unexpected results?
One of our most exciting findings was showing that serum is incredibly important for the hibernation phenotype. In cell culture, we showed that applying serum from active season bears to cells that were sampled during hibernation shifted those cells into an active state from a transcriptomic perspective as well as a physiological perspective.

We showed that serum from bears that were fed glucose for two weeks during hibernation was sufficient to shift the cell signature back to active season. That was really surprising because the large-scale protein composition in that serum were very similar to hibernation serum. This meant that just a few proteins must be driving these changes.

We went on to identify just eight circulating proteins that seem to be involved in seasonal shifts in insulin sensitivity. We are now thinking about how to manipulate those in a cell culture setting to find out exactly how these serum proteins drive this change.

What makes you and your research a game changer?
It is very humbling to be listed as a game changer. I think I am just lucky. I was in the right place at the right time and found an incredible collaborative group to work with. … It was the constellation of expertise, technology and a collaborative team—all of those things coming together at the right moment.

Interview conducted by science writer Nancy D. Lamontagne.

READ MORE

"Feeding during hibernation shifts gene expression towards active season levels in brown bears (*Ursus arctos*)," *Physiological Genomics*, 55:368–380 (2023)

"Circadian gene transcription plays a role in cellular metabolism in hibernating brown bears, *Ursus arctos*," *Journal of Comparative Physiology B*, 193, 699–713 (2023)

"Hibernation induces widespread transcriptional remodeling in metabolic tissues of the grizzly bear," *Communications Biology*, 2:336 (2019)

STATS & FACTS

1954

The year of the first successful organ transplant, which was a kidney donated from one identical twin to another.

United Network for Organ Sharing

The device was an exemplar of Rube Goldberg ingenuity. It consisted of 50 yards of sausage casing wrapped around a wooden drum set into a salt solution.

A description of the first successful hemodialysis machine, *The New York Times*.

150 quarts

The average amount of blood filtered by healthy kidneys in one day.

National Institute of Diabetes and Digestive and Kidney Diseases

Workers ages 65 and older are more satisfied with their jobs than younger workers and are less likely to say they find it stressful.

Pew Research Center

Beauty in the Simplicity

Renal physiologist Jan Michael Williams, PhD, is intrigued by seemingly simple research questions that are full of possibility.

BY RACHEL CROWELL

For Jan Michael Williams, PhD, change has been a steady part of life. "I'm an Army brat," he says. Williams was born on a military base in Frankfurt, Germany, and moved to the U.S. at around age 2. One year, his family moved three times within North Carolina and Georgia.

Williams credits that upbringing with helping him develop the fortitude to excel in new situations. "I've always looked at any transition as 'Is it going to be a good transition for me? Is it going to help me out for my career and for the future?' Then I've always adjusted very well," he says.

By drawing on his adaptability and resilience, Williams was even able to use one of life's curveballs—a medical emergency during his senior year of college—to discover his scientific passion for renal physiology. Williams is now a professor in the Pharmacology and Toxicology Department at the University of Mississippi Medical Center. He studies renal disease associated with childhood obesity. He is also director of his university's experimental therapeutics and pharmacology PhD program.

Growing up, Williams always loved math. As a teenager, he discovered the joys of science, too. He fondly remembers a high school chemistry assignment that tasked him with identifying a mystery solution provided by his teacher. That experience piqued his interest in the field.

Photos by Bryan Tarnowski

Left to right: Williams speaks to graduate students and postdoctoral fellows about his research on how non-diabetic obese rats develop glomerular injury at early age prior to puberty. Williams teaches graduate student Sautan Mandal how to isolate immune cells from renal tissue for flow cytometry.

He was also inspired by observing one of his cousins, who is a pharmacist. When Williams started college at Georgia Southern University, he planned to become either a pharmacist or a chemist. An academic adviser told him that majoring in chemistry would prepare him for both careers. During his senior year, Williams was set to begin a graduate program in organic chemistry the next year. However, a sudden and jarring change to his circumstances altered his career trajectory: He developed an acute kidney injury.

"I was probably in the hospital for about two weeks, very close to being put on dialysis," he says. Williams describes the experience as his "first time realizing how important the kidneys were."

His plans for graduate school were derailed by the injury, as doctors recommended he take extra time to recover. During what became a gap year, he worked at Procter & Gamble as a winder operator—in charge of placing tissue paper on its cardboard roll and checking the quality of the tissue's perforations. The only drawback to the job was that he wasn't able to use his chemistry background, so he began researching career options in biomedical science.

Taking the extra time to recover paid off: His kidney health was restored. "Luckily, with rest and eating properly, things worked out for me," he says. Then one day, he had an unexpected interaction with someone from the Medical College of Georgia about a PhD program he had applied to while finishing up his undergraduate degree. "They actually called me on the phone and asked me, was I still interested?"

Williams jumped at the opportunity, which he credits with putting him on a path to become the scientist that he is today. In his second year of graduate school, he joined a laboratory that was focused on renal physiology and, more specifically, the roles the kidneys play in helping control and regulate blood pressure.

EXPLORING NEW TERRITORY

Williams also studies how obesity and kidney disease intersect in pre-pubertal children. Research into possible physiological relationships between childhood obesity and renal disease is in its infancy, he says. "We're starting to see children with obesity develop kidney disease or have early signs of kidney disease, and nobody really focuses on that population." However, he has seen an uptick in related research in recent years.

One key challenge in better understanding the physiology of kidney disease in children is a lack of relevant clinical data. Proteinuria, or elevated levels of protein in the urine, is often "one of the first signs of renal disease," Williams says. But when kids go in for wellness exams, doctors may not collect urine samples. Furthermore, some families don't have the resources to take their children to the doctor regularly, meaning missed opportunities to catch kidney disease before they reach adulthood.

"My lab has a unique obesity model that we use and have characterized very well," Williams says. "Our rodent model develops progressive renal disease or progressive proteinuria before they reach puberty." The researchers use the model to study various mech-

> "With Black in Physiology we have knocked down a couple doors. ... To attend an event where we're in a room with other Black physiologists ... where we can actually talk and network has been a real benefit."

anisms, such as inflammation and immune cell function, in the kidney.

The lab team also looks at different aspects of alterations in renal hemodynamics before puberty, along with how insulin resistance in the kidney may play a role in early stages of kidney disease in prepubescent children with obesity.

Specifically, Williams is working with a model of leptin dysfunction. "Leptin is involved in telling the body to stop eating," he explains. "When there is a dysfunction or deficit in this pathway, an individual or animal will constantly eat and become obese."

One hurdle he has encountered is "trying to get the point across that this model is what we say it is." Some researchers, he says, "just automatically assume 'Well, it's an obesity model. We have seen it before.'" However, Williams says his model is different for two reasons: It's on renal disease susceptible background, and it is distinguished by its representation of the time period before the sex hormones increase.

When exploring potential research questions, Williams is drawn to seemingly fundamental questions that surprisingly open doors to new scientific inquiry. For instance, a few months ago when one of his graduate students was questioned during a dissertation defense, someone asked the student if the kidneys are insulin resistant. Before then, Williams hadn't considered that question. Digging deeper into it, he discovered that current data suggest that the kidneys—or at least certain parts of the kidneys—may be insulin resistant. Williams is now pursuing grant funding to continue exploring the nature of insulin resistance in the kidneys.

INTROVERTED COLLABORATION

Williams describes himself as an introvert, but he also emphasizes the importance of working with others to solve research problems and build community. For example, if he finds that his progress toward answering a research question has stalled, he focuses on being patient and connecting with colleagues from different research backgrounds. "It's always good to talk with people. It's always good to have an outlet," he says. For him, serving as a basketball coach and mentor for kids through the Amateur Athletic Union is one of his outlets outside his work. "Get your mind away from science for a while," he suggests.

Williams is also involved with the community-building and advocacy efforts of Black in Physiology, which is working to achieve official nonprofit status. He is president-elect of the organization, which was formed through virtual meetings during the COVID-19 pandemic and in the aftermath of the murder of George Floyd.

"Before the organization, we felt that we weren't noticed, that we were taken for granted," Williams says. "I think with Black in Physiology that we have knocked down a couple doors." The group, which is one of a growing number of "Black in" organizations, has served as a sounding board for researchers to discuss their experiences and express themselves.

Just meeting with other Black physiologists in other fields has been a new experience for many members, Williams says. When attending professional conferences, "most of the time, we don't see people like us." Now, "to attend an event where we're in a room with other Black physiologists and other ethnic groups as well, to come in as one, where we can actually talk and network, has been a real benefit."

Getting started with networking can be challenging for introverted researchers. This can be especially true for researchers who come from backgrounds that are historically minoritized in science and who haven't had many opportunities to meet scientists with similar experiences.

However, Williams offers advice for introverted students and colleagues who want to become more comfortable approaching other researchers: "Don't be scared to just hang out with the well-established scientists," he says. "Be bold, get out and just have conversations with people because you may be thinking about similar ideas and questions as other scientists. You'll be surprised how many scientists will actually just want to have a normal conversation."

GENERATIONAL POWER

How to harness the talents of a multi-generational team in the lab.

BY BRIAN BUSENBARK

Fostering diversity has increasingly become a foundational principle for many organizations over the past several years. While the driving factors may vary, it's generally accepted that leveraging the unique thoughts and experiences of a mixture of people with different identities, backgrounds and experiences strengthens a team.

Often lost in that conversation, however, is the importance of age diversity. In fact, a 2015 survey by PwC, an international consulting firm, found that fewer than 10% of organizations include age in their diversity, equity and inclusion (DEI) strategies.

While some teams look to embrace DEI with open dialogue around topics once considered taboo in the workplace—including race, ethnicity, religion, sexual orientation and gender identity—age and generational differences largely remain unspoken. Of course, it would be incorrect to assume everyone fits neatly into a broad category and carries the characteristics of a group based solely on their date of birth. Pew Research Center, a leader in generational research for decades, published new guidelines in 2023 outlining how it plans to take increasing care in the studies it puts forth. Among them is a plan to cease "always defaulting to using the standard generational definitions and labels."

But we'd be remiss to ignore generational traits entirely. Generations are defined by the events and surroundings that people of a similar age experienced during their formative years (see "5 Generations in the Workplace"). Learning to better understand how these influences shape our co-workers, leaders and team members can help build a stronger, more productive and cohesive team.

Facing page: iStockphoto

RESOLVE TO UNDERSTAND DIFFERENCES

As a speaker and bestselling author on generational differences, Ryan Jenkins has spent years advising organizations of all shapes and sizes on how to leverage the strengths of various age cohorts in the workplace. So, it's a bit ironic that he frames his work with the words of someone born a full century before the first generational label gained traction in the U.S.

"I always like to quote Abraham Lincoln, who once said, 'I don't like that man; I must get to know him better,'" Jenkins says. "That's ultimately why I think the generational conversation is so important—we are different generationally, so that should be our cue to take a step closer to better understand that generation and the context in which that person came of age."

Maintaining an open mind is crucial—as labels often devolve into negative stereotypes.

Understanding the background from which a generation emerged, and its resulting traits and characteristics, is important, but maintaining an open mind is crucial—as generational labels often devolve into negative stereotypes. For example, a common misconception about the younger generations is that they don't want to work. But working alongside them and understanding their motivation helps illuminate a perceived weakness as a strength.

"My experience has been that they're much better at boundary setting," says Taben Hale, PhD, associate professor in the Department of Basic Medical Sciences at the University of Arizona in Phoenix. "I think that gets misinterpreted as not wanting to work, but that's not it,"

5 Generations in the Workplace

Odds are your daily work routine involves members of four—and perhaps five—distinct generational groups. Generational experts may vary slightly on the age ranges they assign to each group, but the central theme is that each generation shares a common history. The events and surroundings of their formative years determine their worldview and shape their shared "generational personality."

Source: Workforce-share data via the U.S. Bureau of Labor Statistics for workers age 25 and older in 2022

Silent Generation

Born between 1928 and 1945
2% of workforce

WHAT THEY SHARE

Their formative years were during the Great Depression and World War II.

Known for hard work, loyalty and thriftiness.

Value interpersonal respect and professional courtesy.

Given the events surrounding their upbringing, they are comfortable working in teams to benefit the greater good. Adherence to traditional norms means they may be more likely to thrive in a hierarchical workplace.

Baby Boomers

Born between 1946 and 1964
14% of workforce

WHAT THEY SHARE

A competitive nature—the sheer number of baby boomers led them to fight for jobs and career advancement.

Fiercely determined and take tremendous pride in their work. As such, employer recognition moves the needle for boomers. Embracing opportunities to acknowledge their fine work and loyalty to an organization is key.

Have had to adjust to technology in the workplace.

she says. "They do want to work, but they don't want their work to be their life—and that's actually healthy and appropriate."

Therein lies the crux of the chicken-and-egg aspect of the generational conversation. As the world around us constantly evolves, change is inevitable. But when change in the workplace appears to be ushered in by a youth movement, it can cause a rift with the established guard, who may feel they're being forced to change for the younger generation.

"That's looking at the conversation all wrong," Jenkins says. "It shouldn't be about changing for a generation, but it should be about understanding differences across generations and changing in light of the future of the work."

TWO TYPES OF INTELLIGENCE

Adding complexity to the generational conversation is the biological factor. The strengths and capabilities that everyone brings to the workplace—regardless of their generational background—evolves with age. Jenkins cites the work of Raymond B. Cattell, PhD, a psychologist who developed analytic techniques that allowed for more nuanced empirical measurements of the components of personality and intelligence.

Cattell identified two categories of general intelligence: fluid intelligence and crystallized intelligence. While everyone uses both types of intelligence daily, their relationship with our age is important to consider when looking at the relative strengths of different generational groups.

Did You Know?

The platform Generation Z relies upon most—far and away—when researching prospective employers is YouTube. Overall, nearly 90% of Gen Z spends time on the video-sharing app, so it's no surprise that it plays a huge role in how this group plots their careers.

"They're using YouTube because they want to know what it looks like to work somewhere," says generational expert Ryan Jenkins. YouTube is a place that employers who are serious about attracting next-generation talent have to play in."

Generation X

Born between 1965 and 1979
34% of workforce

WHAT THEY SHARE

Many grew up in households with two working parents. Dubbed "latchkey kids," they adopted an independence at a young age.

Resourceful and independent.

Comfortable adapting to new technologies.

Desire flexibility in the workplace.

Work-life balance has always been a driving force—they watched their parents make sacrifices for jobs that may not have paid off.

Millennials

Born between 1980 and 1994
38% of workforce

WHAT THEY SHARE

Known as the most collaborative generation, they work well in team settings and prefer flat organizations.

Driven to make a difference with meaningful work.

Desire opportunities to effect widespread change—especially if done collaboratively.

The first technology-native generation—they grew up surrounded by technology and are comfortable with new programs and processes.

Generation Z

Born between 1995 and 2012
12% of workforce

WHAT THEY SHARE

Their formative years were during the Great Recession and other financial turbulence. This has led to a competitive nature and drive for money.

Growing up in the "gig economy," they understand that a paycheck isn't the only way to make a living.

They value the flexibility to customize job responsibilities and better position themselves for their next challenge.

They expect to have access to the highest-quality technology at work.

Fluid intelligence refers to the ability to process new information and solve problems. It's what helps us work puzzles, recognize patterns and devise strategies to tackle new problems. It's essentially innate but tends to decline in most people by age 40. On the other hand, crystallized knowledge comes from accumulated experience and typically increases as we age. It represents our ability to work and solve problems by leveraging skills and knowledge we've amassed from prior learning.

Fluid intelligence and crystallized intelligence work in tandem and are equally important. Jenkins says embracing the biology around when these types of intelligence typically peak is key to harnessing the power of a multi-generational team. "It's important that we leverage the emerging generations' fluid intelligence and use them for fresh eyes to explore our blind spots and innovate," Jenkins says. "But we also need the crystallized intelligence of older generations as guideposts—knowing where we need to focus and in which direction we should go."

> "Everyone needs to feel valued and important in their role and understand where they fit into the work."
>
> —Taben Hale, PhD

Did You Know?

3 Must-Haves for Gen Z

Leadership. The emerging generation craves strong, effective management.

Future. They're laser-focused on opportunities that may await down the road.

Vision. Generation Z is seeking meaningful work with a lasting impact.

"These are three things that any generation would want, but for previous generations, they were nice to have," says generational expert Ryan Jenkins. "For the emerging generations, they are conditions of employment; if they don't feel like these are being delivered, they're literally a finger swipe away from going somewhere else."

EFFECTIVE COMMUNICATION IS CRITICAL

Generational lines are becoming more blurred as the modern workplace evolves and more people take circuitous and non-traditional career paths. This is particularly true in academia, where it's not uncommon for older workers to choose the lab environment following a career in another industry.

"Science is ageless in a way that I can easily be mentoring a graduate student who is in their 50s," says Daria Ilatovskaya, PhD, associate professor and director of the graduate program for physiology at Augusta University in Georgia. "Previously, it was more common to have someone older be in charge and the trainees were usually younger, but I think that's shifting now because more and more people change professions later in life."

Both Ilatovskaya and Hale manage labs staffed with team members spanning multiple generations. They admit they aren't sure where many of their workers are grouped from a generational standpoint. "As long as they are engaged, curious, flexible and science is their passion, that's all that matters," Ilatovskaya says.

Perhaps most importantly, communication is key to navigating a multi-generational workplace. The research indicates that each age group prefers different methods—baby boomers and Generation Z (perhaps surprisingly) value face-to-face communication, while Generation X and millennials would rather hear from others in an email or text message.

But one point is clear: Solid communication and clarity of direction are a universal language that cuts across generational lines. "When everybody understands the process and how they all fit together, all of that other stuff sort of falls away," Hale says. "Everyone needs to feel valued and important in their role and understand where they fit into the work."

Academia is naturally insulated from some of the generational concerns that may plague other industries, according to Hale and Ilatovskaya. They cite the steady influx of young people entering the workforce, as well as the energy all five generations now in the workplace typically bring to their job. Still, challenges will persist. Understanding what innately drives a generational group is an instructive start to handling issues that may arise. But ultimately, it's often best to emulate Lincoln's approach.

"We shouldn't be dismissive and create blanket statements about any generation, but rather listen to them and learn from them," Hale says. "In the end, we're all just people, so we need to learn from each other, find out what is important to them and work with them—as opposed to directing them."

Contemplating graduate school as the next step in your education and career?

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THE AMAZING KIDNEY

Physiologists are advancing what we know about the kidney and its functions.

BY DARA CHADWICK

Illustration: Roger Harris/Getty Images

The kidney is one of the body's most complex organs. Diverse cells within these fist-sized structures drive a mosaic of physiological processes. Our kidneys work constantly to filter blood, remove excess fluids and acids, and balance water, salt and minerals.

"It's a fascinating organ," says Heddwen L. Brooks, PhD, professor and chair of the Department of Physiology in the School of Medicine at Tulane University in New Orleans and editor-in-chief of *American Journal of Physiology-Renal Physiology*. "There are probably more than 100 cell types that make up your kidney."

The kidneys—or more accurately, chronic kidney disease (CKD)—has a profound effect on the health and quality of life for many Americans. The Centers for Disease Control and Prevention (CDC) estimates that CKD affects about 35.5 million adults—more than 1 in 7—in the U.S. CKD is most prevalent in people over 65 (33.7%). The disease is also more prevalent in Black Americans (19.5%) than in non-Hispanic white Americans (11.7%).

Today, there is no cure for CKD. Controlling high blood pressure and diabetes can help stop the disease from progressing to end-stage renal disease. But many people who have CKD don't experience symptoms until kidney damage is advanced. Lifestyle changes and current medications may not be enough to stop disease progression in some individuals.

> **"It's a fascinating organ. There are probably more than 100 cell types that make up your kidney."**
>
> **—Heddwen L. Brooks, PhD**

Investigating the functions of kidney cells—with the goal of translating physiological research into clinical applications that could prevent or halt kidney disease—is happening in research labs across the globe. Here, we examine the latest research in renal physiology.

A COMPLEX SYSTEM

The kidneys control your blood pressure by sensing blood fluid content, excrete toxins and metabolize substances in a never-ending loop. It's a delicate balance, according to Brooks.

Jennifer Pluznick, PhD, associate professor of physiology at the Johns Hopkins School of Medicine in Baltimore, studies olfactory receptors in the kidney. These G-protein-coupled receptors (GPCRs) help regulate sense of smell in your nose, but it turns out they're also found in kidneys. "It sounds counterintuitive, but I encourage people to think of them as sensitive chemical sensors," says Pluznick, an associate editor of *AJP-Renal Physiology*.

Pluznick began this research after a surprising finding while working with a kidney model. "I saw expression of olfactory receptors in a cell line where I didn't expect to see them," she says. "That was our first clue that olfactory receptors may be expressed in the kidney."

Each GPCR seems to have a different role, Pluznick says. As an example, she cites olfactory receptors expressed in the renal tubule. "These receptors fine-tune renal transporters that play an important role in renal function.

Other GPCRs are expressed in the kidney's vasculature, she says. "What's interesting is all of them have a class of ligands in common," she says. "These receptors and blood vessels are activated by a type of ligand produced by our gut bacteria. This has us thinking about how gut microbiota may affect kidney physiology and cardiovascular physiology."

The kidneys also know what time it is and are regulated by circadian rhythms. Michelle Gumz, PhD, professor of physiology and aging at the University of Florida in Gainesville, was trying to identify early aldosterone target genes when she came across an interesting finding. A microarray of mouse kidney cells showed the most highly upregulated gene was a circadian rhythm gene called Period (PER) 1.

"We knew that kidney function had a circadian rhythm," says Gumz, an associate editor of *AJP-Renal Physiology*. "But we didn't know the mechanism of it. My hypothesis was that aldosterone induced the circadian PER1 protein that in turn regulated transport mechanisms in the kidney."

Each cell type within the kidney has its own circadian clock, Gumz says. "We're trying to figure out how these individual cellular clocks work together within the kidney—and how the clock in the kidney integrates with the clock in other tissues," she says. "You want all the clocks throughout your body to be synchronized. But we don't have a good handle on how these body clocks talk to each other."

Generating knockout models is challenging because you can't make a whole kidney where the clock gene is missing from every cell type. Gumz's team creates transgenic models and challenges them in different ways, such as giving them a high-salt diet or eliminating dietary potassium. "What we find is there seems to be a connection between these clock proteins and salt sensitivity," she says.

Gumz hopes her lab's research may lead to clinical applications in personalized medicine. "Inherent circadian rhythm is different from person to person," she says. "If we know more about the circadian clock and how it works in individual tissues and cell types, that could inform the use of circadian biology in treating patients, such as which drug to give and what time of day to give it."

UNRAVELING THE KIDNEY'S MYSTERIES

Jeff Sands, MD, FAPS, a nephrologist and emeritus professor at Emory University School of Medicine in Atlanta, studies urine concentration and dilution. His team is developing a novel therapy for a rare pediatric condition called congenital nephrogenic diabetes insipidus, or CNDI. Boys born with this X-linked disorder have a mutation in vasopressin receptor 2 (V2R) and produce up to 20 quarts of urine a day.

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Sands and his team have explored ways to activate the protein and concentrate urine when the receptor is mutated. "We found a pathway we can target with novel therapeutics that may eventually lead to a therapy," he says. "We're in late preclinical development right now with the hope of getting to Phase I trials by the fall of 2024."

In developing potential new therapies, the kidney's complexity means off-target effects and unintended consequences can occur. Sometimes these effects are harmful, but sometimes they're beneficial. Sands cites sodium-glucose cotransporter-2 (SGLT2) inhibitors as an example. "They were developed as a treatment for diabetes mellitus. But many of their beneficial effects are not what anyone thought they would be at the time the drugs were developed," he says, noting their protective effects on the heart. "As a physiologist, you want to know why a drug that inhibits this transporter in the kidney leads to beneficial effects elsewhere."

That complexity is part of what makes the kidney so fascinating to study, says Robert Fenton, PhD, professor in the Department of Biomedicine at Aarhus University in Denmark and APS Renal Section chair. "It's difficult to understand one part of kidney function in isolation," he says. "Whatever you change in one part of the kidney directly has an effect elsewhere in the kidney, which then maybe affects the vascular system, which then may feed back to the kidney."

Fenton studies how the transport of ions and water affects kidney function. He and his team also examine the effects of kidney function on whole body homeostasis, including the kidney's role in maintaining blood pressure. High blood pressure and kidney disease can be complex, he notes.

"Over time, high blood pressure affects the blood vessels in the kidney," he says. "They become damaged and narrow and don't deliver oxygen and nutrients the kidney needs to function properly and repair. This limits their ability to compensate for damage from kidney disease, and the kidneys lose their ability to filter blood and regulate fluid and salts in the body. This drives blood pressure up, and then it's a circular problem."

Fenton's lab explores how dietary interventions can help reduce blood pressure. "What we uncovered, alongside several other research groups, is that not only is blood pressure greatly influenced by sodium intake, but it is also influenced by dietary potassium intake," he says. "There's a negative correlation between dietary potassium intake and blood pressure. People that take in a potassium-deficient diet tend to have higher blood pressure and vice versa."

Potassium can help the kidney switch from retaining sodium to excreting sodium, he says. "The overall consequence of this is a reduction in blood pressure," he says.

PLENTY TO DISCOVER

One area of potential advancement is diagnostics for kidney disease—particularly biomarkers. Today, Fenton says, biomarkers for kidney disease typically have predictive value only when disease is advanced, meaning about 50% of kidney function is already gone.

> **"Men and women can both develop kidney disease and hypertension, so understanding the role of sex as a biological variable is critical."**
>
> **—Michelle Gumz, PhD**

"We've worked on trying to get a better diagnostic tool to study kidney disease," he says. For example, a simple urine dipstick could alert users to see a doctor for further analysis.

Brooks also names biomarkers as a research area with potential for clinical application. "I think biomarkers are going to be important, but we also need to take sex into consideration when studying how the kidney works," she says.

Brooks is focusing on how sex differences affect kidney cell function. Many kidney diseases are worse in men than in women, for example women are protected—compared to men—from conditions like acute kidney injury, chronic kidney disease and hypertension and resulting kidney damage.

Menopause shifts this protection, however. "In our studies, we've seen that in high blood pressure, males have more immune cells in their kidney than females, leading to higher inflammation, thus these cells seem to be contributing to the pathology," Brooks says. Females are protected before menopause, with higher levels of anti-inflammatory immune cells, regulatory T-cells that may protect the kidney. "After menopause, when estrogen is no longer available, these specific cells are reduced, and this correlates with an increase in kidney damage and inflammation," she says. "Our goal is to understand the physiology behind sex differences and a female's resilience to kidney disease."

Gumz says her team tries to conduct their experiments in groups of male animals and in groups of female animals. "What we've found is the responses to challenges and the effect of the knockout is different between the males and females," she says. "Men and women can both develop kidney disease and hypertension, so understanding the role of sex as a biological variable is critical. We're now working on looking at the mechanism of the clock in female kidneys in our mouse model to see what differences there are."

Shuvo Roy, PhD, professor of bioengineering in the School of Pharmacy at the University of California in San Francisco, is developing an implantable bioartificial kidney that mimics the kidney's natural physiology. "The vast majority of people with kidney failure rely on dialysis," he says. "But there's a physiological difference between dialysis function and our native kidney function."

Filtration in the glomeruli is largely size based, Roy says. "Dialysis is fundamentally a diffusion-based process," he says. "Its efficiency depends on the size of the molecule. Larger molecules move slowly, whereas in the convection or pressure-driven filtration of our kidneys, all molecules move faster and at the same speed. Dialysis has the complications it does because it doesn't remove toxins as efficiently as our kidneys do."

Roy's device uses a biohybrid approach to mimic kidney physiology. Semiconductor silicon wafers create a mechanical hemofiltration unit, and engineered cadaver renal tubule cells create a bioreactor. The person's blood pressure drives the filtration, so there's no need for a battery or pump.

"Blood goes into the hemofilter and generates ultrafiltrate, just as the kidney does," he says. "Ultrafiltrate then goes to a renal tubule-mimicking bioreactor, where engineered kidney cells process the ultrafiltrate, selectively transporting water and ions back into the bloodstream and producing urine. It's not dialysis—it's filtration followed by selective reabsorption."

Roy sees potential for the device to get people to readily achieve 20% to 30% of kidney function, allowing them to avoid dialysis. He credits the pioneering work of physiologists in understanding kidney cell function as key to this effort.

"We have been inspired by physiologists and the fundamental kidney studies they've done," Roy says.

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April 6, 2024, 8:30–10 a.m. PDT

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Speakers: Alexis M. Stranahan, PhD; Scott Kanoski, PhD; Eva Feldman, MD, PhD

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Speakers: Richard Flavell, PhD, FRS; John Cryan, PhD; Quynh Nhu Dinh, PhD

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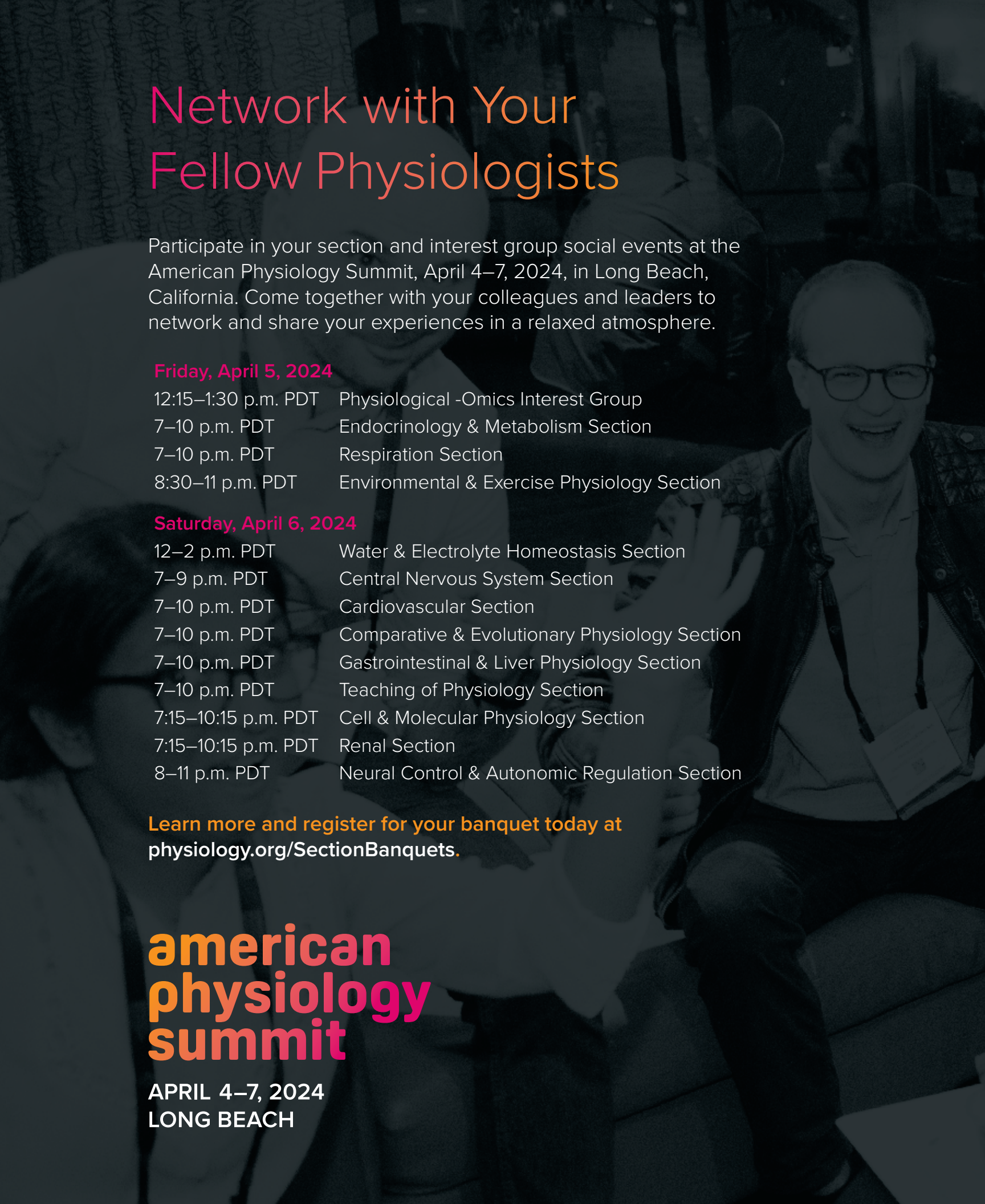
Innovative Space for Scientific Exchange, Collaboration and Learning

Social Events

Opportunities to Connect at Social Events

american physiology summit

#APS2024 | physiology.org/APS2024



Network with Your Fellow Physiologists

Participate in your section and interest group social events at the American Physiology Summit, April 4–7, 2024, in Long Beach, California. Come together with your colleagues and leaders to network and share your experiences in a relaxed atmosphere.

Friday, April 5, 2024

12:15–1:30 p.m. PDT	Physiological -Omics Interest Group
7–10 p.m. PDT	Endocrinology & Metabolism Section
7–10 p.m. PDT	Respiration Section
8:30–11 p.m. PDT	Environmental & Exercise Physiology Section

Saturday, April 6, 2024

12–2 p.m. PDT	Water & Electrolyte Homeostasis Section
7–9 p.m. PDT	Central Nervous System Section
7–10 p.m. PDT	Cardiovascular Section
7–10 p.m. PDT	Comparative & Evolutionary Physiology Section
7–10 p.m. PDT	Gastrointestinal & Liver Physiology Section
7–10 p.m. PDT	Teaching of Physiology Section
7:15–10:15 p.m. PDT	Cell & Molecular Physiology Section
7:15–10:15 p.m. PDT	Renal Section
8–11 p.m. PDT	Neural Control & Autonomic Regulation Section

Learn more and register for your banquet today at physiology.org/SectionBanquets.

american physiology summit

APRIL 4–7, 2024
LONG BEACH

APS Members Receive National Medal of Science

Eve Marder, PhD, FAPS, and **Sheldon Weinbaum, PhD, FAPS**, received the National Medal of Science in October 2023. The Medal of Science is one of "the nation's highest honors for achievement and leadership in advancing the fields of science, technology and innovation."


Marder


Weinbaum

Marder is the Victor and Gwendolyn Beinfield Professor of Neuroscience at Brandeis University in Waltham, Massachusetts. Her work focuses on the dynamics of small neuronal networks, which was instrumental in demonstrating that neuronal circuits are not "hard-wired" but can be reconfigured by neuromodulatory neurons and substances to produce a variety of outputs. Marder is a longtime advocate for women, diversity and international representation and is a past editor-in-chief of the *Journal of Neurophysiology*. She has been an APS member since 1994.

Weinbaum, a distinguished professor emeritus at The City College of New York, is widely recognized for a number of novel biomechanical models that have changed existing views of structure and function at the cellular and whole organ levels. He has solved longstanding medical mysteries, including aqueous drainage of intraocular fluid for the treatment of glaucoma, how the LDL molecule crosses the arteries' endothelial lining, and vulnerable plaque rupture. Weinbaum has been an APS member since 2006.

Taben Hale Receives Excellence in Graduate Student Mentoring Award

Taben Hale, PhD, a professor in the Department of Basic Medical Sciences at the University of Arizona, College of Medicine-Phoenix, is the 2023 recipient of the college's Excellence in Graduate Student Mentoring Award.

This honor recognizes "a faculty mentor for their exceptional dedication and work as mentor in an affiliated graduate program." Hale's laboratory investigates the early drivers and long-term consequences of hypertension. These include the effect of prenatal stressors on the autonomic nervous system regulation of blood pressure and heart function in the adult offspring and the regulators of cardiac fibroblast activation in the pressure overloaded heart. She is also director of the University of Arizona, College of Medicine-Phoenix Women in Medicine and Science program. Hale has been an APS member since 2008.

Dexter Lee Receives Teaching Award

Dexter Lee, PhD, associate professor at Howard University College of Medicine in Washington, D.C., has received the college's Excellence in Teaching Award. This honor recognizes faculty who have "gone beyond their position to demonstrate excellent teaching skills and a commitment to medical education." Lee's research centers on the role of inflammatory mediators on blood pressure regulation by the kidneys and their effects on acute kidney injury and the influence of inflammatory mediators on sodium transporters in the kidneys. He has been an APS member since 1994.

Merry Lindsey Receives ACDP Distinguished Service Award

Merry Lindsey, PhD, FAPS, dean of the Meharry Medical College's School of Graduate Studies, is the 2023 recipient of the Association of Chairs of Departments of Physiology (ACDP) Distinguished Service Award. This honor recognizes a person "who has given long and illustrious service to ACDP, physiology as a discipline and/or the field of science in general." Lindsey is the editor-in-chief of the *American Journal of Physiology-Heart and Circulatory Physiology*, where she works to establish guidelines for cardiovascular research, improve the diversity of the journal and promote professional development of early-career investigators. Her research focuses on inflammation and extracellular matrix remodeling during cardiac wound healing. Lindsey has been an APS member since 2003.

Share your news with us. Email tpysmag@physiology.org.

GOVERNANCE

APS Presents Proposed Governance Updates to Members

Over the past 18 months, an APS Governance Modernization Task Force has been examining the Society's governance model and seeking ways to modernize and strengthen the leadership program.

Although the discipline and the laws governing nonprofit organizations have significantly changed over the past 40 years, the Society's governance model has remained largely unchanged. During this time, more than 100 members participated in interviews, focus groups, a leadership retreat and a survey to inform this work. This process identified key themes: the need for clear and consistent pathways to leadership; enhanced communication among leaders, members and the Society; and a streamlined governance structure reducing redundancies and complexity.

Drawing from the themes and issues identified in a review of the APS governance model, the task force presented a modernization proposal to Council. The group discussed the proposed changes' merits, challenges and potential effects. Council amended the proposal and voted to approve the governance restructuring changes, subject to member feedback.

The next phase included a town hall to present the governance proposal. The event provided members with an overview of the recommended structure, background on why the changes are essential and opportunities for submitting feedback. Council will consider the feedback and finalize the proposal as necessary. Upon proposal approval, Council will vote on the corresponding bylaws revisions and will communicate proposed changes to the membership for review and a vote. Catch a recording of the town hall on the proposed changes and get up to date: **physiology.org/govmod.**

2024 SUMMIT

NASA Astronaut to Close Out 2024 Summit

With a career that has taken her from the depths of the ocean to the depths of space, **Jessica Meir, PhD**, has covered more ground than perhaps any other comparative physiologist. As an astronaut working for NASA, she served as a flight engineer on a 205-day spaceflight expedition from September 25, 2019, to April 17, 2020. During the expedition, Meir and her crewmates conducted experiments in biology, Earth science, human research, physical sciences and technology development. She also conducted the first three all-female spacewalks.


Meir

Don't miss Meir's talk, "The Physiology of Space Flight," the closing keynote presentation at the 2024 American Physiology Summit. Learn more at **physiology.org/jessicameir**.

It's Not Too Late to Register for the Summit

You can still register for the American Physiology Summit, April 4–7, in Long Beach, California. Check out the program and start planning your trip at **physiology.org/APS2024**.

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APRIL 4–7, 2024
LONG BEACH

HONORS

APS Award Winners Announced

APS has announced the recipients of the 2024 Physiology in Perspective: The Walter B. Cannon Award and the Henry Pickering Bowditch Award lectureships. These awards recognize the lifetime achievement of an established researcher and the physiological research excellence of an early-career researcher. This year's awardees will each deliver a lecture at the American Physiology Summit in April.

Sadis Matalon, PhD, ScD, FAPS, was named the 2024 Walter B. Cannon Award lecturer. This lectureship is the most prestigious award the Society bestows and recognizes the lifetime achievement of an outstanding physiological scientist and APS member. Matalon is the Alice McNeal Endowed Chair and a distinguished professor at the University of Alabama at Birmingham (UAB) Heersink School of Medicine's Department of Anesthesiology and Perioperative Medicine. He is also director of UAB's Pulmonary Injury and Repair Center. His research interest centers on understanding the basic mechanisms by which oxidant gas inhalation damages mitochondrial function and its implications in the onset and development of acute and chronic lung injury. He is a past editor-in-chief of the *American Journal of Physiology-Lung Cellular and Molecular Physiology* and is editor-in-chief of *Physiological Reviews*.


Matalon

Steven Romero, PhD, is the 2024 Henry Pickering Bowditch Award lecturer. The lectureship is awarded to a regular member who is 42 years old or younger or less than eight years from the start of their first faculty or staff research scientist position beyond postdoctoral training. The recipient is recognized for original and outstanding accomplishments in the field of physiology. Romero is an


Romero

associate professor at the University of North Texas Health Science Center in the Department of Physiology and Anatomy. He is director of the Human Vascular Physiology Laboratory, where his work investigates how the vascular system adjusts and adapts to exercise and environmental stress in health and disease. Romero is a past recipient of the APS Porter Physiology Development Fellowship, a reviewer for the APS family of journals and an editorial board member for the *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*.

PUBLICATIONS

APS to Launch Subscribe to Open Model for its Journals

Starting in 2025, APS will move 10 of its primary research journals to a Subscribe to Open (S2O) publishing model. APS is committed to championing the discipline of physiology by extending its reach worldwide. Adopting S2O will help the Society facilitate an open access publishing environment. In addition, it will provide APS members and authors with a home to publish their work using an approach that is compliant with funder policies around the globe. S2O will also benefit the research community broadly by improving access, advancing scientific discovery, and enabling the communication of science to the broadest audience possible in a fair and sustainable manner.

The S2O model helps libraries and publishers bridge the transition to open access. Current institutional library subscribers are offered continued access to their publications through the standard subscription process. If enough subscribers agree to renew, APS commits to making that year's content open access. To learn more and see the list of journals moving to this model, visit **journals.physiology.org/S2O**.

AWARDS

**Award deadlines may be subject to change*

Environmental & Exercise Physiology Section Edward F. Adolph Distinguished Lectureship (March 1)

Environmental & Exercise Physiology Section Honor Award (March 1)

Environmental & Exercise Physiology Section Impact Award (March 1)

Cell & Molecular Physiology Section Hugh Davson Distinguished Lectureship (March 15)

Neural Control & Autonomic Regulation Section Carl Ludwig Distinguished Lectureship (May 19)

John F. Perkins Jr. Research Career Enhancement Awards (May 31)

Teaching Career Enhancement Awards (May 31)

Local Undergraduate Research Awards in Physiology (Applications accepted on an ongoing, year-round basis)

More details: physiology.org/awards

CALLS FOR PAPERS

American Journal of Physiology-Endocrinology and Metabolism
- Immunometabolism (March 1, 2024)
- Clinical Metabolism (April 30, 2024)

American Journal of Physiology-Gastrointestinal and Liver Physiology
- Cell and Animal Models of Gastrointestinal Disease (July 1, 2024)
- Epithelial Cell Metabolism (July 1, 2024)
- The Microbiota-Gut-Brain Axis (July 1, 2024)

American Journal of Physiology-Heart and Circulatory Physiology (June 30, 2024)
- Vascular Contributions to Human Disease

American Journal of Physiology-Lung Cellular and Molecular Physiology (July 1, 2024)
- Alveolar Biology, Pulmonary Surfactant, and Beyond: A Tribute to Dr. John Allen Clements on His 100th Birthday

American Journal of Physiology-Regulatory, Integrative and Comparative Physiology
- José Antunes Rodrigues: 90 years in life and 70 years in science: The central nervous system and the control of hydroelectrolytic balance (June 30, 2024)
- Cardiovascular regulation during exercise: role of biological sex and consequences of aging (July 1, 2024)

Journal of Applied Physiology (June 30, 2024)
- Identifying Factors Driving Heterogeneous Responses to Exercise Training

Journal of Neurophysiology (July 31, 2024)
- Sleep Disorders

Physiological Genomics
- Integrative Physiology and Translational Omics of Exercise and Physical Activity (June 1, 2024)
- The Microbiome in Health and Disease (June 1, 2024)
- Now and Then in Physiological Genomics (June 1, 2024)

Physiological Reports (April 10, 2024)
- Physiological Effects of Atmospheric Pollution

Advances in Physiology Education (July 15, 2024)
- Teaching in an Era of Generative Artificial Intelligence

Function
- Function invites submissions, including original research articles and evidence reviews, in the areas of molecular, cellular and systems neuroscience.

More details: journals.physiology.org/calls

MEETINGS & EVENTS

American Physiology Summit
April 4–7, 2024
Long Beach, California
- Housing deadline: March 11
- Regular registration deadline: March 11
- On-site registration rates apply: March 12–April 7, 2024

More details: physiology.org/APS2024

Working Less Is the Key to Greater Scientific Productivity

BY ROBERT A. FENTON, PHD

During my PhD studies, I was officially employed as a research technician, supposedly working a 37-hour week. However, I realized I was working a lot more when I was told I had, in principle, accumulated a further eight weeks' vacation in my first year as official "time in lieu."

This process repeated year after year until I graduated, but I presumed this was commonplace among PhD students. During my postdoctoral years, I noticed a similar working trend. I would be at work before 8 a.m. and leave after 6 p.m. and frequently worked whole weekends. Now, to clarify, I was not forced to do this; I enjoyed seeing the benefits of my hard work. It appeared to be the same for my peers. Were we trying to demonstrate our dedication to research by working long hours? Was this required to be successful?

In July 2005, I relocated to Denmark. In hindsight, this was not the best time of the year to move to Denmark and try to secure the necessary permits and health insurance card. Administrative offices that deal with these issues were closed. Why? Because business largely shuts down at this time of year, as people take time off to enjoy the summer.

In Denmark, all full-time employees are legally entitled to five weeks of paid vacation per year, and academics are granted one extra week. Then there are the 10 public holidays, which, in principle, results in approximately 40 days of vacation per year. Employees—even those in academia and research—are not shy about using every hour of it.

By mid-August 2005, I presumed things would return to normal, as academic staff would be back refreshed from their vacations. I presumed they would be ready to put in the long working hours required to help Denmark retain its ranking as one of the top countries for scientific impact. But at 4 p.m. most offices and labs were virtually empty. Had I missed an important seminar or meeting? No. Most of my new colleagues had left work to collect children from day care, begin preparing the family dinner, go to the gym, meet friends or set off on a long cycle home. They were not afraid to walk away when they had accomplished what they had set out to achieve that day.

It took time to adjust to this way of working, but now I appreciate the importance of a good work-life balance. I realized that working fewer hours, but in a different way, could make me more efficient.

My academic life in Denmark has certainly been highly productive and rewarding. For example, instead of spending hours mid-afternoon staring at a screen, writing and rewriting a paper, I go home, jump on my road bike, and head off into the countryside. My brain resets. Upon returning home, the words fall into place rapidly and effectively. And I rarely work on weekends. I write most of my funded research grants in the weeks after summer vacation while sitting in my garden. I edit my research group's papers using my phone while walking to or from work. I have a lot of international collaborators, so I often take online meetings away from my desk—sometimes from the sideline of my daughter's soccer match or gymnastics class.

At my career stage, I don't have to justify my whereabouts to those around me. Even so, I believe encouraging similar work-lifestyle changes could benefit researchers at all levels, increase their productivity and aid them in their career path. Food for thought?

Robert A. Fenton, PhD, is a professor of cell biology at Aarhus University in Denmark. Something on your mind? Send your column ideas, questions or comments to tphysmag@phsyiology.org.

Illustration by Brett Affrunti

APPLY FOR SOCIETY AWARDS

american physiological society®

The American Physiological Society (APS) offers more than $1.2 million in awards and fellowships each year as part of our mission to encourage excellence in physiological research and education. These awards are a vital investment in our researchers and educators of all career levels.

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

March 1

Environmental & Exercise Physiology Section Edward F. Adolph Distinguished Lectureship

$1,000 honorarium. Recognizes an eminent research scholar with meritorious contributions to the areas of environmental, exercise, thermal or applied physiology.

March 1

Environmental & Exercise Physiology Section Honor Award

$1,250 honorarium. Recognizes a collegial citizen of the section who has made significant contributions in environmental, exercise, thermal or applied physiology.

March 1

Environmental & Exercise Physiology Section Impact Award

$1,000 honorarium. Recognizes a mid-career member who has established a line of impactful research or made a seminal discovery in physiology research.

March 15

Cell & Molecular Physiology Section Hugh Davson Distinguished Lectureship

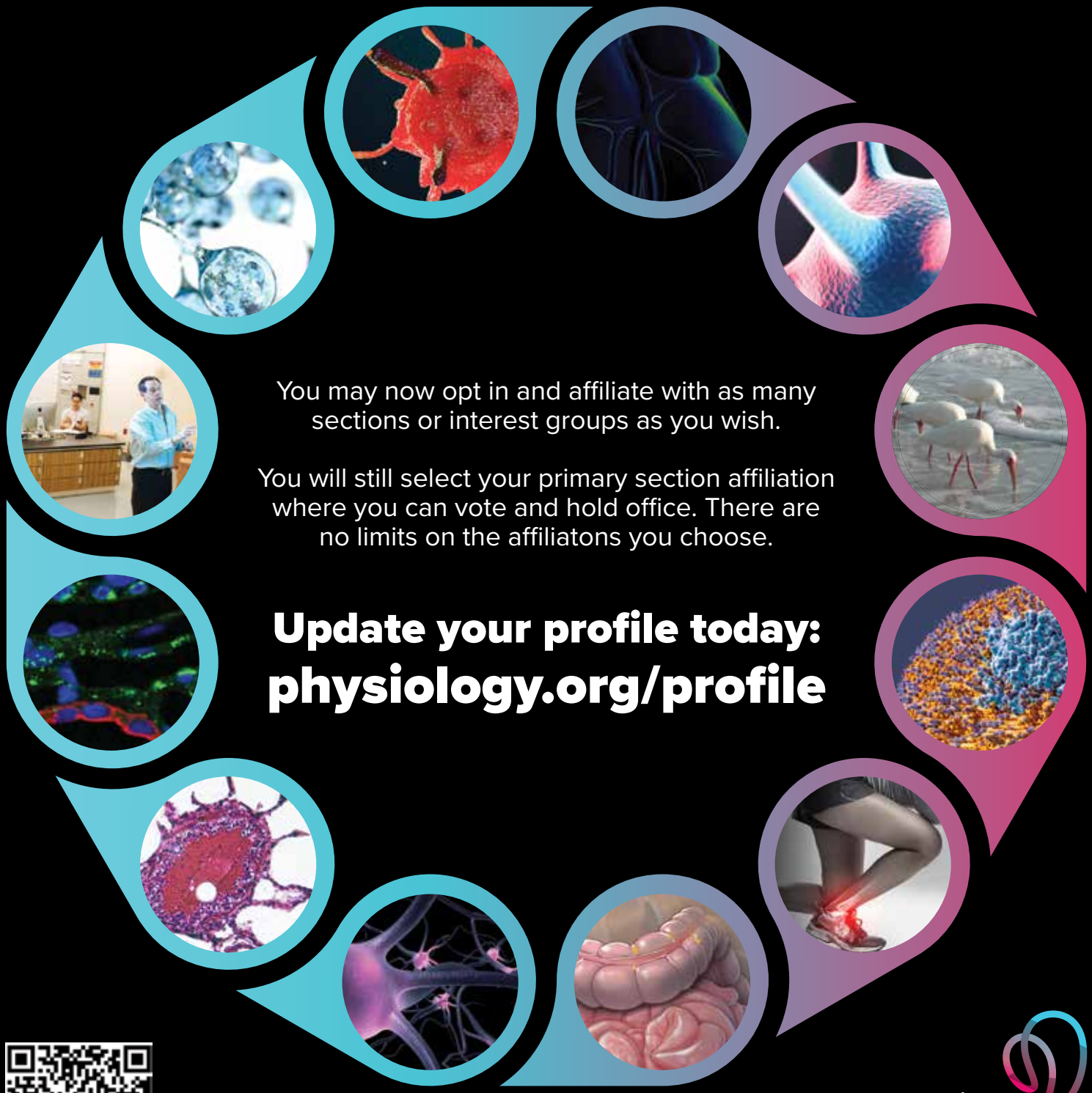
$1,000 honorarium. Highest award bestowed to a scientist with meritorious contributions to the Cell & Molecular Physiology Section in honor of Hugh Davson, DSci.

Ongoing

Local Undergraduate Research Awards in Physiology

Established to foster interest and encourage undergraduates in physiological research. Recognizes APS members at their home institution.

APS Members May Now Affiliate with More Sections



You may now opt in and affiliate with as many sections or interest groups as you wish.

You will still select your primary section affiliation where you can vote and hold office. There are no limits on the affiliatons you choose.

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physiology.org/profile

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