

THE **Physiologist** MAGAZINE

MARCH 2022

EDUCATING THE
PUBLIC ABOUT
THE VITAL ROLE
ANIMALS PLAY
IN RESEARCH **24**

DECIPHERING
THE COMPLEX
MECHANISMS
THAT LEAD TO
CHRONIC PAIN **30**

DRIVEN BY DISCOVERY

Whether decoding the mysteries of the extracellular matrix or reviewing data for journals, Liliana Schaefer, MD, draws inspiration from the unknown.

PowerLab^C

Re-engineered for unparalleled flexibility



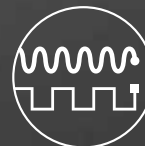
PowerLab C is a data acquisition device at the heart of a modular system that provides unparalleled flexibility for researchers looking to invest in customizable and reliable solutions for both now, and in the future.



Modular
system



Powerful
and portable



Analog
compatible



Digital framework
for the future

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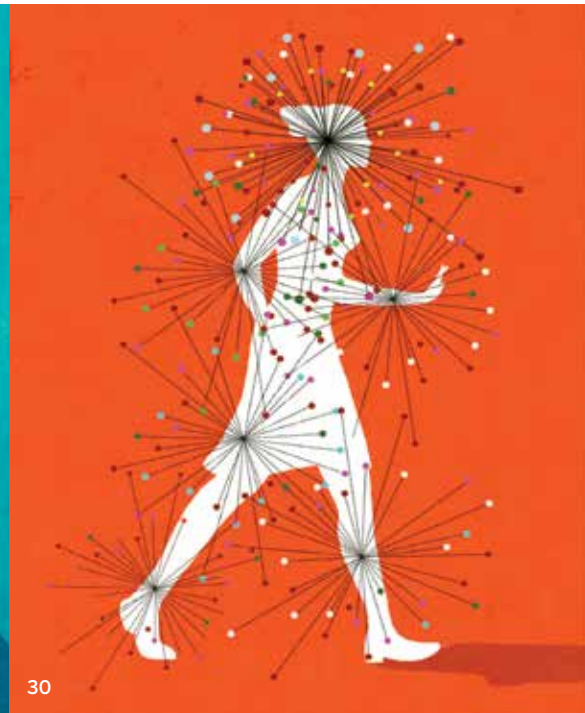
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Driven by Discovery

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The Elephant (and Mouse) in the Room

Educating the public about the vital role animals play in research can be daunting, but it must be done.

BY CHRISTINE YU

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The Physiology of Pain

The feeling of pain involves complex mechanisms that researchers are trying to figure out—as 50 million people in the U.S. continue to suffer from chronic pain.

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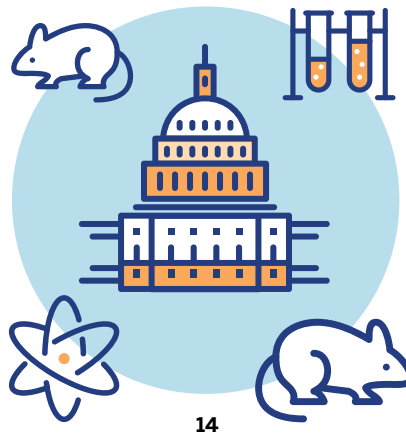
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SWIMMING PERFORMANCE

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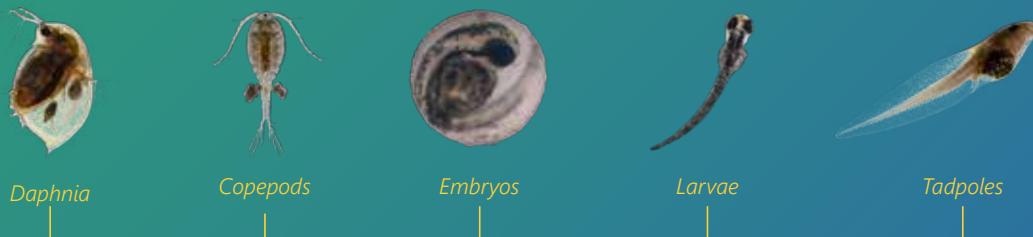


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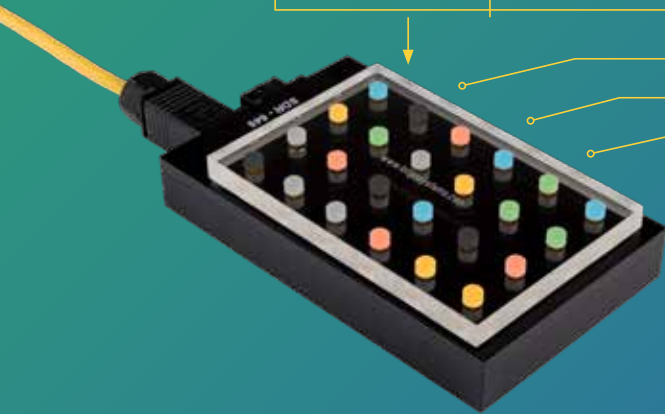
Daphnia

Copepods

Embryos

Larvae

Tadpoles



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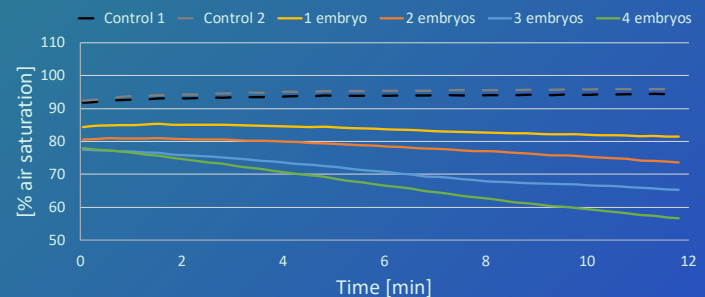
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REAL DATA EXAMPLE

24-HPF ZEBRAFISH EMBRYOS (PER WELL)



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Loligo® Systems

Introducing a New Thought-Provoking Column

BY STACY BROOKS



Dear reader:

One of our goals at *The Physiologist Magazine (TPM)* is to peer into the most pressing topics in the discipline of physiology and the business of science. We always strive to keep that in mind, particularly with our feature articles, as we examine what is happening in the field today. This month, we are pleased to launch another section of the magazine where we're examining the physiology field in this way.

We bring you "Evolution," a new column from APS Executive Director Scott Steen, CAE, FASAE (see page 8). Steen will share his thought-provoking conversations with physiologists who are making a difference in their own communities and the world at large. In this inaugural column, Steen talks to Sue Bodine, PhD, FAPS, about the progress—or lack thereof—that the scientific community has made on gender discrimination in research.

OUR FEATURES

We often talk at APS about the importance of animal research—a practice critical to the advancement of research and medicine but often controversial in our society. In fact, 52% of Americans are opposed to animal research, according to a 2018 survey from the Pew Research Center. Our feature article on page 24, written by freelance writer Christine Yu, examines this "elephant in the room." In addition, on page 14, APS Science Policy staff speak with several members of our Animal Care and

Steen will share his thought-provoking conversations with physiologists who are making a difference in their own communities and the world at large.

Experimentation Committee about how they see their role as advocates for animal research and how they talk about it—both to policymakers and the public.

Many of us are fortunate to live without chronic pain, but I bet you remember those excruciating times when you injured yourself and had to spend time healing. Pain is often unforgettable. Maybe you tweaked your back, broke a few ribs or severely sprained your ankle. For 50 million Americans, those types of temporary, acute incidences of pain have become ongoing, often debilitating, chronic pain. Or, sometimes their chronic pain just suddenly appeared, with little warning and no obvious cause.

The feeling of pain is complex, and on page 30, freelance writer Lauren Arcuri talks with several researchers about the physiology of pain and what we're learning every day about how pain works—and how we can better manage and treat it.

Our cover profile this month on page 18 is Liliana Schaefer, MD, a pharmacology professor in Germany who has shaped the field of matrix biology and has created a new path for herself in publishing. She talks about her passion for her research and, as the editor-in-chief of the *American Journal of Physiology-Cell Physiology*, shares her efforts to bring about geographic diversity and more opportunities for early-career researchers.

WE WANT TO HEAR FROM YOU

Remember that without you, there is no *TPM*. I invite you to email us at tphysmag@physiology.org to share your feedback, suggestions and story ideas. I look forward to hearing from you. 📧

Stacy Brooks is the editor-in-chief of *The Physiologist Magazine* and APS director of marketing and communications.



Amplify the message. Advocate for science.

Raise your voice in support of scientific research with just a few clicks. Sign up to receive APS Action Alerts, and hear about strategic opportunities for members like you to speak out collectively on the issues that matter most to physiologists and the broader scientific community.

physiology.org/advocacy



APS

ACTION

ALERTS

THE Physiologist MAGAZINE

VOL. 65 | MARCH 2022

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APPLY FOR SOCIETY AWARDS



The American Physiological Society (APS) provides more than \$1 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.

View all available awards and apply for our highlighted awards by the deadlines below at [physiology.org/awards](https://www.physiology.org/awards).

March
19

Carl Ludwig Distinguished Lectureship Award

\$1,000 honorarium. Honors a world-renowned, distinguished investigator who has made major contributions toward a better understanding of some aspect of autonomic regulation in normal and/or disease states.

Postdoctoral Fellowship Program

\$50,000 honorarium. Honors early-career members seeking career development opportunities in worldwide physiological research. This award is a two-step application process with the first deadline of April 15.

April
15

May
31

Teaching Career Enhancement Award

\$10,000 honorarium. Honors an individual looking to enhance their career potential through the development of innovative and potentially widely applicable programs for teaching and learning physiology.

John F. Perkins, Jr. Research Career Enhancement Award

\$20,000 honorarium. Honors an individual looking to enhance their career potential through the development research skills or special training.

May
31

Sexual Harassment in Science Today



Steen



Bodine

APS Executive Director Scott Steen, CAE, FASAE, invited Sue Bodine, PhD, FAPS, professor of medicine at the University of Iowa Carver College of Medicine, to a wide-ranging discussion around how women are doing in science, the progress they've made over the course of Bodine's career—especially in regard to sexual harassment and workplace culture—and what needs to be done. Here's an excerpt of their conversation:

STEEN: As a woman scientist, did you find the experience in academia different than the experience in industry? Was one more accommodating and able to harness your talent more?

BODINE: I would say that they were similar. I think some of the challenges and barriers are similar in academia and industry for a woman.

STEEN: I know this might be too personal, so feel free to not answer, but have you personally experienced harassment and gender discrimination? I would imagine, unfortunately, it's fairly universal for established women scientists, right?

BODINE: Yes, I have.

There are many reports in the National Academies of Sciences, Engineering and Medicine report that came out in 2018 that showed that the majority of women in the STEM field have

experienced sexual harassment and gender discrimination in various levels.

STEEN: That study said that between 20 and 50% of female students experience sexual harassment directed at them by faculty or staff.

I think, in addition, women can also face a host of degrading or threatening treatment from male colleagues, and even worse, people in positions of authority.

BODINE: Yeah.

STEEN: Do you think we are making progress at all? I mean, 2018 was four years ago.

BODINE: Yes and no. What I really liked about that National Academy of Sciences report was the illustration of [sexual harassment] as an iceberg. Most institutions have just concentrated on everything above the water, and that's just a very small piece of it.

STEEN: Which is the most blatant.

BODINE: Right. Sexual harassment or coercion, and assaults, and physical assault. And to some extent, I think the 2018 report drew attention to that part above the water, and institutions have instituted policies, but I still think there's a lot of harassment still going on. The reports that I read recently say little has changed. I think women are still sometimes reluctant to say anything because it's a small community and there's a fear of retaliation, or that nothing will be done, or they won't be taken seriously. I think NIH and NSF started paying more attention to it, and men who have been accused of sexual harassment ... have lost grants and lost membership in National Academy of Science and other things. That's a positive outcome, but I still think what's under the surface still hasn't been addressed and is still a major problem.

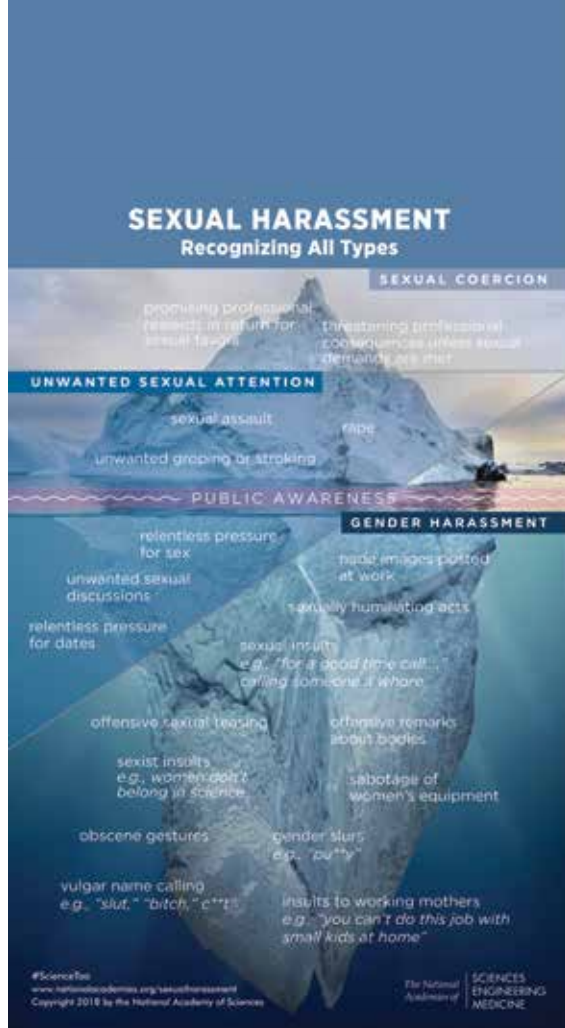
STEEN: And you're not going to lose your job because you're rude, or because of microaggressions ... so you could be someone who still treated the women who were subordinate to you in a laboratory horribly, but not necessarily have any consequences to that.

BODINE: And it's this constant persistent environment that women find themselves in that ultimately [causes] many of them to leave. And it's often at the department level; they decide they've had enough and they decide to leave science. I was reading a couple of reports where people have talked about women leaving at early stages, but it's actually happening throughout their career. Women are leaving at all stages. Pipeline is not just leaky at the assistant level, where women are mak-



The median earnings of women in STEM occupations (\$66,200) are about 74% of men's median earnings in STEM (\$90,000).

Pew Research Center



ing tenure or having families; it's occurring at all levels of their career, at full professors, associates. So, I think it's still a persistent problem. Everybody talks about changing the climate, and it's hard to describe it. It's hard to come up with metrics to measure it if they claim it's gotten better or not. But I think it's something that needs more discussion and is still a persistent problem.

STEEN: It feels like it's structural, and I think there is a perception that academia and science generally are progressive institutions concerned with facts and with achievement and the best idea. And clearly, there are huge issues still regarding both sexual harassment and gender discrimination.

BODINE: Yeah.

STEEN: Why do you think it's so prevalent in both academia and science?

BODINE: Historically, it's been a male-dominated field. It's very hierarchal. ... [In science,] you have a lab head and your trainees, your subordinate. There's this power structure, so I think that's part of it. ... There's not enough women in leadership

positions to change this power structure, so the climate hasn't changed and it just persists, and nobody calls attention to it or does anything to change it. I've often heard people say, "Well, when the older faculty retire, it'll get better," but that doesn't happen because it gets passed down generation to generation because the younger people see what's tolerated and that becomes the norm and nobody says anything.

STEEN: Do you think institutions where there're greater representation of women in leadership are doing better on the issue? Or do you think it's just so baked into the system?

BODINE: I think some areas of science where women are a majority, like psychology, are doing better than those that still have this imbalance. It's been three decades, and if you look at the numbers, they haven't changed that much as far as women at these higher ranks of department chairs, deans, presidents. So, what is holding women back?

Because at first it was, "OK, it's a numbers game. There's just not that many women in the pipeline." Well, now there are plenty of women in the pipeline, and at least 50% or more of graduate students in the biological sciences are women. So, what is hindering women from getting hired in tenure-track positions, making tenure or then getting appointed as department chairs, deans or chancellors?

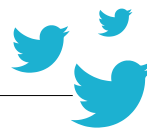
One of the things you see is people say, "Oh, well, look, we've hired a female chancellor." OK, that's one woman. And that's at the head of the institution. There's still a very small percentage of department chairs that are women, and it's at the level of the department where I think that we need to change the climate, and if it changes there, it'll permeate up. But that's where it's tolerated. And if it can change there, maybe we can change the climate to the better, but there needs to be a critical mass of women in the department also and a critical mass of senior women. ♻️



Among tenure-track faculty members (STEM and non-STEM), women make up 50% of assistant professors but only 45% of associate professors and 32.5% of full professors.

American Association of University Professors

View the conversation in full at
www.physiology.org/evolution



As the new year began, physiologists and other scientists shared their thoughts and lessons about academia.

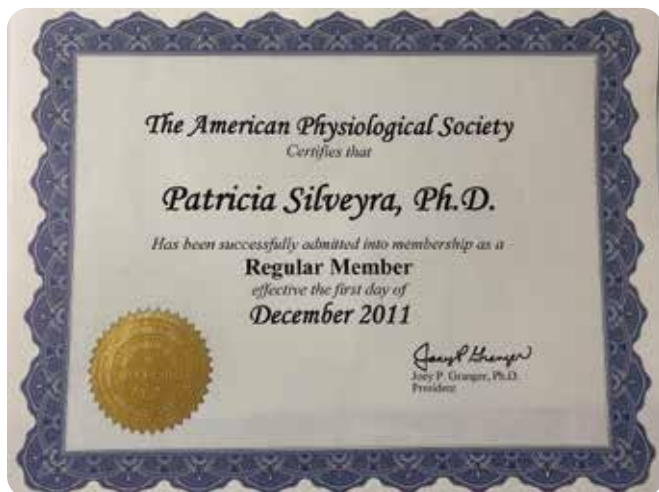
Share your story with us and it may appear in the next issue of *The Physiologist Magazine*. Email your thoughts—and links to your tweets and posts—to tphysmag@physiology.org.



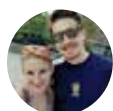
Doctora Patricia Silveyra

@patosilveyra

it's my 10th anniversary as an @APSPHysiology member!! Here are some of the highlights of this decade 🎉🥳📚



12:14 AM · Dec 16, 2021



Megan Rosa-Caldwell, PhD

@MuscleSciMegan

Something I've recently noticed, the more grants you write the easier it gets. Partially because you get a lot more efficient at getting words on paper, but you already have key references and language for diff portions. So grad students take advantage to help w grant writing!

12:13 PM · Jan 19, 2022



William Adams, PhD, ATC, FACSM

@william_m_adams

Apparently some light #reading on fluid and electrolyte physiology was too much for them this morning. #hydrationscience #naptime



9:27 AM · Jan 11, 2022



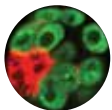
Junie P Warrington, PhD, FAHA
@JunieWarrington

#PositiveAcademia2022

Day 12: Be flexible. In academia, we deal with frequent changes: Colleagues, research directions, and circumstances. To be successful, we need to be adaptable.



11:42 AM · Jan 12, 2022



Tanentzapf Lab
@TanentzapfLab

Looking forward to an end to the pandemic so Science Twitter can get back to focus exclusively on what it does best, complaining about funding & publishing.

1:19 PM · Jan 8, 2022



Nicole Gasparini
@NMGasparini

Diversify your seminar speakers, whatever that means for your department. Are you representing career choices, career stages, career paths, race, gender, scientific subdisciplines? Do you have disabled speakers? Caregivers? Single people? LGBTQIA folks?

#AcademicEquityActions

12:22 PM · Jan 23, 2022



Katie Wilkinson
@DrK_Wilkinson

If universities are looking to take something off the plates of profs right now, strongly suggest canceling the yearly, growing list of useless online trainings. I'd rather use the time to plan for omicron disruptions than sit through videos on not clicking phishing links.

10:45 AM · Jan 12, 2022



Stella Gouloupoulou, PhD
@SGouloupoulou

Taking a break 🚶 away from my desk. I am starting falling in ❤️ with this small campus. **#happywednesday**
#stopandsmelltheroses



4:01 PM · Jan 19, 2022

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LABNOTES

MENTORING Q&A YOUR QUESTIONS ANSWERED
POLICY IQ PHYSIOLOGY ON THE HILL AND IN THE HALLS
RESEARCH FIZZ TOP TRENDING RESEARCH FOR 2021
STATS & FACTS PHYSIOLOGY BY THE NUMBERS
UNDER THE MICROSCOPE OUR MEMBERS, UP CLOSE
PUBLISH WITH POLISH BUILD A BETTER RESEARCH PAPER

STATS & FACTS

1953

The year APS adopted the first iteration of the Guiding Principles for the Care and Use of Animals

History of the American Physiological Society: The First Century, 1887–1987

RESEARCH FIZZ



Physiological demands of running at 2-hour marathon race pace

This study explores the physiology of elite distance runners performing at a two-hour marathon pace, including how much oxygen they consume while running at high speeds.

Journal of Applied Physiology, February 2021
<https://doi.org/10.1152/jappphysiol.00647.2020>

STATS & FACTS

92%

The portion of working PhD scientists who support animal research.

Pew Research Center



MENTORING Q&A | NEW WAYS

Postdoc Appreciation

How can the postdoctoral system be improved?

Each issue, we ask a trainee member to pose their career questions to an established investigator and mentor. Here, Kibrom M. Alula, PhD, an APS 2021–2022 Postdoctoral Fellow at the University of Colorado, Anschutz Medical Campus, asks Luis “Gabby” Navar, PhD, professor and chair at Tulane University School of Medicine, about the postdoc system.

Q: Postdocs are often considered underpaid and overworked for the amount of time they invest in research work. How can the postdoc system be improved?

A: Through the many years that I had postdoctoral

fellows, I always emphasized that the stipends should not be considered salaries, although I know that this is starting to be considered as a salary. The stipend is meant to partially defray expenses while the fellow has an extended period of advanced scholarly research and training that will provide the foundation for future work and perhaps the fellow's entire career. That is why the ideal situation is for the fellow to join a laboratory and have a mentor who

is measured by the salary and not the investigational advances. Call me an idealist, but I have lived and worked by these concepts, and when my fellows left me they felt ownership of a specific area of research achieved during the period of postdoctoral activity.

Q: Any tips on how to work to live, not live to work?

A: I am not a good person to answer this question because I look back at my life and I can say that I probably lived to work and

and enjoy mentoring students and fellows.

Q: There has been a lot of talk recently about journals and the scientific community disregarding negative data. Do you feel negative data has value? How can we report on and use negative data to improve research?

A: We have to remember that we are supposed to be unbiased experimentalists with a hypothesis to be tested. The experimental approach should not be contrived to yield a positive answer and should give an equal chance to go either way. Nevertheless, a negative result also means something because it leads to alternative possibilities. If viewed within this framework, negative data are publishable and yield significant insights, but one has to be creative. Some of my best projects resulted from negative data that led to the study of alternative hypotheses. ④

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

RESEARCH FIZZ



Three weeks of interrupting sitting lowers fasting glucose and glycemic variability, but not glucose tolerance, in free-living women and men with obesity

Frequent activity breaks from sitting may improve fasting glucose levels. The study is the first of its length to explore the effects of activity breaks in "free-living" conditions.

American Journal of Physiology-Endocrinology and Metabolism, August 2021

<https://doi.org/10.1152/ajpendo.00599.2020>

STATS & FACTS

7.4%

The portion of adults in the U.S. who experienced chronic pain severe enough to limit work and life activities in the past three months.

U.S. Centers for Disease Control and Prevention

"If you feel that you have a job, you probably are working to live, but if you feel you have a vocation, then you live to work. I believe that most great scientists lived to work."

works in the area that is of greatest interest to the fellow and will launch the fellow's career. Obviously, the research performed will support the mentor's research program, but it will also provide an opportunity for the fellow to attain recognition as an emerging investigator in the particular research area. It is not an ideal situation if the fellow is simply performing assigned laboratory work for the principal investigator without being allowed to contribute intellectually. Under these conditions, salary becomes the benchmark, and success

felt that this was essential if I was to achieve success and recognition. However, I have had many good times and enjoyed my non-working days. My work also gave me the opportunity to travel to many parts of the world, and I always enjoyed these adventures very much. Yet, I was still working. I guess that if you feel that you have a job, you probably are working to live, but if you feel you have a vocation, then you live to work. I believe that most great scientists lived to work. Here I am, 80 years old and still working because I enjoy my work

STATS & FACTS

1,466

The number of institutions cleared to receive funding for animal research from the U.S. Public Health Service.

National Institutes of Health Office of Animal Welfare

RESEARCH FIZZ



The effect of acute sleep deprivation on skeletal muscle protein synthesis and the hormonal environment

A single night without adequate sleep may reduce muscle protein production by up to 18%. Chronic sleep deprivation could lead to metabolic disorder and changes in body composition.

Physiological Reports, January 2021

<https://doi.org/10.14814/phy2.14660>

STATS & FACTS

~\$560 billion

The estimated annual cost in medical expenses, lost productivity and social services related to chronic pain.

U.S. Centers for Disease Control and Prevention



POLICY IQ | ETHICAL RESEARCH

Taking on the Challenge of Advocating for Animal Research

Researchers who work with animals have a unique understanding of all that goes into the process from start to finish. Beginning with the earliest stages of planning experiments, researchers prioritize the responsible use of animals. This carries through the entire research process as investigators seek funding and approval for research protocols, obtain animals, conduct experiments and ultimately report the results.

At APS, the Animal Care and Experimentation (ACE) Committee is charged with educating policymakers and advocating for the responsible use of animal experimentation when necessary for research to advance the understanding of health

and disease in humans and other animals. ACE Committee members come to this work with knowledge and experience from their scientific roles, but also a passion for communicating about why animal research is important.

Former ACE Committee member and Chair J.R. Haywood, PhD, FAPS, joined the committee many years ago when he saw colleagues being targeted by animal rights activists. He stayed active even beyond his tenure, noting that during his time on the committee he learned that “everyone’s experience and perspective is a little different, but their passion is still great. We all work with animals to improve the health and well-being of humans and animals.”

EDUCATING CONGRESS

In carrying out the committee’s mission, members take on a role as advocates for responsible animal research. Committee member Frank van Breukelen, PhD, says that “without advocacy, it’s too easy for people to forget that ethical animal research is still required to answer the complex questions that biology presents.”

Members of the committee work together to develop advocacy messaging that emphasizes the crucial role of animal research and the ethical and regulatory safeguards that the scientific community uses to ensure that animals are treated humanely. These positive messages are communicated to congressional offices to help members and their staff understand the need for this type of research, which also underscores why placing arbitrary limits on the use of animals in research is short-

sighted and likely to hinder scientific progress.

Committee member Michael Golding, PhD, says as he observed what was happening in Europe with initiatives to limit animal research, he became concerned that similar restrictions would be implemented in the U.S. Such restrictions would “have a devastating effect on our ability to improve human health and respond to emergent health crises, including viral pandemics,” he says.

Members of the committee also bring their perspectives as working scientists. Former committee member Gaylen Edwards, DVM, PhD, is careful to always highlight how well cared for research animals are when he talks about the issue. “Procedures are reviewed by other scientists as well as local community members that serve on institutional animal care and use committees,” he explains.

Committee member Mike Wyss, PhD, FAPS, says he hopes to help members of Congress understand the rigorous peer review and oversight that is in place to ensure that research animals are only used when appropriate for the research question and are treated humanely.

INFORMING THE PUBLIC

In addition to conducting high-level advocacy at the federal level, committee members seek opportunities to engage in advocacy every

day. ACE Committee Chair Sonnet Jonker, PhD, FAPS, shares her experience telling a new friend about her research on fetal heart development. While the person initially expressed reservations about the use of animals in research, Jonker noticed how her perspective shifted as she heard about how Jonker’s research might someday benefit babies—and that the research can’t be carried out in human pregnancies. “We definitely agreed that there are ethical issues to consider when working with animals, and that point of agreement served as a basis of common understanding for expanding the conversation,” Jonker says.

Corey Reynolds, PhD, a former committee member, agrees: “People don’t consider that many of the products, medications and procedures that they use or take part in are tested out in animal models during pre-clinical studies.”

When people have the opportunity to learn how human disease can be modeled in animals, allowing scientists to develop medications to help keep humans well, they begin to understand the importance of animal research. As a Black physiologist, Reynolds finds that he isn’t who people typically think of when they picture an animal researcher or physiologist. This is part of his motivation for sharing his perspective: “I will talk to anyone who will listen—

ranging from a kid in an elementary school, a person on the street, to a staff member in a congressional office—about how and why animal research is conducted and its importance.”

THE POLICY LANDSCAPE

The ACE Committee also addresses the policy landscape that exists to regulate the use of animals in federally funded research. Finding consensus on policy issues and bringing together stakeholders is a key part of the committee’s work. During his time on the

research projects spend 42% of their time on administrative tasks related to the project, rather than research. Working directly with federal agencies, ACE Committee members provide input on how policies affect the research community and what steps can be taken to minimize administrative and regulatory burden while still ensuring high standards.

As scientific technologies progress, there are increasing calls to replace animal research with other methods, including in vitro

“People don’t consider that many of the products, medications and procedures that they use or take part in are tested out in animal models during pre-clinical studies.”

—Corey Reynolds, PhD

committee, Wyss hopes to address a “weakness in constructive communications and interactions among researchers, regulators, veterinarians and politicians.” Haywood adds that the documents generated by the committee provide critical policy guidance for institutions and agencies.

While regulations provide crucial safeguards, compliance with excessive or duplicative regulations diverts time and resources that could be more effectively spent. A 2009 survey conducted by the Federal Demonstration Partnership reported that faculty who work on federally funded

techniques, computational models and newer technologies such as organs-on-a-chip. Physiologists across disciplines work deliberately to make wise use of resources and identify the best methods to answer the research question at hand, and the result is often a combination of approaches. APS continues to advocate for animal research as a crucial resource for answering scientific questions about complex biological systems. To read more about how physiologists think about animal research, see “The Elephant (and Mouse) in the Room” on page 24. 🐘

RESEARCH FIZZ



Dysregulation of endocytic machinery and ACE2 in small airways of smokers and COPD patients can augment their susceptibility to SARS-CoV-2 (COVID-19) infections

Compromised airways of people who smoke and have chronic obstructive pulmonary disease (COPD) can increase their susceptibility to COVID-19 infection.

American Journal of Physiology-Lung Cellular and Molecular Physiology, January 2021

<https://doi.org/10.1152/ajplung.00437.2020>

STATS & FACTS

#1

Chronic pain is the top cause of disability and disease burden worldwide.

British Journal of Anaesthesia

RESEARCH FIZZ

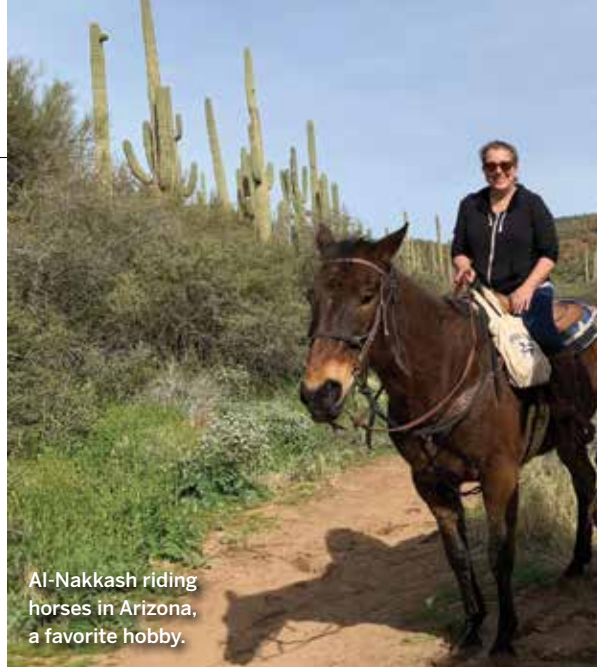


Vascular alterations among young adults with SARS-CoV-2

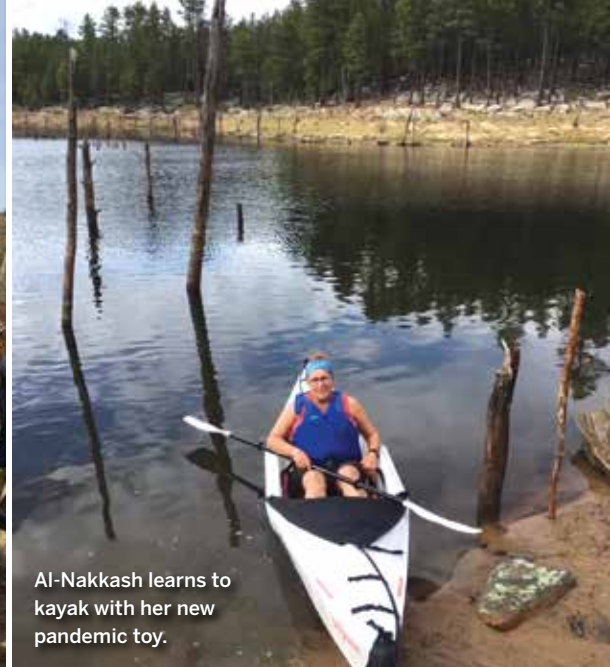
Young adults who were previously infected with SARS-CoV-2 continued to have impaired blood vessel function after recovery.

American Journal of Physiology-Heart and Circulatory Physiology, January 2021

<https://doi.org/10.1152/ajpheart.00897.2020>



Al-Nakkash riding horses in Arizona, a favorite hobby.



Al-Nakkash learns to kayak with her new pandemic toy.

UNDER THE MICROSCOPE

Rapid Fire Q&A

Layla Al-Nakkash, PhD, shares the lab story of how she met her husband, techniques she's proud to have mastered and her delicious guilty pleasures.

Q: What do people call you?

A: Dr. A. (students at work), the General (close friends).

Q: What inspired you to become a scientist?

A: Working with my awesome mentors and peers during my undergrad and PhD at the University of Newcastle upon Tyne in England. Those formative years really shaped an interest in physiological science and collaborating.

Q: "Old school" technique you're most proud of mastering?

A: The Ussing chamber. It's a lab favorite of mine—instant results and very satisfying.

Q: Most challenging laboratory technique you've learned to use?

A: The gastrointestinal motility system: Segments of intestine are isolated, placed in a circulating bathing medium and

video recorded. The analysis is the tricky part.

Q: Items on your lab bench that you are most possessive of?

A: I have a special small volume pipette near my Ussing chamber (few folks in the lab notice it's there, and I'm OK with that!) and my dissecting tools (those forceps get blunt and broken super easily).

Q: Favorite lab mishap story that you can share without incriminating the innocent?

A: This story isn't so much a mishap, but a funny story related to lab access: When I was a research assistant professor at the University of Missouri-Columbia I would work late evenings, and there was often this knocking on the outer building door. This certain grad student never had his keys and I'd always let him in the building—he worked down the hall in another lab—and he's now my husband!

Q: Best "MacGyver" moment in the lab?

A: Using Gorilla glue to seal up a cracked SureLock western blot chamber when it was leaking. It worked really well!

Q: If you could meet any scientist (living or dead) who would it be and why?

A: Henry Carter—an unsung hero from the text "Gray's Anatomy." He created these masterpiece gorgeous drawings that changed the teaching of anatomy. He didn't get dual headline status for the work.

Q: What do you wish the general public understood about science or research?

A: Science and research are fluid, ever evolving and oftentimes slow processes. Patience and trust are key. Just because they are modified over time, doesn't mean the original data were wrong; it's just perhaps we have better tools and more data to address the same questions.

Q: No. 1 guilty pleasure?

A: Chocolate (Cadburys, made in England of course). I do enjoy baking though, and I'm always inspired by

"The Great British Baking Show." Of course, cheese and crackers are always a go-to snack—all with a nice glass or two of prosecco!

Q: Tell us a surprising fact about you.

A: I'm half Iraqi-half British. A lot of folks think my surname is from marriage, but it's not. It's my family name and my heritage. Other fact: I like to quilt. I enjoy making two-sided reversible quilts as gifts.

Q: Favorite part of your job?

A: Students. Either witnessing those "a-ha" moments in lab as they learn a new technique and can troubleshoot and generate their own data (very cool) or teaching and helping students learn complicated topics in lecture by breaking it down into easily understandable units.

Q: How would you describe your job to a child?

A: I teach students how to be good doctors, to know how the body works.

Q: First place you want to visit once pandemic-related travel restrictions are lifted?

A: Back home to the U.K. I haven't seen my family for two years (which is way too long), and we are going this year. 🐾

Layla Al-Nakkash, PhD, is a professor and chair of the Department of Physiology in the College of Graduate Studies at Midwestern University, in Glendale, Arizona. She is also the medical physiology course director. She earned her PhD at University of Newcastle upon Tyne in the U.K. and completed her postdoctoral work at Case Western Reserve University in Cleveland, Ohio, and at the University of Missouri-Columbia.



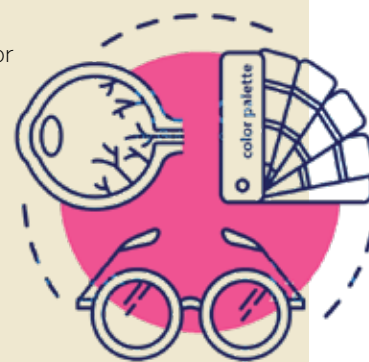
Al-Nakkash hikes with her husband, Greg, and their two puppies, Tess and Esme.

PUBLISH WITH POLISH | IMAGE ACCESSIBILITY

How to Make Figures User-Friendly for Colorblind Readers

APS strives to make its content accessible to all readers. According to the American Academy of Ophthalmology, color blindness affects 8% of men and 0.5% of women (with protanopia type more common than deuteranopia type), so we encourage all authors to make their figures user-friendly to colorblind readers.

One easy method is to avoid a green and red color palette in favor of a green and magenta palette or a combination of varying shapes, patterns, grayscale and line types. If problematic color schemes such as red and green must be used, be sure to leverage alternate methods, such as using light versus dark colors, to distinguish data. Color names and data values should also be clearly stated in figures when colors are mentioned within the text of your manuscript.



Online resources such as ColorBrewer and Coolers can assist in choosing a colorblind-friendly color palette. Authors may also upload completed figures to the Coblis Color Blindness Simulator (<https://bit.ly/ColorBlindnessSimulator>) to mimic different viewing scenarios and ensure readability.

Photoshop users may also test color figures for both types of color blindness by opening the figure in Photoshop and then choosing view, proof setup, color blindness-protanopia-type and then view, proof setup, colorblindness-deutanopia-type.

For more information, visit the "Use of Color for Data Presentation" section on the APS journals website at https://bit.ly/Preparing_Figures.

As always, be sure to reach out to APS journal supervisors and art editors if you have any questions or need any assistance in preparing your manuscript. 🐾

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DRIVEN BY DISCOVERY

Whether decoding the mysteries of the extracellular matrix or reviewing data for journals, Liliana Schaefer, MD, draws inspiration from the unknown.

BY RENEE BRINCKS





Schaefer's lab team prepares samples for mass spectrometry. Schaefer says she's excited that they will soon know all the binding partners of the newly identified autophagy receptor.

In July 2021, Liliana Schaefer, MD, started her work as editor-in-chief of the *American Journal of Physiology-Cell Physiology* (AJP-Cell). She included in her welcome letter to journal readers a favorite quote from pioneering scientist Marie Curie.

"I am among those who think that science has great beauty," says the passage from Curie, who won 1903 and 1911 Nobel Prizes for her work in physics and chemistry. "A scientist in his laboratory is not only a technician: He is also a child placed before natural phenomena which impress him like a fairy tale."

Schaefer is a pharmacology professor at the Institute of Pharmacology and Toxicology at Goethe University in Frankfurt/Main, Germany, and an adjunct research professor of pathology, anatomy and cell biology at Thomas Jefferson University in Philadelphia. Her own fascination with scientific discovery—"the

beauty of the unexpected," as she describes it—fuels her research interests in renal and lung inflammation, fibrosis and innate immunity.

Schaefer shaped the field of matrix biology when she determined that decorin and biglycan, two small leucine-rich proteoglycans, act as endogenous danger signals when soluble in the blood or released from the extracellular matrix by proteolytic enzymes. The two molecules can trigger inflammatory response reactions when recognized by innate immunity receptors.

With this knowledge, Schaefer and other researchers are working to clarify the mechanisms of inflammation and

autophagy triggered by the extracellular matrix. Over time, these discoveries could inform how medical teams treat conditions that affect the heart, kidneys, liver, lungs and other organs.

FROM PATIENT CARE TO PROTEOGLYCANS

Schaefer grew up in western Poland, where her parents were professors at the University of Poznan. As a student, she excelled at math and science and decided to pursue a medical career that combined those interests while also connecting her with people. Schaefer was studying medicine at the University of Poznan when a professor recognized her aptitude and encouraged her to apply for a scholarship that took her to Germany. She completed her medical degree at the University of Wuerzburg and later participated in postdoctoral research at the University of Wuerzburg and University of Muenster.



Schaefer discusses their newly published paper with her team.

“At one time, we didn’t understand how you could have no bacteria and no pathogens but still have inflammation. Now, we are better able to imagine this. With this understanding, we can also intervene in the signaling process and create new therapies.”

Though trading patient care for lab research required a shift in focus, Schaefer enjoyed the challenge. “It was a pretty difficult time, when I first went to the laboratory, but what is difficult also makes you strong. I quickly learned the techniques and I liked the work,” she says.

While in Muenster, Schaefer met some matrix researchers focused on proteoglycans. The glycanated proteins are found in the extracellular

matrix of the body’s connective tissue. “This became my passion,” Schaefer says. “The extracellular matrix was always considered as the static scaffold necessary for structuring and maintaining cells. We were the first lab to show that some components of the extracellular matrix, when released from the matrix because of stress or injury, bind to the toll-like receptors like pathogens and trigger sterile inflammation.”

Schaefer’s discovery took the research community by surprise, but as contemporaries reviewed and embraced her data, the findings significantly changed the general understanding of matrix biology.

“At one time, we didn’t understand how you could have no bacteria and no pathogens but still have inflammation. Now, we are better able to imagine this. With this understanding, we can also intervene in

“I tell students and scientists to always think big. If you look only at dogma, you will never find anything new. And, if you have strong data, believe in it. Don’t be afraid to continue the research. This is how you make new discoveries.”

the signaling process and create new therapies,” Schaefer says. “Before, we only treated these inflammatory diseases with steroids. That might not always be the best way. With this specific targeting of proteoglycan binding co-receptors for toll-like receptors, we’re trying to not switch off the innate immunity but to block matrix-signaling selectively. Blocking innate immunity receptors means we can’t always be protected from pathogens. Instead, we’re working to block the binding side of proteoglycans to co-receptors of toll-like receptors.”

photos, pages 22-23, courtesy Liliana Schaefer, MD



In 2007, Schaefer and her team celebrate their first publication generated in their Frankfurt laboratory.

Today, in her Frankfurt lab, Schaefer and a team of six colleagues continue to study proteoglycans and the mechanics of inflammation. Outside the lab, she has forged a path in publishing. Schaefer wants to advance scientific knowledge

Top, Schaefer in her favorite flower shop in Frankfurt. Her No. 1 way to relax is to buy single flowers and make an unusual composition. Bottom, Schaefer says her best publications were written in her friend's garden in Provence, France.



while also expanding opportunities to a wider research community.

"I realize as an author that it is very important to get a professional review of your paper from knowledgeable colleagues. In my first paper about the danger signals in cells, the review process brought new ideas to my research," she says. "I decided that if people have helped me, I also want to help younger colleagues and other researchers."

ENCOURAGING DIVERSITY IN RESEARCH AND PUBLISHING

For her first foray into editorial work, Schaefer reviewed extracellular matrix submissions for the *Journal of Biological Chemistry*. From there, she became deputy editor of *Matrix Biology* and *Matrix Biology Plus* and deputy editor of *Cellular Signalling*. Over the past 15 years, she has also done editorial work for the *Journal of Histochemistry & Cytochemistry*, *FASEB BioAdvances* and other peer-reviewed titles.

In her new role with *AJP-Cell*, she's tapping into a network built while serving as the president of the Histochemical Society, chair of the 2022 Gordon Research Conference on Proteoglycans, past president of the International Society for Matrix Biology and an active member of several other professional associations. Since heading up *AJP-Cell*, she has welcomed an associate editor from Peking University in Beijing. She is also seeking manuscript submissions and editorial board participation from professionals in Asia, Europe, South America and beyond.

"We have wonderful scientists in China, in Japan, in Australia, in New Zealand, but those scientists are not represented in as many journals. We don't always understand their grant opportunities and their university situations, and I'm working to change that.

Their research is important, and people are happy to be involved," she says.

In addition to introducing greater geographic diversity to the journal, Schaefer is inviting early-stage researchers to engage in *AJP-Cell* opportunities. This is an extension of her teaching work. After presenting guest lectures, she often hears from students who want to discuss their data or apply to work in her lab. She appreciates their ideas and enthusiasm and encourages them to approach their work with confidence.

"I tell students and scientists to always think big. If you look only at dogma, you will never find anything new. And, if you have strong data, believe in it. Don't be afraid to continue the research. This is how you make new discoveries," she says. "Frequently, students in my lab send me their data for review. They sometimes say, 'Look at this. I'm sure there is no mistake, but these results just can't be.' I tell them that their findings always have a reason. The challenge is to uncover that reason."

While her own research findings have made a lasting impact in the field of cellular physiology, Schaefer considers her efforts to promote and boost the field to be as meaningful.

"In terms of my biggest impact, you could think about single findings, but I don't think they are the most important," she says. "Over many years, I have been a strong ambassador to other scientists, authors and young people coming into the field. It's important to be known for your enthusiasm and dedication and to be known as a person who does many things in parallel. By focusing those various efforts in one direction, you help to move research forward." 🐾

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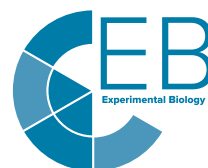


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April 3, 2022

Lecture Title TBD

Bodil M. Schmidt-Nielsen Distinguished Mentor and Scientist Award

12:15–1:15 p.m. EDT *Suzanne Moenter, PhD, University of Michigan at Ann Arbor*

Physiology in the Anthropocene: Insights from Intraspecific Variation in Response to Environmental Stressors

August Krogh Distinguished Lectureship

1:30–3 p.m. EDT *Patricia M. Schulte, PhD, University of British Columbia, Canada*

The Climate Change Within: Microbiota and Metabolites

Ernest H. Starling Distinguished Lectureship

1:30–3 p.m. EDT *Bina Joe, PhD, University of Toledo, Ohio*

Aldosterone Versus Potassium: A Battle for Control of the Distal Nephron

Carl W. Gottschalk Distinguished Lectureship

3:30–5 p.m. EDT *Robert A. Fenton, PhD, Aarhus University, Denmark*

Tissue Metabolism in Mucosal Inflammation: The Paradox of Hypoxia

Horace W. Davenport Distinguished Lectureship

3:30–5 p.m. EDT *Sean Cogan, PhD, University of Colorado, Aurora*

Exploring the Extracellular Matrix: From Outside to Inside and Back Again

Hugh Davson Distinguished Lectureship

3:30–5 p.m. EDT *Josephine C. Adams, PhD, University of Bristol, United Kingdom*

Heart Failure as an Immune Mediated Disease

Robert M. Berne Distinguished Lectureship

3:30–5 p.m. EDT *Sumanth D. Prabhu, MD, Washington University School of Medicine, St. Louis, Missouri*

An Ode to Signal Transduction: How the Growth Hormone Pathway Revealed Insight into Height, Malignancy and Obesity

Physiology in Perspective: The Walter B. Cannon Award

5:40–6:30 p.m. EDT *Christin Carter-Su, PhD, University of Michigan at Ann Arbor*

April 4, 2022

Lecture Title TBD

2022 Annual Marion J. Siegman Lectureship Award

8:30–10 a.m. EDT *Award Recipient TBD*



The Baroreceptor Reflex from Sensors to Sympathetics: A Historical and Personal Perspective

Carl Ludwig Distinguished Lectureship

1:30–3 p.m. EDT Mark W. Chapleau, PhD, FAPS, University of Iowa Carver College of Medicine, Iowa City

How Random Events Altered My Career

Claude Bernard Distinguished Lectureship

1:30–3 p.m. EDT Robert L. Hester, PhD, FAPS, University of Mississippi Medical Center, Jackson

The Symmorphosis of Aerobic Capacity in Health and Disease: Reason to Dys the Sym?

Edward F. Adolph Distinguished Lectureship

1:30–3 p.m. EDT Russell Richardson, PhD, University of Utah, Salt Lake City

Stress, Sex and Coping Strategies: Where Erlanger's Oscilloscope Took Me

Joseph Erlanger Distinguished Lectureship

3:30–5 p.m. EDT Rita Valentino, PhD, National Institutes of Health, Bethesda, Maryland

A Stem Cell Odyssey

Soloman A. Berson Distinguished Lectureship

3:30–5 p.m. EDT Jeanne Loring, PhD, Scripps Research Institute, La Jolla, California

Lecture Title TBD

Henry Pickering Bowditch Award

5:40–6:30 p.m. EDT Emilyn Alejandro, PhD, University of Minnesota, Minneapolis

April 5, 2022

Skeletal Muscle Microcirculation: Misconceptions and Missed Perceptions

History of Physiology Lecture

1:30–3 p.m. EDT David Poole, PhD, Kansas State University, Manhattan

An Unexpected Journey Through Channels of Pulmonary Vascular Physiology

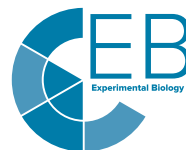
Julius H. Comroe, Jr. Distinguished Lectureship

1:30–3 p.m. EDT Larissa Akimi Shimoda, PhD, Johns Hopkins School of Medicine, Baltimore, Maryland





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2022 PHILADELPHIA
APRIL 2–5

Presidential Symposium Series

Circadian Physiology

April 3, 2022 | 8:30–10 a.m. EDT

New advances in the mechanisms controlling the timing of physiological outcomes and the consequences of mistiming.

Stress Mediated Disease Risk and Disease Resilience

April 4, 2022 | 8:30–10 a.m. EDT

How the endothelium orchestrates integrated physiological responses and its importance.

The Endothelium and Integration of Physiology Responses

April 4, 2022 | 8:30–10 a.m. EDT

Novel concepts of stress and physiological consequences.

APS Nobel Lecture

Edvard Ingjald Moser, PhD

April 5, 2022

5:40–6:30 p.m. EDT

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THE ELEPHANT (AND MOUSE) IN THE ROOM

Educating the public about the vital role animals play in research can be daunting, but it must be done.

BY CHRISTINE YU

Eryn Dixon, PhD, describes herself as a non-confrontational person. The postdoctoral research scholar at Washington University School of Medicine in St. Louis doesn't normally like to go toe-to-toe with someone, especially when it comes to controversial subjects. It's in part why she didn't always share that her lab research involved working with animals. She would sidestep the topic if she could, simply saying she studied kidney disease but not mentioning exactly how she investigated it. If she talked about her cell model, she would omit the fact that the cells were derived from mice. She wanted to avoid heated debates.



Scientists are often caught in a precarious position; they must balance the urgency of finding scientific and medical breakthroughs that could advance health with the public's discomfort with animal research.

But a visit to Capitol Hill in 2018 changed her mind. As a member of the American Physiological Society's Animal Care and Experimentation (ACE) Committee, Dixon and her colleagues were in Washington, DC, to talk with congressional staff members about the role animals play in advancing the understanding of health and disease in both humans and animals. During one conversation, a staff member remarked that if scientists involved animals in their biomedical research studies they must hate animals.

Dixon was taken aback, shocked by the assumption that scientists lacked human emotion and empathy for other living beings and by the inadequate understanding of the scientific process. Yet, at the same time, she understood where some of those misconceptions came from.

Dixon is an animal lover. She grew up in rural West Virginia surrounded by dogs, cats, rabbits, birds and horses. Her initial perception of animal research was largely influenced by negative portrayals of the practice in the media. Family members and friends had mixed feelings about it, too. "The research aspect was kind of scary," she says.

When Dixon entered graduate school at the University of Maryland, Baltimore, she wanted to avoid using animal models. Yet, as her graduate studies progressed, Dixon's perspective changed as she saw firsthand that

animals were indispensable to understanding disease pathways.

For her dissertation project, she worked on an in vitro model system for cyst formation in polycystic kidney disease. "The kidney is so cellularly complex that at this point, even with all the technology we have, we are unable to model it in culture," she says. There are so many variables to take into account—not just how cells, tissues and organs communicate with each other but also how whole-body factors, such as hormones, circadian rhythms and metabolism, can influence those interactions. "We still need these animal models to push our understanding of the kidney or any other organ forward," she says. And that understanding is not only vital for improving human health but animal health, too.

But it was the experience on Capitol Hill that lit a spark in Dixon. She knew she had to speak more openly about how and why animals are involved in research. "I need to be able to talk about this because if people don't know what we're doing and it's not normalized, then there's still going to be this huge barrier between the public and the biomedical research community," as well as continued misinformation, she says.

According to a 2018 survey from the Pew Research Center, Americans are split on animal research, with 52% of Americans opposed to it. Within the current political environment, the

scientific establishment continues to come under attack, seeming to lose the public relations battle around animal research. Animal activist groups persist in winning favor among politicians and threaten to stymie research efforts, claiming that the practice is cruel, unnecessary, a waste of money and doesn't lead to meaningful treatments.

Across the scientific community, institutions, universities and scientists recognize that they need to do a better job engaging and educating the public and politicians about the vital role animals play in biomedical research. Yet, scientists are often caught in a precarious position; they must balance the urgency of finding scientific and medical breakthroughs that could advance health with the public's discomfort with animal research. It's an emotionally laden topic, one that can land scientists on the radar of activists. And, it can be overwhelming at times.

A PUBLIC RELATIONS PROBLEM

Scientists don't just have to square their personal feelings for animals with the need to advance science. They must also contend with a general public that has mixed feelings about animal research.

Part of the problem is that the public doesn't have a good grasp on how animal research builds the foundation of basic science and helps researchers understand living systems. Those

basic science findings have led to virtually every major medical breakthrough—treatments, vaccines, surgical interventions and diagnostic procedures that people depend on. “There’s this tremendously long pipeline that occurs before you get a medication in a bottle, and key portions of that process involve animals,” says Jim Newman, director of strategic communications for Americans for Medical Progress.

Take the mRNA COVID-19 vaccines, for example. While the vaccines were developed and approved in record time, they were built on several decades of research with animals, points out Jeff Henegar, PhD, director of animal care and quality assurance and the Office of Animal Resources at the University of Missouri in Columbia. Those proof-of-concept studies showed that mRNA technology works, which then allowed scientists to apply it to a new context and fast-track the vaccines.

But when it comes to discussing the pros and cons of animal research, scientists aren’t the loudest voice. “We scientists don’t do as good a job as we could promoting what we actually do and how what we’re studying is important to the human condition or to the animal condition,” Henegar says. Instead, activists and animal rights groups have stepped into the informational void and have defined animal research on their own terms.

“They deliberately craft a message intended to horrify you,” says Cindy Buckmaster, PhD, director of public outreach for the National Animal Interest Alliance and host of the GetReal! podcast. “The full context is deliberately left out so that your imagination can fill in the blanks using their half-truths, overstatements and outright fabrications.”

Now, when scientists try to counter the narrative, they face an uphill battle. The scientific community’s reticence to discuss animal research

has largely been in response to tactics used by activist groups opposed to animal research. “In the late 1990s and early 2000s, the animal activists were directly targeting individuals by harassing people at home, and they even damaged property by setting fires, flooding homes and using graffiti to intimidate and frighten scientists,” says

Paula Clifford, executive director of Americans for Medical Progress.

When Clifford attended conferences earlier in her career as a veterinary technician, she was advised to remove her nametag when leaving the conference hall and not talk to protesters to avoid being a potential target. Today, groups continue to protest in front of

A Balancing Act

When scientists choose to work with animals, they don’t take the decision lightly. “I feel pretty certain that most scientists wouldn’t use animals if we didn’t need to,” says Jeff Henegar, PhD, director of animal care and quality assurance and the Office of Animal Resources at the University of Missouri in Columbia. But to understand how living systems work—the cellular mechanisms and pathways that drive health and disease, which could lead to new treatments—scientists need to study living systems. And right now, there is no complete replacement for a living biological organism.

Before moving forward with an animal study, scientists must consider several questions: Do we need to perform this experiment? Will the results move science and medicine forward? Are animals the best next step to investigate this specific research question? Are there alternatives we could use instead? Do we have enough evidence from studies in cells or tissues that would justify working with animals? If so, what’s the right animal model to use?

“We always have to think if the outcomes will be translatable to another species or to humans,” Henegar says. For example, while mice are one of the most common laboratory animals, they’re not always the best fit. In some cases, pigs, sheep, primates or other animals might more closely resemble the human systems scientists are trying to understand.

There’s also the question of how many animals to include in a study.

Larry Suva, PhD, professor and head of the Department of Veterinary Physiology and Pharmacology at Texas A&M University, says all animal use procedures are built around using the smallest number of animals possible to answer the specific research question. While scientists don’t want to use a single animal more than they have to, they can’t use too few either. They need a big enough sample size to generate statistically valid results.

Most importantly, researchers must balance animal welfare with the needs of science and must justify every step of their research methodology. They are helped in this process by the institution’s institutional animal care and use committee, which reviews every study’s animal use protocol to make certain that the use of animals is warranted, ethical and humane. These are standing committees mandated by federal laws, such as the Animal Welfare Act, and policies, such as the Public Health Service Policy, and are required for federal funding.

There are several factors for researchers to consider: How will they, along with specially trained veterinarians and laboratory animal science professionals, ensure they meet all of the animal’s needs—physical, nutritional, environment and social enrichment? What protocols, such as the use of anesthesia and other measures, are in place to reduce pain and distress? At what point, if any, would animals be euthanized? While it can be an onerous process, Suva says scientists should be forced to think through every last detail thoroughly because “you don’t want to mess this up.”



“We scientists don’t do as good a job as we could promoting what we actually do and how what we’re studying is important to the human condition or to the animal condition.”

—Jeff Henegar, PhD

some scientists’ homes and workplaces and bombard neighbors and colleagues with phone calls and emails. The fear of backlash has led some institutions to discourage scientists from speaking openly about their work.

Despite their passion for their research, there’s the very real possibility that scientists and veterinary care staff will opt out of the profession. They have to weigh the mental health costs along with their passion for their work. Larry Suva, PhD, professor and head of the Department of Veterinary Physiology and Pharmacology at Texas A&M University, shares the story of a colleague who became a target of an activist group’s campaign a decade ago: “It has negatively impacted her research productivity because she was nervous and afraid of what might happen if she continued to do this work,” he says. “She’s traumatized. She’s fantastic, smart as heck, and that’s a loss.”

“If we continue to let the opponents define what we do, then [animal research] won’t occur much longer,” Newman says. If harassment from activist groups is allowed to continue, Buckmaster worries it will drive animal studies to other countries where protections aren’t as stringent, potentially jeopardizing the safety and well-being of the animals themselves.

A WAY FORWARD

Despite the challenging times, the pendulum is starting to swing the other direction. And it needs to. Henegar

says without animal research, “We will lose a ton of time to get to that next solution to a medical problem,” the therapeutics that the public demands for themselves, their family and their pets.

If the goal is a kind, humane and ethical biomedical research system that supports stronger science, faster cures and fewer animals, there is a way forward. Buckmaster says it involves all parties—including activists if their goal is truly to protect animals and improve science and human health—coming to the table in good faith to develop a comprehensive strategy.

It should include deliberate investment in non-animal alternatives, such as tissue-on-a-chip, mathematical models or computer simulations that have valid, predictive value. While researchers agree that these methods can’t completely mimic the complexity of living systems, they can be used to answer questions about biological pathways or as a screening tool. In doing so, it could help reduce the number of animals involved in research.

In the lab where Dixon is conducting her postdoctoral research, scientists are creating public catalogs of genetic information based on their research. This collaborative, open-science platform could also reduce the use of animals and streamline the research process. “They don’t have to redo the models, redo the sequencing, redo the analysis. It’s all right there, and they can use it,” she says.

Clifford believes there’s an opportunity for the scientific community to close the information gap with more education and outreach to the general public and politicians about the why, when and how of animal research. But scientists also need more support and training so that they feel comfortable speaking about their work in simple, compelling ways.

Most importantly, the public deserves transparency. “They absolutely should know how I’m spending their taxpayer dollars on my federally funded research and am I doing anything to animals that’s inappropriate,” Suva says.

The research community has an animal research openness initiative designed to help more institutions contribute to meaningful conversations with the public about their work with animals. There are formal agreements in place in several countries in Europe, such as the Concordat on Openness on Animal Research in the U.K., and in New Zealand. A group in the U.S. is working on something similar.

Ultimately, it’s a group effort to protect and advance animal research, one that needs to involve scientists, universities, drug companies and public health officials.

“We really respect the opportunity that we have to do this because we know it’s important work,” Dixon says. 🐾

APS Career Gateway

Succeed at Every Step of Your Physiology Career

Now live! The American Physiological Society (APS) has launched Career Gateway—a new member resource to enhance your professional skill set. Find streamlined access to critical leadership and career advancement content designed to round out your scientific expertise. Resources include tips on:

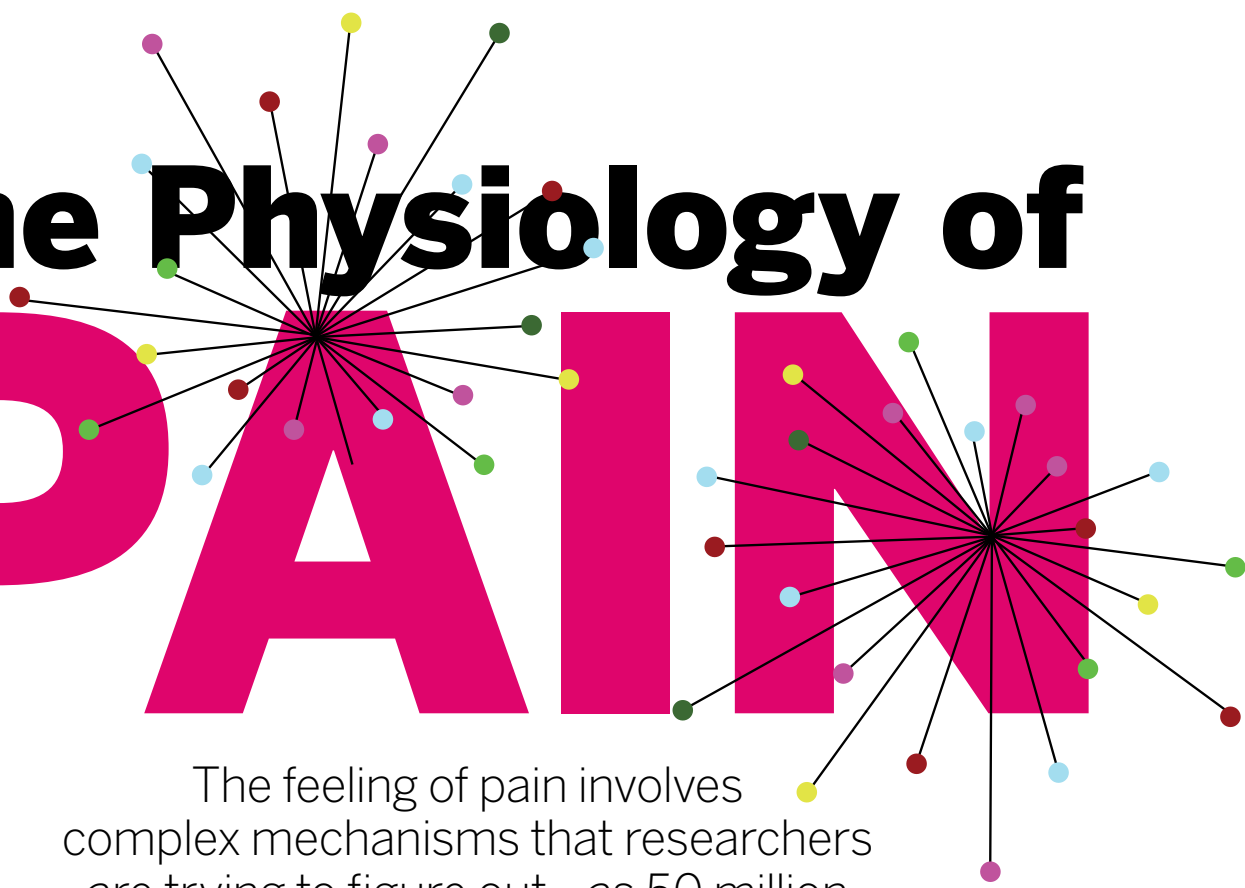
- leading and managing a team,
- funding and communicating your science,
- intentionally designing your career,
- teaching and mentoring today's students, and
- maintaining scientific integrity.

APS provides professional development for every step of your career journey. Access the Gateway and start moving forward.

Access these critical resources at
physiology.org/careergateway







The Physiology of **PAIN**

The feeling of pain involves complex mechanisms that researchers are trying to figure out—as 50 million people in the U.S. continue to suffer from chronic pain.

BY LAUREN ARCURI

Pain is a universal human experience, one that is protective at its core: Acute pain warns us of harm and prevents us from damaging our bodies, or limits that damage. We experience pain as unpleasant, and it generally signals us to move away from a dangerous situation or stimuli. Acute pain often disappears fairly quickly once we're safe.

But acute pain doesn't always resolve as expected, especially if it's part of a disease process or begins with an injury that isn't treated appropriately and swiftly. An estimated 20% of the U.S. population—50 million people—suffered from chronic pain in 2016, according to the Centers for Disease Control and Prevention (CDC). And, that number may have increased during the pandemic.



Chronic pain is one of the most common reasons U.S. adults seek medical treatment. The lack of adequate medical treatment for chronic pain is also a catalyst that fuels the ongoing “opioid epidemic,” a massive increase in addiction to prescription and/or illegal opioids and the cause of more than 100,000 overdose deaths in 2021, according to the CDC (see sidebar on page 33).

Researchers are working hard to understand the complex mechanisms that underlie our experience of pain. According to the International Association for the Study of Pain,

“In my laboratory, our overarching concept is that chronic pain pathology involves not only a foot stuck on the accelerator, but also a dysfunction with the brake—the inhibitory system.”

—Bradley Taylor, PhD



pain is defined as an “unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage.” There are three types of pain classified by cause.

The pain you feel when you stub your toe or put your hand on a hot pan is called nociceptive pain. A sensory neuron—or nociceptor—transmits an electrical impulse to the spinal cord and then to the brain, where it is experienced as pain.

Inflammatory pain results from infection or tissue injury, leading to activation of the immune system. The body produces proinflammatory mediator molecules that include

cytokines, chemokines, nerve growth factors and more. Both of these types of pain are protective.

The third type, pathological pain, is not protective and often results from peripheral nerve damage. “In some cases of neuropathy, nerves begin to fire spontaneously, leading to pain sensation in the absence of a stimulus. In other forms of dysfunctional pain after nerve injury, the central nervous system relays pain messages to the brain, regardless of input from peripheral nerves,” says Bradley Taylor, PhD, professor of anesthesiology at the University of Pittsburgh.

Our experience of pain is often described as made up of two components, Taylor says. One is a sensory component where the noxious stimulus—anything from a bee sting to hitting your elbow on a doorjamb—activates nociceptors in the skin. Or, if the stimulus comes from inside the body, receptors within the organ or area of injury are activated, leading to electrical impulses that travel first to the spinal cord and then up to the brain.

The spinal cord isn’t a mere relay station for the electrical input. “Really, there’s a lot going on in the spinal cord before it sends the brain signals that are rich in information,” Taylor explains.

The second component of pain is affective and cognitive in nature, where the brain experiences the sensation of pain as something unpleasant, a form of suffering. While this experience is generated in the brain, it’s influenced by the specific nature of the message it receives from the spinal cord, according to Steve Prescott, MD, PhD, professor at the Hospital for Sick Children and University of Toronto in Canada. “Pain is a really multidimensional experience, and while your experience of the emotional component of it is dependent on cortical

processing, it's typically triggered by sensory input from the periphery," he says.

CHRONIC PAIN: A CENTRAL NERVOUS SYSTEM GONE AWRY

According to the World Health Organization's International Classification of Diseases, chronic pain is pain that lasts more than three months. Our pain systems become sensitized for days to weeks as we heal from an injury. "There's inflammation around the tissues and they experience pain from even light touch or movement," Taylor says.

Sometimes those sensitization processes don't go away and the person is in a state of chronic pain hypersensitivity. Some chronic pain sufferers experience pain even in the absence of touch or movement, Taylor adds. The induction of pain by a normally innocuous stimulus is the major problem that people who have chronic pain experience.

When pain persists after an injury or infection has healed, changes in the central nervous system may have occurred. "It's somewhat controversial, but I'm a firm believer that chronic pain can exist completely

in the central nervous system," Taylor says. In these cases, pain is no longer driven by nerves at the site of the initial injury, but instead by pathological changes in the brain or spinal cord.

"I believe that the pain experience is governed in a very homeostatic fashion," Taylor says. "There are excitatory systems that drive the initial response to pain and pain sensitivity, and there are very powerful endogenous inhibitory systems within the body that inhibit the pain experience. These work together as a rheostat." If inhibitory systems

Living with Chronic Pain during the Opioid 'Epidemic'

The overprescription of opioid drugs in the past several decades has led to a consensus against their routine use for chronic pain. "The consensus now is that if a patient comes to you and is diagnosed with chronic pain, or pain lasting more than three to six months, you don't want to start them on opioids," says Bradley Taylor, PhD, professor of anesthesiology at the University of Pittsburgh.

While that approach seems sound, what about chronic pain patients who have long used opioid medications to control their pain and who are not abusing them? Kelly Hills, a bioethicist in Boston, is one such patient. She's had complex regional pain syndrome for 17 years after several bad car crashes.

Hills' pain has been controlled on a relatively low dose of opioids, but she must jump through time-consuming hoops to continue her prescription, even though her care team agrees it is the best and only option for her. She's tried other appropriate possibilities, including physical therapy, aquatic therapy and

stellate ganglion blocks, in which a local anesthetic is injected into the stellate ganglion nerve in the neck.

To continue her pain relief, Hills must meet with her prescriber every three months, a pain psychiatrist twice a year and a separate chronic pain specialist once a year. And her refills aren't automatic even after nearly two decades: Every month she must request that her primary care physician refill the medication and hope that her pharmacy either has the prescriptions in stock or can get them in time for her to receive them without missing doses.

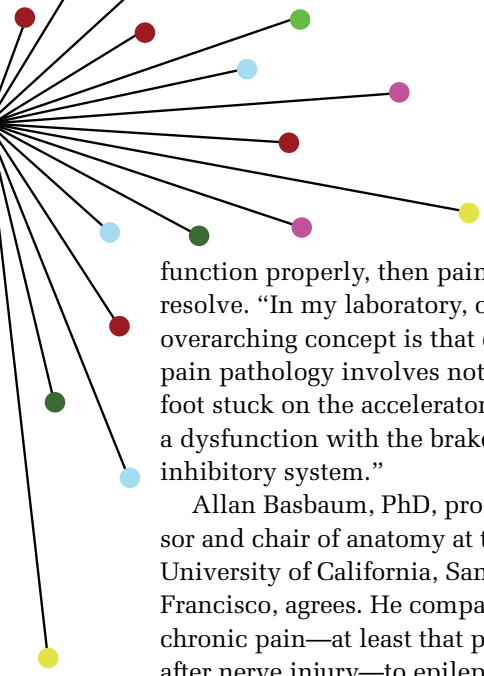
In an effort to curb overprescription of opioids, physicians must now participate in a prescription data monitoring plan, or PDMP, where all of their opioid prescribing must be compared against other physicians monthly. If a physician has too many chronic pain patients, they may have to justify their prescribing.

Taylor says that for some chronic pain patients who take opioids, it's important to recognize the significant damage that

can be done by forcing them off their medication. "While the consensus is that you don't want to start patients on opioids, if an established chronic pain patient has been taking opioid medications responsibly for a long time, then it may be best to just leave them be," he says. "In the absence of large-scale research trials indicating otherwise, we cannot rule out the possibility that opioids can manage their pain for long periods of time."

Hills feels the term "opioid epidemic" is a misnomer. "It creates this impression of a reality that doesn't really exist, that people get medications from their prescribers to sell them on the street. That's a really common misconception," she says. "It's really an 'overdose epidemic.' That's what people are concerned about. When we call it an opioid epidemic, we create a stigma around anyone who needs to use opioids for pain management."

"I think what most people miss is the idea that a war on opioids is a choice," she continues. "We are choosing to ignore disabled people who need pain management. And we could make life a whole lot better for a whole lot of people, if we just changed the way we thought about it."



function properly, then pain should resolve. “In my laboratory, our overarching concept is that chronic pain pathology involves not only a foot stuck on the accelerator, but also a dysfunction with the brake—the inhibitory system.”

Allan Basbaum, PhD, professor and chair of anatomy at the University of California, San Francisco, agrees. He compares chronic pain—at least that produced after nerve injury—to epilepsy, a disease process that involves a loss of inhibition in the cortex, which manifests as seizures. “In neuropathic pain, comparable changes occur,” he says. “There’s loss of inhibition at different levels, particularly in the spinal cord. There’s hyperexcitability. There’s new connections being made, new genes being induced—all these constitute features of the disease.”

Some cases of neuropathic pain occur after damage in the central nervous system (such as after spinal cord injury, post-stroke and in patients with multiple sclerosis). Here, the “disease” of pain is independent of inputs. In the case of neuropathic pain that is peripherally induced, such as in diabetic neuropathy where there is nerve damage, there is still a peripherally located driver of the pain, but “it’s now engaging an altered central nervous system,” Basbaum says.

Ru-Rong Ji, PhD, professor of anesthesiology at Duke University School of Medicine in Durham, North Carolina, believes that chronic pain may be caused by dysregulation of glial cells, the supportive nervous system cells that provide nutrition, immune support, insulation and protection to neurons. Glial cells include microglia and astrocytes, which are found throughout the spinal cord and brain and help maintain the homeostasis of the nervous system.

“The glial cells then produce inflammatory mediators, cytokines and chemokines that increase the intensity and amplitude of pain and enhance its duration.”

—Ru-Rong Ji, PhD

Ji and other researchers have found that during the transition stage from acute to chronic pain, there is activation of certain signal transduction pathways that involve glial cells. This activation switches them from their anti-inflammatory, supportive role to a pro-inflammatory one. The glial cells then produce inflammatory mediators, cytokines and chemokines that increase the intensity and amplitude of pain and enhance its duration, Ji says.

“It is a major shift in thinking that glia may be a driver of chronic pain,” he says. Glia in the central nervous system may underlie a specific type of central nervous system inflammation called neuroinflammation.

Those same glial cells seem also to contain the potential to resolve chronic pain. Resolvins are a specific family of mediator molecules that are part of the “brake” or inhibitory system. Enzymatically generated in glia from the polyunsaturated fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in fish oil, they are thought to be involved in the active phase of resolution of inflammation. “Resolvins are very exciting potential mediators,” Ji says. “They produce a very potent analgesic effect at much lower doses than morphine and without any side effects.”

NEW APPROACHES TO TREATING CHRONIC PAIN

Chronic pain is not just an extension of acute pain. The mechanisms underlying it are different. Thus, treating it merits a different approach: Instead of treating pain as a symptom by blocking the pain transmission pathway from periphery to brain, researchers hope to address the underlying disease process that is keeping the pain sensation alive. “We know that some treatments like non-steroidal anti-inflammatory drugs and opioids that are effective for acute pain only give transient mild relief for chronic pain, if at all, and may even make it worse in some cases,” Ji says. Steroids can reduce inflammation-induced pain temporarily, but they have potent side effects and can’t be used safely long-term. Steroids have also been shown to delay the resolution of inflammation.

The longer the chronic pain process continues, the more difficult it is to resolve. “We have started to ask: How can we promote resolution of recovery?” Ji says. “Neuromodulation and spinal cord stimulation have been used for years, but usually as a last resort. But neuromodulation can be extended to different regions—not just the spinal cord, but the dorsal root ganglia and peripheral nerves.

Vagus nerve stimulation can help control inflammation system-wide, and exercise can help modulate sympathetic tone.”

Ji believes that fish oil, which contains the precursors to resolvins, in concert with neuromodulation or exercise, can help the body produce resolvins and move toward a state of resolution of chronic pain. Treatments such as acupuncture have long worked to help resolve chronic pain, but now, Ji says, we have a better understanding why: They may reduce inflammation in the body.

Basbaum agrees that neuro-modulation has potential to treat chronic pain at its root, even though researchers don’t yet fully understand the mechanisms by which it works. “It’s hard to have a placebo-controlled trial because patients often can tell when they’re being stimulated. But some of these approaches, in particular dorsal root ganglion stimulation, have been remarkable for some patients,” he says. Transcranial magnetic stimulation of the motor cortex also works in many cases. “Why would you stimulate the motor cortex to relieve pain? Stimulating the somatosensory cortex doesn’t work, but the motor cortex does. How does it work? We don’t really know,” he says.

These approaches have the potential not just to relieve ongoing pain, but also to reverse dysregulation and promote pain resolution.

Taylor’s lab studies how interconnections between interneurons in the dorsal horn of the spinal cord can change after injury. “The changes in circuitry may explain the transition from acute pain to chronic pain,” he says. The lab has focused on a neuropeptide receptor system that they think may be a potential target for chronic pain. It’s called neuropeptide Y (NPY). “We’ve been finding for 25

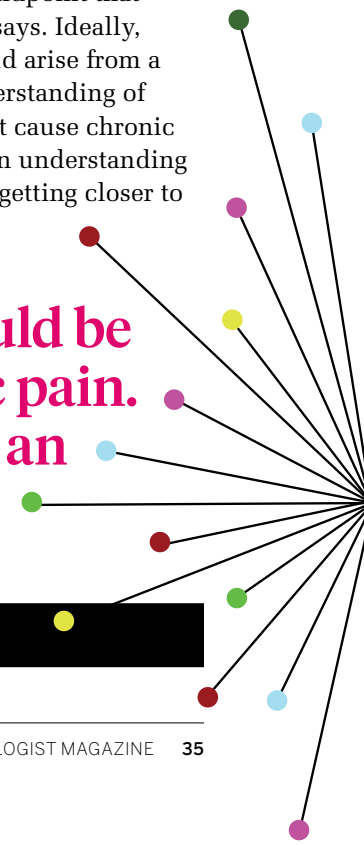
years now that application of NPY to the spinal cord can inhibit pain transmission in rodents,” he says. And along the way, “we started to realize that what we were doing was to mimic a natural, endogenous pain inhibitory system.”

To better understand the mechanisms of action of NPY, Taylor’s lab is using chemogenetics and optogenetics to manipulate the activity of the neurons that express specific types of NPY receptors found in the dorsal horn of the spinal cord, most notably the Y1R type. When they selectively ablated Y1R interneurons in rodents, the intensity of pain-like behaviors after peripheral nerve injury were reduced. They concluded that spinal Y1R interneurons can contribute to pathological pain—and present a potential target for treatment of chronic neuropathic pain.

“After an injury, connections between spinal neurons change in such a way that touch information becomes cross-wired and enters into the pain pathways, so that even a light touch activates Y1R-expressing neurons, producing pain,” Taylor says. There are some challenges with turning NPY into a therapeutic for humans, as it can have off-target effects on hunger and blood pressure, but his lab is searching for a solution. “We’re now conducting studies to understand how endogenous opioid

and NPY receptor mechanisms might interact to prevent chronic pain.”

The Taylor lab is also interested in repurposing existing drugs to see if they work for chronic pain. They are studying a specific class of drug that targets peroxisome proliferator-activated receptors (PPARs), currently used to treat diabetes, which shows promise as an analgesic for chronic pain. The thiazolidinedione class of drugs approved by the U.S. Food and Drug Administration include rosiglitazone and pioglitazone and target a specific isoform of PPAR called PPAR γ . The lab discovered that PPAR γ mRNA and protein are expressed in the dorsal horn of the spinal cord and that PPAR γ agonists reduce inflammatory and neuropathic pain—likely through actions at the spinal glia. “We’re hoping to move those studies to clinical trials,” Taylor says.

While the search continues for potential therapeutic treatments, one thing that would help, Basbaum says, would be to find a biomarker for chronic pain. “If you want to treat, you need an endpoint that you can target,” he says. Ideally, this biomarker would arise from a more complete understanding of the mechanisms that cause chronic pain in the body—an understanding that researchers are getting closer to day by day. 

One thing that would help would be to find a biomarker for chronic pain. “If you want to treat, you need an endpoint that you can target.”

—Allan Basbaum, PhD



Matalon Elected to Academy of Athens



Sadis Matalon, PhD, FAPS, Distinguished Professor and Alice McNeal Endowed Chair in the Department of Anesthesiology and Perioperative Medicine at the University of Alabama at Birmingham, has been selected as a corresponding member of the Academy of Athens, one of the oldest research institutions in Greece.

This honor is one of the highest bestowed upon scientists of Greek descent. Matalon is a past editor-in-chief of the *American Journal of Physiology-Lung Cellular and Molecular Physiology* and is the current editor-in-chief of *Physiological Reviews*. He has been an APS member since 1976.

Sullivan Named Augusta University Graduate School Dean



Jennifer Sullivan, PhD, professor of physiology at Medical College of Georgia at Augusta University, became dean of the Augusta University Graduate School in December 2021. She studies the molecular mechanisms behind the regulation of blood pressure and kidney function and was named interim dean in July 2020. Sullivan is a recipient of

the *American Journal of Physiology-Regulatory, Comparative and Integrative Physiology* Star Reviewer Award and has been an APS member since 2001. 📧

Check out this featured job listing. To find your next career opportunity or to list your job announcement with us, visit www.physiology.org/jobs.

TWO ASSISTANT PROFESSOR POSITIONS UNIVERSITY OF LOUISVILLE

The Department of Health and Sport Sciences in the College of Education and Human Development at the University of Louisville invites applications for two clinical assistant professor positions. These positions are 10-month renewable clinical (term, non-tenure-track) faculty appointments.

Read more at www.physiology.org/ulouisville.

APS ELECTION RESULTS

APS President-elect, Three Councilors Elected

The results of the APS 2022–2023 elections are in. The following winners will begin their terms in April at the conclusion of the APS annual meeting at Experimental Biology 2022.

PRESIDENT-ELECT



Willis K. "Rick" Samson, PhD, DSc, FAPS
Professor of pharmacology

and physiology and director of biomedical science graduate programs, School of Medicine, Saint Louis University



Evangeline Motley-Johnson, PhD
Interim dean, School

of Graduate Studies and Research; professor, Department of Microbiology, Immunology and Physiology, Meharry Medical College, Nashville, Tennessee

COUNCILORS



Heddwen Brooks, PhD
Professor of physiology, University of Arizona



Nisha Charkoudian, PhD
Research physiologist,

U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts

NEW FAPS INDUCTEES

Congratulations to the APS 2022 Class of Fellows

The Fellow of the American Physiological Society (FAPS) designation is the highest honor APS can bestow upon a member. It is a means of recognizing distinguished leaders who have made significant contributions to the physiological sciences as well as served the Society.

Please join us in congratulating the 2022 FAPS inductees:

Lacy Alexander, PhD, FAPS
David Busija, PhD, FAPS
David Evans, PhD, FAPS
Carlos Ferrario, MD, FAPS
Gregory Florant, PhD, FAPS
Matthew Hodges, PhD, FAPS
Dewan Majid, MBBS, PhD, FAPS
Steven Mifflin, PhD, FAPS

Kenneth Olson, PhD, FAPS
Jeffrey Osborn, PhD, FAPS
Damian Romero, PhD, FAPS
Terrence Sweeney, PhD, FAPS
Glenn Toney, PhD, FAPS
Janice Urban, PhD, FAPS
Charles Wade, PhD, FAPS



REGISTER NOW!

Don't Miss the Final Experimental Biology

Experimental Biology (EB) will be back in person this spring, April 2–5 in Philadelphia. Don't miss this final EB (American Physiology Summit debuts in 2023). EB 2022 is expected to have 5,000 scientific posters, 900 speakers and 65 countries represented. Advance registration rates take effect March 1. Visit www.experimentalbiology.org/registration for more information and to register.

CALL FOR PAPERS

Educators: Share Your Experiences Implementing Core Concepts in Physiology

Advances in Physiology Education invites educators at any career stage and institution to submit their experiences using and assessing the core concepts of physiology in their classrooms. See the full description of this call for papers and submit your abstract for consideration at <https://bit.ly/AdvancesCoreConceptsCfP>. Abstract deadline: June 30, 2022. Full manuscript deadline: July 15, 2022.

DEI UPDATE

Progress Report: An Update on Our Work in DEI

At APS, diversity, equity and inclusion (DEI) goes beyond race, ethnicity and gender representation; it means all members have the opportunity to be seen, heard and valued. We are working to ensure this applies to our individual members, member communities (sections, committees, interest groups and chapters), leadership and programming. And we are actively lifting the voices of those who are underrepresented in physiology and helping develop allies who support and sponsor them.

Keeping our members abreast of the projects and initiatives we're undertaking to increase and improve DEI at the Society is also a priority. Read on to learn more about our recent and upcoming efforts.

Member Demographics

As our diversity statement says, "APS is a community that appreciates, values and seeks the different dimensions that age, race, ethnicity, sex, sexual orientation, gender identity, gender expression, socio-economic status, religious beliefs, experiences, perspectives, lifestyles, geographic regions and cultures have to offer."

APS membership represents a variety of age and career stages, genders, races and ethnicities. Thirty-three percent of APS members are female, and 26% identify as a person of color (anyone who does not self-identify as white). The majority of our members are in the U.S. (75%), hold a PhD and work primarily in academic settings.

When comparing leadership roles to other similar life science organizations, APS is among the top in female representation in leadership positions. APS is average for those from underrepresented groups engaged at the leadership level. While there are a lot of positives to report, we also recognize that we have a lot of work to do.

Where Are We Today?

We are proud of our long-standing commitment to DEI in research and have expanded that commitment in recent years. In 2019, thanks to the work of the Task Force on Sexual Harassment, APS began to define our values and culture.

We developed the APS core values, a diversity statement and a member code of conduct (visit www.physiology.org/values). APS worked with the Societies Consortium on Sexual Harassment in STEM to develop our Honors and Awards Policy and a process to submit reports of misconduct.

In 2020, we made DEI a strategic, organization-wide goal, and APS members voted for the DEI Committee chair to have an ex-officio seat on Council. We also worked to increase the visibility

of our Porter Fellows and continue our work with the William Townsend Porter Foundation (which provided \$144,000 in funding for the Porter Fellowship program in 2022). Our Porter Fellows are now working in official roles with their section steering committees to contribute their voices to the important work of our member communities.

We launched an APS staff-focused DEI Working Group to ensure that the same critical discussions around DEI are explored and addressed among APS employees. We also spoke up against hate and violence by issuing statements that reaffirmed APS' DEI values within the larger social context in the U.S.

In 2021, APS launched a 10-session webinar series that overall drew more than 1,600 attendees. Recordings are available to APS

members, and the series will continue in 2022. We also began a comprehensive DEI baseline assessment. We worked with Impact Consulting LLC to:

- determine the current state of inclusive culture for APS members;
- deepen awareness of the member experience, uncover blind spots and understand gaps; and
- create a community where members feel included.

We are pleased with the progress we're making, but we know there is much more to do. We thank the many members who've shared their time, ideas, suggestions and experiences to shape the Society's efforts.

As we look forward to the next 135 years, APS aims to support our members from all backgrounds so that they may achieve their career and professional goals and further scientific knowledge in physiology and medicine.

We look forward to sharing the results of our DEI baseline assessment and next steps with you soon. 📢

MEMBERSHIP SNAPSHOT

33% are women

26% are people of color

75% are in the United States

60% have a PhD

17% have a MD

53% have a professor title

79% consider research a major type of work

21% list primary section as cardiovascular

60% are general members

APS is among the top with female representation and at the average for historically underrepresented groups, compared with similar life science organizations.

AWARDS



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)

Carl Ludwig Distinguished Lecture of the APS Neural Control & Autonomic Regulation Section (March 19)

Postdoctoral Fellowship Letter of intent (April 15)

Julius H. Comroe Jr. Distinguished Lectureship of the Respiration Section (May 14)

Solomon A. Berson Distinguished Lectureship of the APS Endocrinology & Metabolism Section (May 15)

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

Teaching Career Enhancement Awards (May 31)

Hugh Davson Distinguished Lectureship (Apply anytime)

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

More details: www.physiology.org/awards

CALLS FOR PAPERS



Advances in Physiology Education (May 31, 2022)

- Physiology Core Concepts

American Journal of Physiology-Cell Physiology

- Inward Rectifying K⁺ Channels (March 1, 2022)
- Deciphering the Role of Proteoglycans and Glycosaminoglycans in Health and Disease (April 30, 2022)
- Advances in GPCRs: Structure, Mechanisms, Disease and Pharmacology (June 1, 2022)

American Journal of Physiology-Endocrinology and Metabolism (March 31, 2022)

- Chronicity in Metabolism
- Deciphering the Contribution of the Gastrointestinal Tract on Glucose, Lipid and Energy Metabolism
- GPCR-Mediated Regulation of Fuel and Energy Metabolism in Peripheral Tissues
- Insulin's First 100 Years—Where Next?

American Journal of Physiology-Gastrointestinal and Liver Physiology

- Gastrointestinal Issues in Neurological Diseases (April 1, 2022)
- Microbiome-based Therapeutics and Their Physiological Effects (May 1, 2022)
- Adaptations of Physiologic Systems to Promote Cancers (June 1, 2022)

American Journal of Physiology-Heart and Circulatory Physiology

- Considering Sex as a Biological Variable in Cardiovascular Research (May 31, 2022)
- Myocardial Ischemia and Inflammation (May 31, 2022)
- Getting It Right (no expiration)

American Journal of Physiology-Renal Physiology

- Molecular Basis of Kidney Injury and Repair (April 30, 2022)
- Renal Adaptations in Pregnancy, Maternal Health Disorders and Women's Health (May 31, 2022)

Function (March 31, 2022)

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

Journal of Neurophysiology (JNP) (March 31, 2022)

- Society for the Neural Control of Movement
- Spinal Networks and Spinal Cord Injury: A Tribute to Reggie Edgerton
- The Neurophysiology of Consciousness

More details: www.journals.physiology.org/calls

MEETINGS & EVENTS



CONFERENCES

Experimental Biology 2022

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A Collective Approach to Reducing Regulatory Burdens

BY J.R. HAYWOOD, PHD, FAPS

Focus on how we can meet regulatory requirements differently. Are we too siloed having separate compliance programs for animals, humans and other areas?

For over 30 years, there has been a national conversation about burdens associated with regulations governing research. Surveys and studies by major agencies and non-governmental entities—including the Federal Demonstration Partnership, Council of Governmental Relations and the National Academy of Sciences—have demonstrated that the effects of these regulations are a real concern for researchers, research administrators and even the regulatory agencies and that the burden is increasing over time. Congress passed the 21st Century Cures Act to address the issue. However, here we are with new rules and guidance being written as this is read.

Why has there been so little progress in reducing burdens? Having thought about regulatory burdens throughout my career, I have come to realize that there may be three principal reasons for the limited progress:

The most likely reason is inertia. Performing a comprehensive evaluation of the problem and then doing something about it necessitates a coordinated approach that requires time, resources and a desire to create change. It, thus, becomes a daunting task.

It is easier to make rules than it is to develop a process to meet the requirements. The desire to have compliance programs that are risk-free leads to overinterpretation of regulations and policies. The result often requires more than regulatory agencies expect and creates more work for investigators and research administrators.

It is not just regulations but also grant requirements. With approximately \$50 billion

in the combined National Institutes of Health and National Science Foundation budgets, the scientific community is held accountable for how the money is spent. Many of the “regulations” are actually terms and conditions that accompany grants. The terms and conditions also provide a way to implement policies and guidance without going through the regulatory process.

No doubt there are other factors, but these seem to me to be the difficult obstacles. So, what is it going to take to reduce regulatory burdens? Here are my thoughts:

Local engagement may be the most effective approach.

Become a member of your institutional animal care and use committee, institutional review board or other regulatory committee. Learn the difference between which processes are required and which are “best practices.”

Then ask why processes are done the way your institution does them.

Team up with research administrators—a group as affected by regulatory burdens as researchers are—to amplify shared concerns about regulations on a national level. Their community is in frequent discussions with agencies to reduce unnecessary burdens.

Focus on how we can meet regulatory requirements differently. Are we too siloed having separate compliance programs for animals, humans and other areas? Can we better integrate regulatory oversight so we protect research participants from hazards in the research environment and experimental harm while promoting the scientific efforts of the investigators?

It feels like we are approaching a tipping point where the mounting regulatory and funding requirements are shifting researcher attention away from discovery to endless forms and paperwork. We must think about novel approaches to achieve the outcomes of research subject protection, laboratory safety and compliance without a negative effect on research. ☞

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