THE Physiologist MAGAZINE

MAY 2024

MOVING ALONG WITH MUSCH

New APS President Timothy Musch, PhD, FAPS, has seen many changes in science and academia. But he's confident that physiology is the future.

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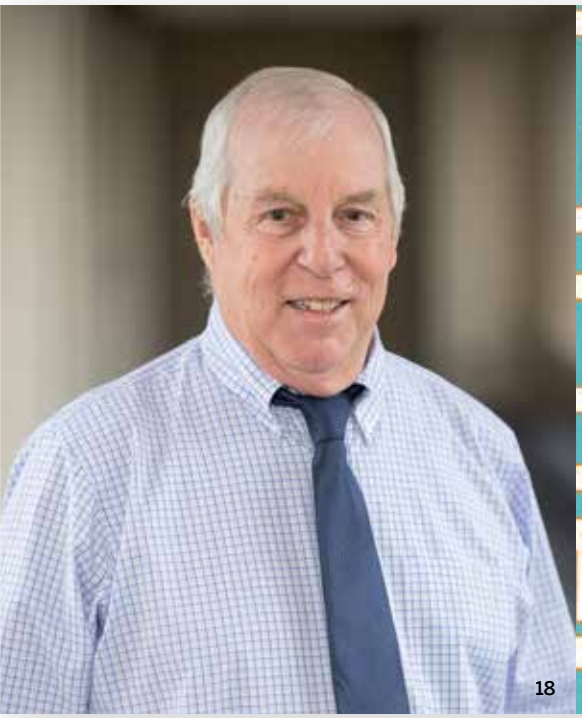

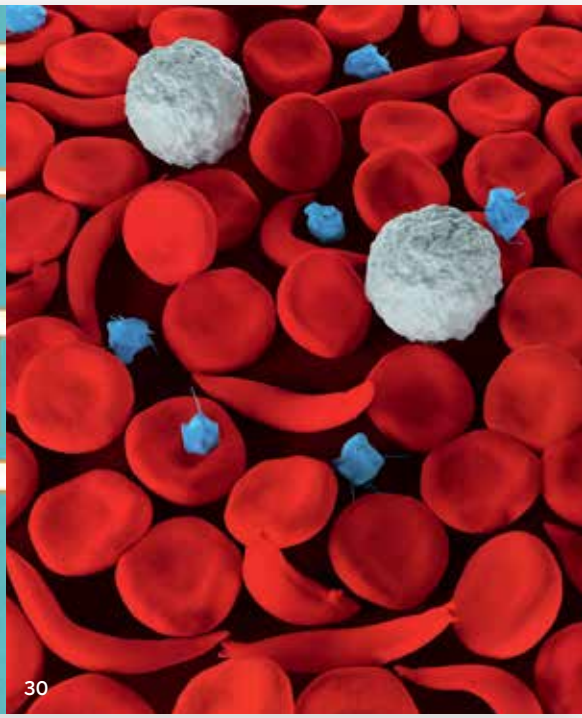

Cover photo by Jeff Moore, Kansas State University Division of Communications and Marketing

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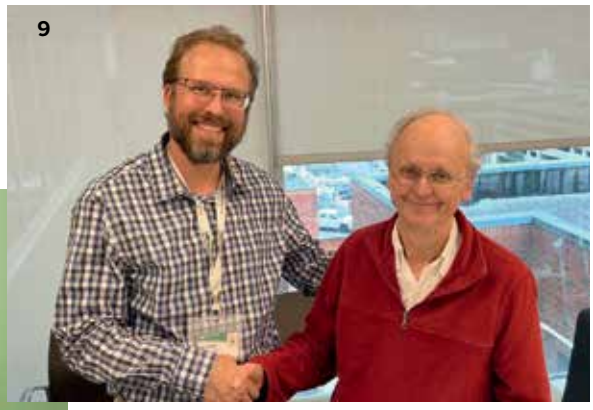

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How to Nominate

Nominations, accompanied by a curriculum vitae, should be sent to Wolfgang Kuebler, MD, FAPS, chair of the American Physiological Society (APS) Publications Committee, via email, care of Charmon Kight (**ckight@physiology.org**) in the APS Publications Department.

The APS Publications Committee plans to interview candidates in the summer of 2024.

CALLS FOR NOMINATIONS

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Nominations Due:
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Meet the Team:
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May 31, 2024

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Meet the Team:
onlinelibrary.wiley.com/page/book/10.1002/cphy/homepage/editorscontributors.html

That's a Wrap!

BY MEEGHAN DE CAGNA, MSC, CAE

Dear reader:

It has been two weeks since the 2024 American Physiology Summit wrapped, and we are still riding the wave of enthusiasm and excitement from the event. If you were at the Summit, I hope you left with newfound insights and connections that have you feeling reinvigorated, energized and eager to tackle your work and professional endeavors with a fresh perspective. Whenever I attend a conference for my own continuing education, there is something about the exchange of ideas, the exploration of emerging trends and gaining fresh perspectives that helps me jump back into my work with renewed focus.

Attending three days' worth of scientific sessions, poster presentations and networking events may have even inspired you to submit a proposal for the 2025 Summit—you have a few days left to do so! Yes, we are a year away from the next event, but the work continues year-round. And we could not plan the premier event for researchers and educators exploring the science behind some of the most important questions affecting life and health without your input, ideas, proposals and abstracts, so thank you. So, stay tuned in the coming months for how you can continue to help shape the 2025 Summit, which will be held in Baltimore April 24–27.

> "I hope you left the Summit with newfound insights and connections that have you feeling reinvigorated, energized and eager to tackle your work and professional endeavors with a fresh perspective."

THIS MONTH'S FEATURES

At the Summit, APS officers took on their new roles. That includes your new APS president, Timothy Musch, PhD, FAPS, whose career spans 43 years. Most of those years have been at Kansas State University, where he was given the opportunity in the 1990s to do what many universities were doing at the time: reorganizing their physical education programs into new kinesiology departments. On page 18, Musch talks about building out that program and how he found his way to physiology in the first place.

This month we also dive into sickle cell disease. This painful and debilitating genetic disease—which primarily affects Black Americans—had a tremendous breakthrough last year, when the FDA approved two curative gene therapies. But gene therapy is a demanding ordeal, and with such a high price tag, insurance likely won't cover it for everyone. On page 30, we look at what research is being done to provide better treatments, and possibly cures, for this terrible disease.

Our third feature this month stems from a question we asked as an editorial team: How do physiologists know when it's time to move on? That could be moving to a new university and lab, changing from academia to industry, or any number of paths. But how do you make such a big decision? What should you consider and how should you evaluate new opportunities and career paths? On page 24, several physiologists answered those questions for you—we hope it will help you with your decision-making as you build a successful physiology career.

WE WANT TO HEAR FROM YOU

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

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

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Interested in contributing?
Email communications@physiology.org.

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APPLIED PHYSIOLOGY

Does *Thinking* Something Is Healthy Make It So?

Research published in the *Journal of Applied Physiology* found that in one study, this dream was something of a reality. Researchers gave study participants a fat- and sugar-laden milkshake on two different occasions. On one occasion, the participants were aware of the accurate nutrient profile of the shake. On another day, they were given the same shake but were told it was a healthier "nutrishake" with more protein and less sugar and fat.

The researchers evaluated the participants' endothelial function after drinking each shake and compared it to when they drank plain water. The findings showed that after drinking the milkshake the volunteers perceived to be unhealthy, their blood vessel function was worse than when they drank water. And when they drank what they thought was a healthier beverage, their endothelial function did not worsen, even though the macronutrient profile was identical to the unhealthy milkshake.

Researchers say the results suggest "perceptions about nutritional information contribute to the impact of food intake on endothelial function and that nocebo effects could be involved in cardiovascular disease etiology."

Source: **doi.org/10.1152/japplphysiol.00308.2023**

APPLIED PHYSIOLOGY

Hand Me My Stilettos, Stat

High heels are often considered to be a fashion statement, but wearing them on a regular basis may also help make walking more effortless. Research published in the *Journal of Applied Physiology* found that volunteers who walked more than 1,500 steps daily in two-and-a-half to three-inch heels (during a 14-week trial) had a decreased walking economy than those who wore them for less than 1,000 steps per day.

The increased plantarflexion of the ankle (top of the foot points away from the leg) that occurs when wearing heels for extended periods shortens the tendon of the calf muscles, which may alter muscle metabolism. These changes can reduce the amount of energy needed for walking. The researchers found that the volunteers had a more efficient walking economy, even when they didn't wear heels, that lasted for several weeks after the study ended.

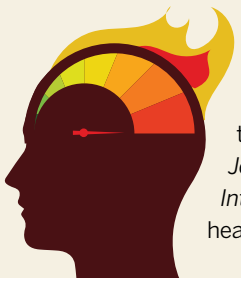
Source: **doi.org/10.1152/japplphysiol.00016.2024**

Clockwise from top left: Kobus Louw; feedough; dcampiglia

COMPARATIVE PHYSIOLOGY

More Reasons to Be Careful in the Summer Heat

Overheating during physical activity—called "exertional heat stroke"—can have lasting consequences,



including a higher risk of heart or kidney disease, problems with the central nervous system or compromised immunity.

Muscle cramps are often an early sign of heat stress. According to research published in the *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, heat stress may affect the muscles for longer than we think. Using a female mouse model of heat stress, researchers found muscle changes in 137 different genes, including some related to muscle structure and function, stress response and wound healing. The findings could be "particularly relevant to athletes and active military, where decisions are made regarding the timing for return to play or duty," according to the authors.

Source: **doi.org/10.1152/ajpregu.00226.2023**

Cristhian Gutierrez
instagram.com/cgmech

I want to thank the American Physiological Society (@apsphysiology) for featuring me in the January edition of their magazine, The Physiologist, in the Under The Microscope section. It was so much fun contributing to this section! And I'm beyond happy to know that APS is so incredibly supportive of their trainees #Physiology #APS #thephysiologist #mdphd

UNDER THE MICROSCOPE

Rapid Fire Q&A

Cristhian A. Gutierrez Huerta explains how he switched his career goals to study to become a physician scientist—and shares which model organism he would be.

Q: What inspired you to become a scientist?

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

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

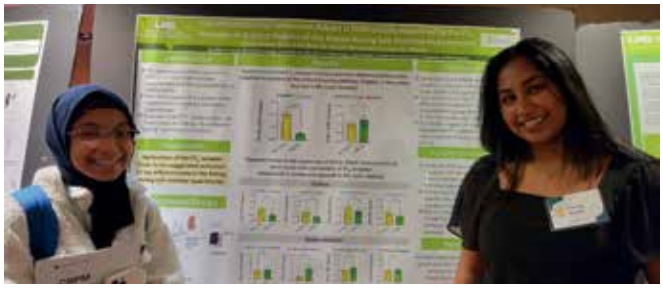
Q: Most influential scientist on your career?

Stephanie Franzén
twitter.com/Steph_PhD

#APS2024 Summit booked and ready to go. Longing for Long Beach! Definitely one of the highlights of the year @APSPhysiology @AJPRenal

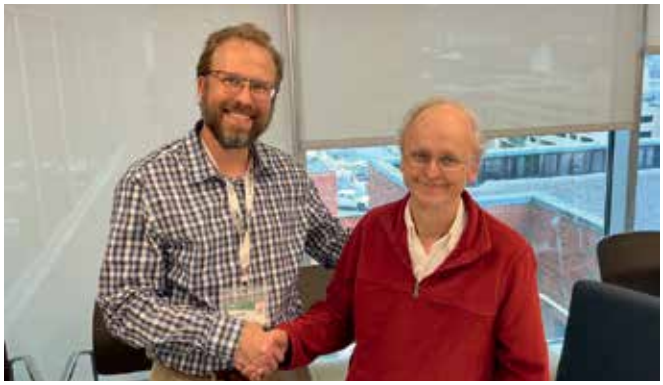
Carmen De Miguel, PhD, MS, FAHA
twitter.com/Carmendemigue12

So proud of my trainees! Thank you Abby, Anmol, Trisha and Sara for representing the De Miguel lab so well yesterday as we celebrated the Section of Cardio-Renal Physiology and Medicine 10th anniversary! @UAB_NRTC @KUHPRIME #proudmentor



Adam R. Wende, PhD, FAHA
twitter.com/@AdamWende

Had a great time meeting a scientific hero from my thesis days, Frank Booth, as he presented at today's @UABExerciseMed Hunter-Bamman Award Lecture. It was inspirational hearing about his accomplishments over the last 50 years and what we still have to learn from him.



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LAB NOTES

MENTORING Q&A | CAREER ADVANCEMENT

Preparation Means Progress

How to set yourself up for career success.

Each issue, we ask a student or early-career member to pose their career questions to an established investigator and mentor. Here, Mareena Pitts, a PhD candidate at Morehouse School of Medicine in Atlanta, asks Bonnie L. Blazer-Yost, PhD, FAPS, advice on how to create a successful career. Blazer-Yost is director of the Hydrocephalus Research Center and professor of biology at IUPUI in Indianapolis.

Illustrations by Kagan McLeod

Q: What topics do you think will drive the field of physiology forward in the next 5–10 years?
A: The biggest contributions that physiology has always made, and continues to make, are those aimed at deep understanding of the physiological responses to alterations in homeostasis, for example, pathophysiology. Physiologists tend to have a more whole-body perspective than most other disciplines, and this is crucial for the development of disease treatments.

"You will find that most scientists are very approachable and willing to interact with early-career scientists."

Q: What advice would you give an early-career scientist to ensure their success?
A: First, seek formal and informal mentor-type interactions not only in your own institution but within your wider scientific circle. This doesn't have to be long term or time intensive; it can be as simple as asking a senior scientist for advice on a method or help with interpreting some particularly complex data sets. I know this is hard, particularly if you are a shy person, but you will find that most scientists are very approachable and willing to interact with early-career scientists. Some of my lifelong colleagues and collaborators are people I met at APS poster sessions.

Also, learn how to write grants as early as possible. One of the best ways is to offer to help your principal investigator or other senior scientist with their grant submission. Even if you are writing up methods or putting together figures, the experience of what is involved is very instructive. If you are helping to put together a grant submission, chances are you will be included in the cadre of people who hear how that grant fares in the review system.

Finally, and arguably most important, don't hold on to your hypotheses when the data are telling you they are not correct. However, don't give them up without delving into why they failed and what that failure is telling you. In my career, the most important discoveries were the result of failed hypotheses.

Q: What strategies do you employ to manage stress and time management?
A: This is a difficult question for all scientists, particularly women. Achieving a work-life balance is not easy. For me, personally, I write everything down and keep a handwritten monthly schedule in pencil so I can erase things as they get done. Very old-fashioned, I know, but once something is written down, I find I can stop worrying about it. Then, since I am a morning person, I try to force myself to do the least favorite tasks (endless paperwork) first, so the afternoon is left for fun things. I find that interacting with my trainees on a regular basis decreases stress because it is so much fun to discuss their results and help plan the next experiments.

Q: In what ways can a physiologist contribute to the ongoing need to improve diversity, equity, inclusion and accessibility in the workplace?
A: My experience has been that the more diverse a laboratory group is the better they will function together. In a diverse group, no one has preconceived notions that other members should be like them and, therefore, one tends to accept differences more readily. Most people, and certainly most scientists, have an innate curiosity about others and wish to understand other perspectives and cultures. One of the most important things we can do is to further encourage this inclusive behavior for all groups and cultures.

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

STATS & FACTS

10.8%

The projected growth of STEM employment between 2022 and 2032.

U.S. Bureau of Labor Statistics

"Our analysis of observed careers finds that there is no single traditional scientist career; rather, trajectories evince numerous pathways."

Edwards et al., May 2023, *Scientific Reports*

12.7

The average number of jobs held by individuals born from 1957 to 1964 between the ages of 18 and 56. Half of these were held before the age of 25.

U.S. Bureau of Labor Statistics

33%

The portion of 2022 research doctoral degree recipients whose principal first postgraduate non-postdoc employment was in academia. In 2002 this portion was 52%.

National Center for Science and Engineering Statistics Survey of Earned Doctorates

FROM EXPERIENCE | PRODUCTIVITY

Break the habit

Tips to stop procrastinating.

Do you keep postponing work you need to do? Most of us procrastinate from time to time. Rather than feeling guilty about it, or beating yourself up, try these strategies to break the habit.

Schedule deep work. It's easier to put off work that requires concentration, so build consistent time into your daily calendar to focus on your most important long-term project.

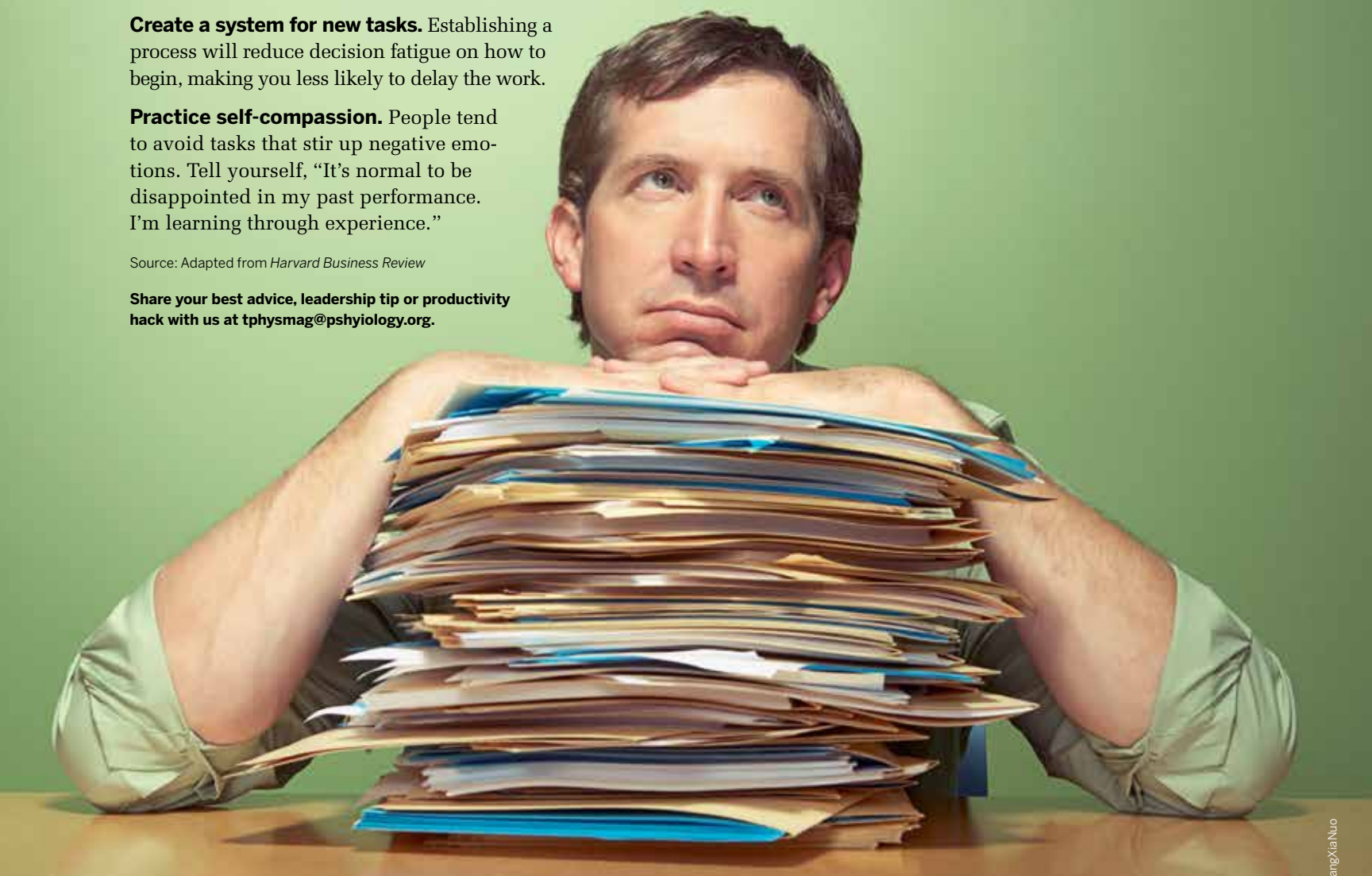
Accept demanding work. The more you can tolerate demanding tasks, the less you will procrastinate. Commit to tackling 90 minutes of one demanding task each day.

Create a system for new tasks. Establishing a process will reduce decision fatigue on how to begin, making you less likely to delay the work.

Practice self-compassion. People tend to avoid tasks that stir up negative emotions. Tell yourself, "It's normal to be disappointed in my past performance. I'm learning through experience."

Source: Adapted from *Harvard Business Review*

Share your best advice, leadership tip or productivity hack with us at tphysmag@pshyiology.org.



FangXiaNuo

POLICY IQ | POSTDOC EXPERIENCE

NIH's Road Map to a Better Postdoc Experience

Working group calls for improvements to postdoctoral life, including a $70,000 minimum stipend.

Increasing salaries for postdoctoral researchers is an important first step to addressing the postdoc shortage—but it shouldn't be the only step. That is the conclusion of the National Institutes of Health (NIH) Working Group on Re-envisioning NIH-Supported Postdoctoral Training, which released its final report in December 2023.

The report contains six concrete recommendations to improve the postdoc experience. The working group's first recommendation to increase the minimum National Research Service Award postdoctoral stipend to $70,000 grabbed headlines, but challenges in meeting the recommended pay level should not overshadow other ideas in the report.

The working group developed the report after more than a year of information gathering through public listening sessions and a request for information, which received over 3,000 comments, including from APS. (You can read the Society's response at **physiology.org/NIHPostdocTraining**.

MORE THAN A SALARY INCREASE

In an analysis of these comments, the working group noted that salary and benefits were the most frequently cited postdoc concerns. Other challenges that were highlighted include job insecurity, harassment, a lack of support for career development and skill training, and limited career prospects in academia. With only 1 in 4 life science postdocs achieving a tenure-track faculty position within six years, postdoctoral training must prepare scholars for a broader range of careers.

In addition to proposing a salary hike and that postdocs receive the full benefits of an employee (including dependent care coverage and retirement savings), the working group's report recommends limiting a postdoc to a five-year time frame. Several suggestions are given to support this timeline and to facilitate career transition. For example, the report describes a revision of the K99/R00 mechanism to target early postdocs and provide a more stable and structured path toward an independent research career. Professional development and skill training are also emphasized, with a proposal that postdocs spend a minimum of 10% of their effort on these activities and that mentors be held accountable for reporting on mentoring activities as part of the Research Performance Progress Report.

Because most postdocs don't end up in tenure-track research positions, it is critical that they have opportunities for professional development targeted at other career tracks. Many postdocs go on to pursue opportunities in industry, government or nonprofits, supported by the technical knowledge and investigative skills they learned at the bench.

Although the report encourages NIH to support postdocs seeking these career transitions, the recommendation is short on details, suggesting that NIH seek collaboration in these various sectors. However, the report does recommend a robust expansion of a staff scientist career track, one which postdocs often end up in after a somewhat blurry transition period. The recommendation would establish staff scientists as meaningfully different from postdocs, with higher compensation and support on NIH grants.

With only 1 in 4 life science postdocs achieving a tenure-track faculty position within six years, postdoctoral training must prepare scholars for a broader range of careers.

LONG OVERDUE CHANGES

The working group's report could result in substantial changes to the postdoc experience. The group incorporated many of the suggestions provided in APS' comment into its final report. It remains to be seen whether NIH is able to implement the plan set forth in the report.

Stay updated on policy efforts and sign up for APS Action Alerts at physiology.org/advocacy.

UNDER THE MICROSCOPE | NATURAL CURIOSITY

Inquiring Minds

This researcher has leaned into his inquisitiveness since his competitive swimming days.

Joseph Brozinick, PhD, directs a preclinical pharmacology lab at Eli Lilly and Company in Indianapolis in the Endocrine Division as an executive director in the Cardiorenal Group. He earned his undergraduate degree in biology from Indiana University of Pennsylvania, a master's in biology from East Carolina University and his PhD in exercise physiology, biology and pharmacology from the University of Texas at Austin. He did his postdoctoral training at the National Institutes of Health and at the University of Pennsylvania.

CURIOUS KID. I have always been fascinated with the mysteries of biology and figuring out how things work. I was involved in sports and was a competitive swimmer in high school and college. This enticed me to understand both how the human body responds to exercise and how the various organ systems responses are coordinated on a physiological level. This innate curiosity led me to major in biology as an undergraduate and pursue a PhD in pharmacology and exercise physiology.

A NEAR MISS. My near lab mishap came from my graduate work at the University of Texas. My research involved isolating plasma membranes from rat skeletal muscle after exercise, which required using another principal investigator's swinging bucket rotor and ultracentrifuge across campus. One day, without noticing, I hung one of the rotor buckets by only one of the two hooks that attached it to the rotor and started the centrifuge. The bucket should have flown off the rotor and destroyed the centrifuge, but somehow managed to stay in place. When I returned and saw the rotor, I thanked the science gods that I had not destroyed someone else's centrifuge and had to enter the federal witness relocation program!

NOBEL-WINNING LEGACY. I would have liked to meet A.V. Hill. When he was alive, one of the biggest unknown questions in physiology was the regulation of muscle contraction. Hill did some pioneering work on frog muscle to show that contraction released heat and required energy. He also came up with a model to describe contraction, which was not entirely correct but did further our understanding of muscle physiology. (Hill shared the 1922 Nobel Prize for Physiology or Medicine with Otto Meyerhof.)

TIME TO PONDER. My favorite part is designing experiments and looking at the data. I also enjoy having time to read scientific literature and brainstorm new ideas for drug targets that we can use in the lab because it engages the creative side of our brains (which we all have) and gives me a sense of accomplishment. My least favorite part: going to meetings. While this is a necessary part of all our jobs, I find meetings to be boring and counterproductive to creativity.

CRITICAL NEED FOR PHYSIOLOGY. The biggest misconception about physiology is that it is an unnecessary part of science, which is far from the truth. While it is easy to find cell and molecular biologists, it is exceptionally difficult to find people who excel at in vivo physiology. Understanding the breadth of human diseases requires knowledge of physiology to fully appreciate the coordinated interactions between the various organ systems. As a society, we need to do a better job of pointing this out to trainees and their mentors.

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

PUBLISH WITH POLISH | SUBMISSIONS

From Meeting to Manuscript

Learn how to turn your Summit abstract or other research into a manuscript worthy of an APS journal.

Welcome home from the 2024 American Physiology Summit! After immersing yourself in three days of science, you are probably feeling inspired to publish your own work or turn your abstract into a journal submission. Now, APS journals make it easier than ever to prepare and submit your manuscript. Here's a guide through the journal selection process to manuscript preparation and submission, which you can review in-depth at **physiology.org/author-info**. Let's get started.

With APS, you know that you will publish with purpose. This means, as a self-publishing society, APS reinvests journal revenue directly into the research community we support. By publishing your research with us, you are supporting your scientific meetings, awards and fellowships, and career and educational resources.

Not sure which of APS' 16 journals to submit to? Check out the "Which APS Journal?" webpage that succinctly summarizes each journal's topic focus. From there, you can easily access detailed scope descriptions to find the perfect home for your research.

The APS Publications team revamped the Information for Authors page in 2023 to streamline what you need to prepare your manuscript. We have several handy tables that illustrate which article types and special features are specific to each journal. Need help structuring the sections of your manuscript? We have a manuscript template for that. Formatting figures should be a stress-free process, too, so we have detailed guidance on how to prepare figures, including handouts on best practices for different imaging software.

APS also still offers FlexSubmit, which allows initial manuscripts to be in a format-neutral style, even as a single-merged PDF. If the required information is present (author details, full text, figures and tables, etc.), the manuscript will be evaluated on its scientific merit. It's a great way to get your research in front of the editors' and reviewers' eyes as quickly as possible. All revised submissions must follow detailed manuscript instructions, as described above. Review the Submission Checklist to ensure your manuscript is ready.

When you're ready to submit, in addition to submitting your manuscript file(s), you'll need a few other bits of information, such as your funding details and an ORCID for the corresponding author. We're also happy to say that we shortened the initial submission process to be more streamlined and user-friendly. For example, supplemental and source data may be uploaded as PDF files at initial submission, not requiring repository upload until the revised submission stage.

Finally, we'd be remiss if we didn't throw in a few general writing tips to help with discoverability after publication. Craft an engaging title that concisely sells your data and conclusions, and let your abstract summarize your results and promote the significance of your findings. And don't underestimate the value of using keywords, which drive discoverability and increase readership.

You have what it takes to turn your American Physiology Summit abstract into a manuscript submission. You've already done the hard work in the lab—now go get published!

To learn more about the resources above, visit physiology.org/author-info or email publishing@physiology.org.

STATS & FACTS

28 to 43

The increase in the median age at death for people with sickle cell disease in 1979 versus 2017.

Centers for Disease Control and Prevention

56%

The percent of surveyed PhD students who changed their career goals between matriculation and graduation.

FASEB BioAdvances

"The sickle cell disease community has historically been underserved and underacknowledged when it comes to rare genetic conditions, so it is heartening to see [it] at the forefront of gene therapy."

Vence L. Bonham Jr., JD, acting deputy director of the National Human Genome Research Institute

$2.2 million

The U.S. list price for the one-time CRISPR treatment for sickle cell disease.

Reuters

1 in 13

The number of Black or African American babies born in the U.S. with the sickle cell trait.

Centers for Disease Control and Prevention

Portra//iStockphoto

Tick-Tock Biology

Breakthrough research into the biology of time is uncovering how restoring natural rhythms could help stave off disease.

Satchidananda (Satchin) Panda, PhD, is a professor at the Salk Institute in California, where his research focuses on the circadian regulation of behavior, physiology and metabolism. Two decades ago, Panda contributed to the discovery that a blue-light sensitive protein called melanopsin is critical for regulating our body's circadian clock. More recently, his lab pioneered research into how time-restricted eating—confining caloric consumption to an 8- to 12-hour period—could help prevent a host of health problems.

What motivated you to study the circadian clock and its role in health? What are you trying to figure out?
When I was finishing my undergrad and master's studies in India, I realized that although we know a lot about biology, it is mostly linked to what and how much. For example, we know what kinds of genes and proteins affect metabolism or behavior. However, the *when* aspect was very little explored at that time. I became interested in what I call the biology of time: how biological systems keep track of time, how they respond in a time-of-day dependent manner and whether the disruption of timing contributes to disease.

The word "circadian" means 24-hour rhythms, and these rhythms are tied to the rotation of our planet around its axis. Humans and almost every other organism on this planet evolved based on this 24-hour day and night cycle. However, over the past 150 years or so we have created a man-made environment that ignores this 24-hour rhythm and sometimes actually requires disruption of the circadian rhythm. For example, nearly 20% of working adults in Western countries work as shift workers, and most high school and college students stay awake late into the night studying for exams.

This widespread disruption in our internal clocks is, in my view, contributing to an increased risk for many chronic diseases, such as diabetes and depression and even dementia and cancer. My research could help reveal how the principles of circadian rhythms could be used to rebuild this anthropogenic world in a way that might prevent, cure and reverse disease.

Tell us more about the approaches you're using to study circadian rhythms and disease.
I use different model systems, including fruit flies and mice, and we also do human studies. We ask very simple questions such as: If a gene is disrupted, does it lead to circadian rhythm disruption? Does disrupting the light-dark cycle

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"Over the past 150 years or so we have created a man-made environment that ignores this 24-hour rhythm and sometimes actually requires disruption of the circadian rhythm."

lead to circadian rhythm disruption? Do disruptions in the feeding-fasting cycle cause circadian rhythm disruption? We also study very simple outcomes such as growth rate and sleep, as well as changes in the amount of fat and muscle and variations in heart rate.

Team science is extremely important for circadian rhythm research because we need specialists who can carry out various kinds of biochemical or physiological assessments. Collection and analysis of large amounts of data requires the expertise of computer scientists, data scientists and statisticians. I also collaborate closely with physicians and physician-scientists to study the circadian rhythm in people.

What are some of the most important findings that have resulted from your research?

Almost 22 years ago, our team, together with two other labs, co-discovered that a protein present in just a few cells in our eyes senses blue light around us and then sends that information to the master clock in the brain to tell us whether it's morning or night. This finding transformed how we light hospitals and the light cycle used in neonatal ICUs. It has also allowed us to understand how lighting can be optimized to improve performance among schoolchildren or to reduce the severity of dementia among older adults.

Another important finding from our lab is that most of our genes turn on and off in different organs at specific times during the 24-hour day. The fact that every organ has its own clock means that the circadian aspect of almost every disease can now be traced back to mechanisms in the respective organ. This has important implications for understanding diseases and for optimal timing of medication.

What has your research revealed about time-restricted eating?

In 2012, we published a very simple but profound study. We divided mice into two different groups. One group was allowed to eat whatever and whenever they wanted from a fatty, sugary diet. The second group was given the same number of calories and quality of diet as the first group but all within an eight-to-nine-hour period each day. After 16 to 18 weeks, the first group became obese, diabetic and had signs of heart and liver disease—almost every metabolic disease that can happen to these mice. Surprisingly, the second group of mice, even after eating the same number of calories from the same fatty, sugary diet, were completely protected from all these diseases.

There are now more than 150 clinical trials related to time-restricted eating being performed around the world. We hope that these studies will show who can benefit from this approach and whether it can be further amplified by combining it with drugs and other interventions.

What's next for your research?

There are three foundations of health: nutrition, sleep and physical activity. We know that sleep disruption leads to various problems, but we don't know why or how. We're working to systematically understand how sleep disruption affects our immune system and metabolism, for example. We are also working to better understand physical activity. There are so many diseases that can be prevented or cured with exercise, but at the same time we don't know how exercise affects physiology. This work will provide new insights into how lifestyle changes can be used to improve health.

Interview conducted by science writer Nancy D. Lamontagne.

STATS & FACTS

~2%

The portion of sickle cell disease patients taking the three medications approved for the disease since 2017.

The Washington Post

"My life is limitless now. I'm full of energy. I don't have pain. It's a real transformation."

Victoria Gray, the first person in the U.S. to receive CRISPR gene-editing treatment for sickle cell disease.

National Public Radio

37%

The number of surveyed employees in the U.S. looking for a new job in 2024.

Staffing Industry Analysts

1922

The year sickle cell was first recognized as a disease, then named "sickle cell anemia."

Johns Hopkins University

Moving Along with Musch

New APS President Timothy Musch's 43-year career has seen many changes in science and academia. But he's confident that physiology is the future.

BY MEREDITH SELL

In 2014, Timothy Musch, PhD, FAPS, and his wife attended their daughter's pinning ceremony before her graduation from physical therapy school. They were at Wichita State University, roughly 130 miles from their home in Manhattan, Kansas, known as the "Little Apple" and the domain of Kansas State University. Musch's daughter introduced him to the head of Wichita State's physical therapy program, and as they shook hands, Musch was caught off-guard by the man's greeting.

"Dr. Musch, I took your Kinesiology 335 class," the program head said.

Photography by Jeff Moore, Kansas State University Division of Communications and Marketing

Musch didn't recognize the man—after all, it's not possible to remember every one of the thousands of students you've taught over 30 years—but he was proud to know that one of his previous students was leading a physical therapy program where not only his daughter, but other Kansas State graduates, continued their education.

Musch, who is a University Distinguished Professor of Exercise Physiology at Kansas State and teaches in both the College of Veterinary Medicine and the College of Health and Human Sciences, never imagined he would pursue a life in research or academia. When he started his undergraduate studies at the University of California, Berkeley in the 1970s, he was planning to go to dental school. "I had a girlfriend and her father was an orthodontist," he says, "and I saw how they lived."

He had a scholarship to Berkeley for swimming and was spending five hours a day in the athletic facilities. "Since I was spending so much time in the athletic department, I declared physical education," he says. He took "physiology of exercise" with George Brooks, PhD, one of the assistant professors, and did exceptionally well. At the end of the course, Brooks

CAREER TIMELINE

1968–1972
Bachelor of Arts in Physical Education — University of California, Berkeley

1973–1974
Master of Arts in Physical Education — University of California, Berkeley

1974–1981
PhD in Exercise Physiology — University of Wisconsin–Madison

1981–1984
Postdoctoral fellowship — Division of Cardiology, University of Texas, Southwestern Medical School

1984–1991
Assistant Professor of Medicine and Cellular & Molecular Physiology — Pennsylvania State University, Milton S. Hershey Medical Center

asked Musch what he was going to do for his career and suggested he go to graduate school.

"Why would I go to graduate school?" Musch remembers asking, and Brooks' answer was simple: "They pay you." Musch was intrigued.

"Dr. Brooks, you couldn't say 'no' to him," Musch says. "He was this young guy. He knew my background and I knew his—kind of blue-collar backgrounds. He would never, ever call me by my first name. It was always, 'Hey, Musch.' 'Yeah?' 'You're gonna do this.' 'Okay.'"

Musch ended up earning his master's at Berkeley and working in the lab with Brooks. When Musch was almost done with his master's, Brooks told him he should pursue his doctorate. "Go to Madison, Wisconsin," Brooks told him. "You'll have more fun there."

FINDING HIS WAY TO PHYSIOLOGY

That's exactly what Musch did. His time in Wisconsin ended up being pivotal: That's where he met his wife, on a blind date set up by a fellow graduate student's spouse. They married in 1980; he graduated in 1981. And then it was on to Dallas, to the University of Texas Southwestern Medical School, for his postdoctoral work.

"I told my wife, if my postdoc wasn't life-changing, then I was going to go to vet school," he says, "but my time in Dallas was great."

He worked with a cardiologist in the lab, looking at blood flow through muscle and how it was affected by cardiovascular stress. He learned the radiolabeled microsphere technique for measuring skeletal muscle blood flow and looked at skeletal blood flow in exercising dogs. His skill in that technique helped him land his next appointment: on the faculty at Pennsylvania State University in the Milton S. Hershey Medical Center.

He heard about the opportunity from a friend, who told him the job was practically written for him. Musch faxed his materials over on a Monday, heard back two days later, flew out the next Monday to interview, and received the job offer that Friday. He, his wife, and their newborn daughter packed up and moved to Hershey, Pennsylvania, where they stayed for nine years. Musch taught a little bit, ran the cardiovascular sheep laboratory for the first-year medical students, experimented on rats, and collaborated with colleagues on studies focused on heart transplant patients and heart failure.

"When I got into the business, if you talked with a cardiologist, they said the problem is the heart is damaged, it can't pump, and so the people become very sedentary and what you see in the peripheral skeletal muscle is a detraining effect," Musch says. But in work that he collaborated on with Lawrence Sinoway, MD, at Penn State, they found that the condition of heart failure changed how skeletal muscle blood flow was regulated at rest and during exercise and that it remained reduced in the patient even after they received a new heart.

In response to the heart's inability to sustain a normal cardiac output, a strong vasoconstriction occurs in the skeletal muscle to maintain blood pressure. When the new heart was transplanted, that vasoconstriction didn't just go away, so even though the new heart produced a greater cardiac output, it did not result in increases in skeletal muscle blood flow.

Findings like these excited Musch, and working closely with clinicians and drug companies meant he could see his work directly making a difference for patients. "It was a tremendous environment to get my career started," he says. "I had all the resources I needed to be successful."

But he says while he was appreciating the real-life impact of his work, the reductionist approach to science was taking hold, progressively narrowing down to the cellular and molecular level and too often neglecting systemic understandings of physiology.

"The big move from the NIH was to go down into the cell. They thought the Human Genome Project would be how we would cure these diseases, so they started funding many cellular and molecular biologists. So, you have a lot of people going down, reduction in science,

1991–1993
Associate Professor of Medicine and Cellular & Molecular Physiology — Pennsylvania State University, Milton S. Hershey Medical Center

1993–1996
Associate Professor of Kinesiology, Anatomy & Physiology — Kansas State University

1996–2017
Professor of Kinesiology, Anatomy & Physiology — Kansas State University

2013–2015
Interim Associate Dean for Research & Scholarship — College of Health and Human Sciences, Kansas State University

2017–Present
University Distinguished Professor, Kinesiology — Kansas State University

but they struggled to bring their discoveries back up to the organ systems level," he says. "When I moved to Hershey, there was the Department of Physiology, then it became the Department of Cellular Physiology, then it became the Department of Cellular and Molecular Physiology."

Then, for unrelated reasons, Penn State's medical school hit financial trouble and Musch started seeking out other opportunities.

RECRUITING HIS KANSAS STATE TEAM

In the 1990s, universities across the U.S. were reorganizing their physical education programs into new kinesiology departments and looking for qualified faculty to teach science-based courses. Kansas State was one such institution.

"When I interviewed, they were ready for me," Musch says. "Every single time I had a question, they had the right answer. Where am I going to do my animal research? 'You can have a lab in the vet school.' Is the administration set up to administer my NIH grant? 'Yes.'"

The university gave him a dual appointment with the Department of Kinesiology on the main campus and the Department of Anatomy and Physiology in the College of Veterinary Medicine. The dean encouraged him to recruit another physiologist. He started with David Poole, PhD, DSc, who was working in the medical school at University of California, San Diego, and whose research was complementary to Musch's.

"We were both interested in the regulation of skeletal muscle blood flow," Musch says. "I was at the macro level, so I looked at total flow to the muscle and muscle parts, and David did the microcirculation, so he was interested in oxygen transport and blood flow down in the capillaries."

Next, they recruited Thomas Barstow, PhD, FAPS, whose research on oxygen uptake and skeletal muscle blood flow in humans complemented Musch and Poole's animal research. Then, Richard McAllister, PhD, who could isolate arterioles and look at their function. "Each hire was instrumental in contributing to a team effort in the research program," Musch says. They also strengthened the academic program, increasing the number of kinesiology majors from less than 200 to more than 600 today.

While other kinesiology programs focus on athletic training or biomechanics, Kansas State's program has focused on the connection between physical activity and public health, and, appropriately, physiology.

"We have enough [faculty] in kinesiology that are physiologists, so we can offer the expertise in respiratory physiology, cardiovascular physiology, skeletal muscle physiology, neurophysiology," Musch says. This background in systems physiology has set his graduates up for success. Feedback indicates that the students who come from the program know more physiology than the people who were teaching physiology in their physical therapy schools.

CALLING MORE ATTENTION TO PHYSIOLOGY

This success, along with the example of peer institutions, led Musch's colleagues to establish an integrative physiology major two years ago. It also backs up Musch's conviction that physiology is the discipline crucial for ensuring discoveries made on the cellular and molecular levels are translated, tested and understood in the big picture. Musch plans to bring this same conviction to the role of APS president, which he stepped into in April. In this role, he will work to elevate the field of physiology and help APS fulfill its strategic plan.

"Physiology, historically, has been an extremely strong and important science associated with medicine, and it's been lost a bit by the academic institutions. We need to re-establish that we are physiology, and we are important," he says, chuckling. But it's not just a joke. He means it.

8 Questions with Tim Musch

What is your best piece of career advice? If the door of opportunity knocks, don't be afraid to step through it and see where it takes you. Life is full of opportunities, and if you don't take those opportunities, you might regret it. Every single time the door of opportunity has knocked, I've been surprised. It's been very good for me.

What is your idea of happiness? Visiting my children and grandchildren.

What is your greatest fear? Losing a family member.

What three traits do you value in a colleague? Honesty, hardworking, collegiality.

Who do you most admire? My three mentors: Dr. George Brooks, Dr. Jerry Dempsey and the late Dr. Jere Mitchell.

What talent would you most like to have? To be able to write a clear and funded grant every single time.

What is your greatest career achievement? Getting Dr. David Poole to come to Kansas State University.

What is your most treasured possession? Life.

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FINDING YOUR WAY

How to know it's time to choose a different path, whether pursuing a new opportunity or making a career pivot.

BY CANDACE Y.A. MONTAGUE AND MELANIE PADGETT POWERS

Karen Edelblum, PhD, was not unhappy at Rutgers University. But after seven years as an assistant professor running her first independent lab, she started to reflect on her career: What would the next phase look like? How had her interests and research changed?

As a researcher of inflammatory bowel disease (IBD), Edelblum realized she missed working in centers that were gastrointestinal (GI) focused, like she had as a trainee. Now, she was based in a center for immunity and inflammation. She thought she might be ready for a change—and she wanted to get back to doing mostly research.

As Edelblum applied for tenure at Rutgers, she also reached out to her network and learned there was a dream position researching Crohn's disease at Mount Sinai in New York City. Crohn's disease, a type of IBD, was first described in 1932 at Mount Sinai, and the institution remains at the forefront of Crohn's disease research and treatment.

"A month and a half later, I interviewed," Edelblum says, "and then four months after that I had an offer. It was not the normal academic interview process, but that was entirely because I had built relationships in the field." In March 2023, Edelblum—and her entire lab team—moved to the Icahn School of Medicine at Mount Sinai. As part of her package, she was promoted to associate professor. She applied for and received tenure after arriving.

SHOULD I STAY OR SHOULD I GO?

Deciding to pursue a new opportunity, whether it is changing universities, adding or subtracting teaching and administrative duties, or leaving academia, is a major step in your career journey. It can be daunting to consider such big decisions, and fear can hold us back from making a change. But it's important to recognize the signs that a change might be what you need and to know how to reflect on your options. Sometimes, Edelblum says, it comes down to a simple question: "Am I happy?"

Illustration by Robert Neubecker

As a dean, "I love helping people get innovative and navigate the complex landscape that is higher education."

—Jason Carter, PhD

To consider whether it's time to move on, first figure out what you can and can't control, says Cassie M. Briggs, PhD, a certified professional STEM career coach and CEO of Success in Science Career Coaching. "If the things outside of your control are negatively affecting you, that's when you need to start having conversations with others, such as [a mentor] or colleagues, about how this can be remedied. What other positions are out there?" she says.

Briggs says it's a little like diagnosing an illness and then finding the right treatment for it. "This is about the diagnosis. You have to figure out what's wrong before you can decide what to do."

As a university biology professor before becoming a career coach, Briggs knows what a pivot feels like. She discovered a passion for supporting students in their career aspirations during office hours. So, in 2020, she resigned from her university position and went into the STEM-tailored career coaching business full-time.

PERSONAL CONSIDERATIONS

Having the flexibility to pursue passions while maintaining meaningful connections with family and friends has become essential to employees in many industries. A 2018 Pew Research Center study revealed that 71% of men and 76% of women in STEM careers say being able to balance work and family is important to them in choosing a job.

Family life was something Alexander Staruschenko, PhD, FAPS, considered when he was ready to move on from his research role at the Medical College of Wisconsin (MCW). Over 14 years, he had "grown up" at the college, moving from assistant to associate to full professor, then eminent scholar, which is the equivalent of an endowed chair. He felt he had achieved all he could at MCW.

In 2021, Staruschenko was offered a position at the University of South Florida (USF). He appreciated USF's commitment to building a high-profile research program and saw how he could continue growing his research and his career. But he and his wife had their kids to consider.

At the time, their son was 15 and daughter, 10. Their son had just started high school, and the couple didn't want to disrupt either child's high school experience, so it was time to make a move or wait several years. Now, at USF, Staruschenko is a professor in the College of Medicine's Molecular Pharmacology and Physiology Department and director of the Hypertension and Kidney Research Center.

EMBRACING THE CURVEBALLS

Sometimes a career move is about more than finding a new position. Maybe you are feeling unfilled in the arena you studied so long to get to and need to pivot. Reflect on what you love—and don't—about your career and how you can lean into new passions. Sometimes opportunities can pop up when you're not even looking.

Growing up in Puerto Rico, Katya Melnik-Martinez, PhD, was always fascinated by the wonders of the environment. After earning a PhD in neuroscience at Case Western University in Cleveland, Melnik-Martinez moved back to Puerto Rico and landed a research position at Universidad Central del Caribe. She worked on a project involving microscopic worms. "I had a really nice project going. I really liked it," she says. But when the one-year grant was not renewed, Melnik-Martinez lost her position. That's when she decided she didn't want to deal with the ups and downs of seeking grant funding anymore. She had come to love teaching, so after reflecting on her options, she decided to become a science teacher.

Melnik-Martinez and her family moved to Maryland, where she is now a high school biology teacher. "I'm glad I went in a different direction," she says. "I absolutely love what I do."

Integrative physiologist Jason Carter, PhD, certainly never expected the trajectory his career took—into administration. Carter is the dean of the Robbins College of Health and Human Sciences at Baylor University in Waco, Texas.

After earning his bachelor's and doctorate at Michigan Technological University, Carter began adjunct teaching for the biology department. He advocated for Michigan Tech to launch a kinesiology department, an idea leadership supported. As Carter began to help launch the program, the plan included him becoming the first tenure-track assistant professor of the new department. Then, the chair of the new department died suddenly, thrusting Carter into the role. While that's not a route anyone would choose, he says, "you have to follow the pathways that are opened up for you."

It turned out that Carter enjoyed the administrative aspects of the role, as long as he could continue to do research. "I found a knack for it," he says. "It wasn't something I sought out. It was something that presented itself, and I was just trying to do the very best job I possibly could with my research, teaching and building a good program."

The new kinesiology department found success and built up its research quickly. After taking on an associate dean role to help grow research across the College of Sciences and Arts, Carter was asked to do the same thing at the university level as associate vice president for research development.

After spending his entire career at Michigan Tech, Carter decided to move on to become vice president for research at Montana State University in Bozeman. Three years later, he was offered the dean position at Baylor, where he works directly with faculty across six departments. "I love helping people get innovative and navigate the complex landscape that is higher education at an R1 university," he says.

4 Steps of Career Diagnosis

STEM career coach Cassie M. Briggs, PhD, shares these tips to help you assess your level of career fulfillment.

STEP 1: Collect data and look for patterns.
Review your tasks, who you worked with and where you worked, and how productive or happy you feel at the end of each day. What patterns or correlations do you notice in a week or month?

STEP 2: Distinguish tasks from their context
Imagine you are responsible for writing and submitting grant proposals for an R1 university but dread it. The question is, do you dislike writing grants, or do you dislike writing them for the university? Would you like your job at the university better if you didn't have to write grants? Would you like your job better if you wrote grants for a nonprofit?

STEP 3: Check your alignment.
How well does your role align with your professional identity, such as your values, interests, skills and priorities?

STEP 4: Reflect on your "why."
Remind yourself: What is the purpose of your career? Are you looking for your career to provide the financial stability needed to experience a fulfilling life outside work, or are you looking for fulfillment within your career itself—or both?

"I was so nervous about making that change. I'd trained to be an academic my whole life. Was I making a mistake?"

—Lisa Ganser, PhD

Carter says not only is it important to know what you want out of a career, but to be patient for the right position to come along. "It's super easy to chase a lot of positions because there are a lot out there for good STEM faculty." But, he says, "People can jump on too many opportunities. It's important to know what you want and where you want to be."

Staruschenko stresses that the decision to stay or go is very individualized. There are benefits to both changing positions and to staying in one place your entire career, he says. When he was younger, well-established physiologists told him, "You need to make a big move every 10 years in your career." He disagrees: "That might be a good timeline and work for some people, but that doesn't mean that it works for others."

Sue Bodine, PhD, FAPS, a professor at the Oklahoma Medical Research Foundation (OMRF), has made three big moves in her physiology career—in one sense all three were lateral moves, as she was already a full professor. But she could see that each change afforded her new opportunities in her research. Bodine is a neuromuscular physiologist studying the regulation of skeletal muscle mass and the mechanisms underlying muscle atrophy.

Her move from an undergraduate department at University of California, Davis to the school of medicine and a clinical department at the University of Iowa allowed her to decrease her teaching load. She then left Iowa for Oklahoma because her research leaned more into aging, and OMRF and the University of Oklahoma Medical School had programs that allowed her to do more translational research.

FACING BURNOUT

Sometimes when you ask yourself that simple question "Am I happy?" the answer is "no." Comparative physiologist Lisa Ganser, PhD, was once quite content with her position as an assistant professor at Kennesaw State University in Georgia. She relished her rich conversations and research projects with students. But the struggle to continually obtain grant funding, the ballooning class sizes after a merger with Southern Polytechnic State University, and the lack of opportunities for women of color took its toll on her mental health.

"I could tell that my anxiety was coming to a head after the merger when it would take all my effort to get ready for class or to take care of the lab animals or be present for both research and course students," she says.

When the opportunity came for Ganser to work as a health scientist at a government agency, she jumped on it. "I was so nervous about making that change," she says. "I'd trained to be an academic my whole life. Was I making a mistake? Because there's no coming back from not being in the research lab for a year or so. The job and atmosphere were so different, but I eventually found my cadence."

Karla Haack, PhD, can relate to the weight of academia. After earning her doctorate in cell physiology (applied biology), she spent five years in postdoctoral studies working in autonomic and cardiovascular physiology. She took time off to have her first child and reentered the workforce as a university lecturer. She loved teaching, but she was burnt out from the demands of academia. Because she had a passion for writing, she decided to leverage that talent.

"I was always helping write everyone's papers; I was the person that was always helping to put together everyone's posters," she says. "That was the part of the work I really enjoyed. I liked problem-solving."

Haack entered a medical writing training program at Merck, where she's now an associate medical writer. "I love my job! It keeps me on my toes. It's an interesting way to use one's science background," she says.

There are many factors and questions to ask yourself when you decide it might be time to move on—it's a personal and individualized process. Reflect on your happiness, whether your values and goals are aligned with your position, and what lights you up every day.

"There are many reasons why somebody wants to move," Bodine says, "but weigh the positives and the negatives, the cost-benefit analysis, of what that move is going to bring you."

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Advances in Sickle Cell *Disease*

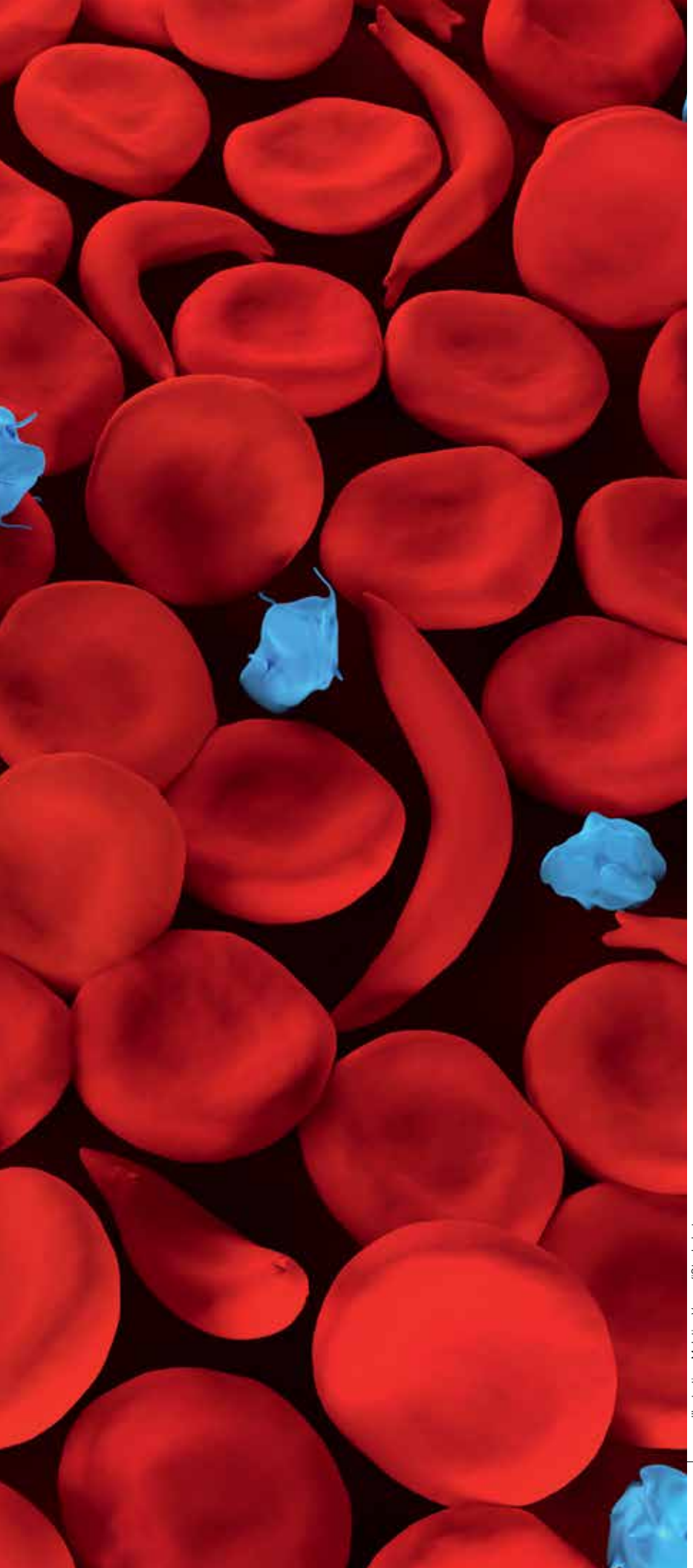

Illustration: Meletios Verras/iStockphoto

Research has led to major breakthroughs in the treatment of sickle cell disease, with promising advances still on the horizon.

BY CHRISTINA SZALINSKI, PHD

Since the 1956 discovery of the sickle cell disease (SCD) gene mutation, our understanding of the disease has increased dramatically, with advancements in diagnosis, treatment and management. However, though medicines helped with pain and other symptoms, until 2023, the only cure was a bone marrow transplant, which has challenges of donor availability and potential complications.

Then, in December 2023, the U.S. Food and Drug Administration (FDA) approved two gene therapies that serve as potential cures for those with severe SCD. Physiologists are among those conducting research that would bring about more treatments. Furthermore, the impact of SCD research extends beyond the disease—it has the potential to unlock valuable insights related to other conditions, such as HIV and beta thalassemia.

SCD is a painful and debilitating genetic disease that, in the U.S., predominantly affects Black Americans. A sickle cell crisis occurs when the sickle-shaped red blood cells block blood flow in different parts of the body. This can cause intense pain. Triggers for these crises can include stress, sudden change in temperature, infection, dehydration and certain medications.

The pain can feel like having a fracture in your bone "and it's not healing, and your bone keeps getting fractured, again and again and again," explains Akshay Sharma, MBBS, bone marrow transplant physician and researcher at St. Jude Children's Research Hospital.

SCD is caused by a mutation in the gene that codes for hemoglobin, the protein in red blood cells that carries oxygen throughout the body. Normally, red blood cells are round and flexible, which allows them to easily move through narrow blood vessels. However, in SCD, the abnormal hemoglobin causes the red blood cells to become fragile (causing anemia), stiff, sticky and sickle-shaped when they lack oxygen. These sickle cells can clump together and block blood flow to organs and tissues, causing pain, tissue damage and other complications such as stroke.

In the long term, SCD can cause blood clots, kidney damage, liver disease, vision loss, splenic sequestration (enlarged spleen and severe drop in hemoglobin), stroke, chronic pain and cognitive decline. "The median lifespan is about 40 to 45 years for individuals with sickle cell disease because there's all these complications that lead to organ damage," Sharma says.

NEW SCD TREATMENTS

The two new gene therapies for SCD edit the DNA within a person's own blood stem cells to promote production of fetal hemoglobin or another normal hemoglobin, such as hemoglobin HbAT87Q. These hemoglobins are naturally flexible and do not sickle or aggregate, thereby reducing the frequency and severity of pain crises, as well as the complications associated with red blood cell damage and thrombosis.

The gene therapy made by Vertex Pharmaceuticals, called Casgevy (betibeglogene autotemcel), uses CRISPR/Cas9 technology to induce fetal hemoglobin production. The gene therapy from Bluebird Bio, called Lyfgenia (betibeglogene autotemcel), uses a lentiviral vector to promote synthesis of normal hemoglobin HbAT87Q by the erythroid precursor cells (young blood cells). In clinical trials, these treatments significantly reduced the frequency and severity of pain crises and other complications. Long-term studies will reveal if they have sustained success.

While this new technology would be life-changing for many people with SCD, it requires a patient to spend a month or more in the hospital, first to mobilize and collect their stem cells and then to undergo chemotherapy to eliminate their bone marrow before it is replaced with new genetically modified cells. This carries risks, says Sharma, who was involved in the Vertex clinical trials. It also costs $2 to $3 million for one person. Because of the price tag, insurers may limit which patients are eligible for gene therapy coverage. Sharma is hopeful that in the future there will be a vaccine, which would be less invasive and more cost-effective.

Some patients may opt to have a bone marrow transplant, which has been a treatment for children with severe SCD since the 1980s. However, patients still require chemotherapy to reset their bone marrow, and physicians need to replace it with a close match. As with any transplant, there's a risk that the body will develop graft versus host disease and reject the new bone marrow cells. This doesn't happen with

Illustration: Ezumelmages /iStockphoto

gene therapy because it uses the body's own cells. However, a bone marrow transplant costs less than gene therapy.

More commonly, people with SCD are treated with a drug called hydroxyurea, which stimulates the production of fetal hemoglobin in the patient's own erythroid cells. Hydroxyurea reduces the frequency of pain crises and thrombus formation and the need for blood transfusion in SCD patients with severe disease. Though clinical trials of hydroxyurea began in 1984, its mechanism of action is still not fully understood. More recent drugs include voxelotor, which prevents red blood cells sickling, and crizanlizumab, which reduces red blood cell adherence and SCD crises.

There are also new drugs in clinical trials. Based on the findings of the group of Anna Bogdanova, PhD, at the University of Zurich's Institute of Veterinary Physiology, the University Hospital Zurich carried out a MemSID Phase II clinical trial of memantine for SCD. A follow-up trial was recently finalized at the Pediatric Hematology Unit at the Emek Medical Center in Afula, Israel.

"The idea was to help people in [developing] countries because it's a very cheap drug. It's already available for treatment of Alzheimer's disease, and we repurposed it into something for sickle cell disease patients," Bogdanova says.

Memantine blocks N-methyl D-aspartate receptors (NMDAR), which allow calcium ions to enter the cell when activated. Red blood cells affected by SCD have an increase in abundance and activity of NMDAR, though its role in red blood cells is an emerging area of research. NMDARs are most abundant in the brain but are also found in other tissues of the body, including the heart, bones, kidneys and blood cells. Overactivation of NMDARs might be involved in pain signaling.

Because gene therapy costs $2 to $3 million for one person, insurers may limit which patients are eligible for gene therapy coverage.

"We hope that memantine can be used to stabilize the red blood cells and also to somewhat relieve pain, inflammation and organ damage," Bogdanova says. It's too early to know its long-term effects, but the first outcomes for the SCD patients treated with memantine for 12 months are promising, she says. And the drug is well-tolerated by adult and adolescent SCD patients. Bogdanova believes that this small molecule can be combined with hydroxyurea for a more comprehensive treatment approach.

BENEFITS OF EXERCISE

An even simpler and more readily available approach to managing SCD could be exercise. Laurent Messonnier, PhD, exercise physiology professor at Université Savoie Mont Blanc and researcher at the Interuniversity Laboratory of Human Movement Sciences in France, is studying how physical activity can help those with SCD.

"High-intensity exercise can be dangerous for patients with SCD because it can cause a sickle cell crisis," he says, "but low- to moderate-intensity exercise is safe and performed regularly can be beneficial for patients with SCD."

Using a stationary bike and a heart rate monitor, Messonnier had patients maintain a target heart rate during moderate-intensity exercise for 30 to 45 minutes three times a week for eight weeks. "That was sufficient to improve physical mobility, muscle function and quality of life for patients with SCD," he says. It doesn't sound like much, but he points out that physical activity can be very demanding for those with SCD because they also have anemia. His team is continuing to study the long-term benefits of regular exercise.

INEQUITIES PERSIST

Despite being a more prevalent condition, SCD research has historically received significantly less funding than research into other genetic diseases, such as cystic fibrosis—a genetic disease that predominantly affects white people. SCD is three times more prevalent than cystic fibrosis in the U.S. This funding gap and decreased attention has likely hampered progress in developing new treatments and improving patient outcomes.

Additionally, SCD patients have been marginalized in medical care, where their extreme pain can be dismissed. Data suggest that children with SCD aren't getting the preventive treatment they should. A Centers for Disease Control and Prevention report found that less than half of U.S. children ages 2 to 16 with SCD received the recommended screening for stroke. Furthermore, many of these children were not receiving hydroxyurea, the recommended treatment that can improve complications, anemia and quality of life.

In addition, the representation of Black Americans in the donor registry is very low, so patients often rely on

Despite being a more prevalent condition, SCD research has historically received significantly less funding than research into other genetic diseases, such as cystic fibrosis.

siblings or parents, which may not provide the optimal match. This isn't an issue with gene therapy because it uses the body's own cells. However, the cost of the new treatments put it out of reach for most people with SCD.

Women with SCD face additional disparities. The U.S. has the highest rate of maternal mortality among 11 high-income countries, and Black women are more likely to die in pregnancy, childbirth or postpartum, according to Layla Van Doren, MD, hematologist at Yale Cancer Center and Smilow Cancer Hospital. "Maternal morbidity and mortality rates are even higher for pregnant persons with SCD," she says. "Even with the recent FDA approval of two gene therapy products, there remain no established standard of care for preventing and managing complications for pregnant persons with SCD and no approved disease-modifying therapies."

Moreover, Van Doren points to research that has shown a relationship between vaso-occlusive events and menstruation. Menstrual blood loss can also make SCD-related anemia worse. She is involved in a study surveying SCD patients about how menstruation affects their pain events and health care utilization.

Van Doren found that while most women who completed the survey had menstrual-related pain and menstrual-associated sickle cell pain, most were not taking hormone therapy. "Contraception not only provides control of unintended pregnancy but can also lead to decreased blood loss and management of menstrual-related sickle cell pain," she says.

Van Doren says sometimes patients might not even make the connection that their vaso-occlusive events are related to menstruation. "It is important for providers to ask because there are treatment options to help alleviate these symptoms," she says.

CONNECTIONS TO OTHER DISEASES

SCD research holds the potential to benefit not only patients with the disease but those with other conditions, too. For example, research suggests a potential link between SCD and reduced susceptibility to HIV infection—individuals with SCD have a lower prevalence of HIV infection compared to the general population, though SCD does not offer complete protection.

By studying the mechanisms that might lead to a reduced susceptibility to infection, "we might find some interesting pathways which can actually help to protect people from infection," says Sergei Nekhai, PhD, medicine, microbiology and pharmacology professor at Howard University.

Previous research indicates that a factor on certain immune cells, a protein called CCR5 that HIV-1 uses to infect these cells, is mutated on the immune cells in people with European ancestry, which may help protect against HIV-1 infection. But this is not the case for SCD patients, who, as Nekhai's research showed, might suppress HIV-1 infection because of the upregulation of innate antiviral factors driven by changes in iron metabolism, hypoxia and production of interferon.

Advances in SCD research also provide clues for a similar disease: beta thalassemia, which is also an inherited blood disorder that affects the structure and function of red blood cells. "The same genetic treatments that are effective for sickle cell disease are also effective for beta thalassemia. So, there is hope that we can develop a treatment for one and use it on the other disease," Sharma says.

MORE TO LEARN

Since the groundbreaking discovery in 1956 of the gene mutation responsible for SCD, our understanding of this condition has grown tremendously. Researchers have made significant strides in diagnosis, treatment options and overall disease management. However, there's still much more to learn.

"The biggest question in the field is what defines the severity of manifestation of this disease," Bogdanova says. "This is a monogenic disease, but we have patients with the same point mutation, and some of them are completely asymptomatic and some of them are dying early or spend life in pain. What is the difference between these two groups of people? That remains unclear."

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Erica Dale Receives University of Florida Rising Star Researcher Award

Erica Dale, PhD, an assistant professor in the University of Florida (UF) College of Medicine's Department of Physiology and Aging, is the 2024 recipient of the UF College of Medicine Rising Star Researcher Award in Basic or Translational Sciences. Dale received the honor, which recognizes rising researchers in their fields, for her work to help restore breathing function in people with spinal cord injuries. She has been an APS member since 2007.

Melinda Engevik Receives American Society for Investigative Pathology Early-career Award

Melinda Engevik, PhD, an assistant professor in the Department of Regenerative Medicine and Cell Biology at the Medical University of South Carolina, is the 2024 recipient of the American Society for Investigative Pathology's Cotran Early-career Investigator Award.

The award recognizes early-career investigators who direct meritorious and impactful independent experimental pathology research programs that are focused on improvement of the understanding of the conceptual basis of disease. Engevik's work focuses on microbiota and the crosstalk occurring between bacteria and the gastrointestinal epithelium. She is the chair of the Trainee Advisory Committee and has been a member of APS since 2014.

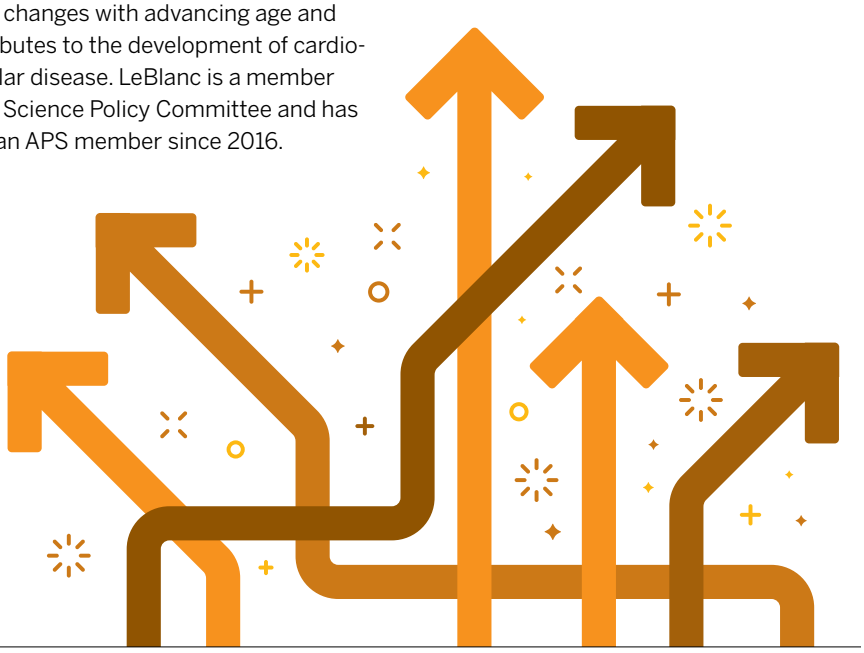
Amanda LeBlanc Appointed Interim Associate Dean for Research

Amanda Jo LeBlanc, PhD, has been appointed interim associate dean for research at the University of Louisville School of Medicine.

LeBlanc is a professor in the Department of Cardiothoracic and Thoracic Surgery. Her research focuses on how the microvasculature changes with advancing age and contributes to the development of cardiovascular disease. LeBlanc is a member of the Science Policy Committee and has been an APS member since 2016.

Shannon Lennon Receives University of Delaware Women's Caucus Award

Shannon Lennon, PhD, a professor of kinesiology and applied physiology at the University of Delaware (UD), is the 2023 recipient of the UD Women's Caucus Torch Award for Women's Equality. The award's aim is "to achieve equality and improve the quality of employment for women" at the university. Lennon was a founding member of the caucus, where she advocated for women on issues of equity and inclusion and continues to do so. She is also the first female chair of the Institutional Review Board at UD and is director of UD's Cardiovascular Nutrition Lab. Lennon has been an APS member since 2001.



AWARDS

**Award deadlines may be subject to change*

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

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

Teaching Career Enhancement Awards (May 31)

Respiration Section Julius H. Comroe Jr. Distinguished Lectureship (June 30)

Water & Electrolyte Homeostasis Section Ernest H. Starling Distinguished Lecture (July 1)

Henry Pickering Bowditch Award Lectureship (July 14)

Physiology in Perspective: The Walter B. Cannon Award Lecture (July 14)

Claude Bernard Distinguished Lectureship Award (July 15)

Endocrinology & Metabolism Section Solomon A. Berson Distinguished Lectureship (July 31)

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

More details: physiology.org/awards

CALLS FOR PAPERS

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

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

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

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

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

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

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

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

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

More details: journals.physiology.org/calls

MEETINGS & EVENTS

2025 American Physiology Summit
April 24–27, 2025
Baltimore
- Call for proposals closes: May 17

More details: physiology.org/summit

WEBINARS

APS-GATORADE SPORTS INSTITUTE

Gx: From Hydration Science to Technology
May 1 at 1 p.m. E.T.

More details: physiology.org/webinars

LEADERSHIP

New APS Leadership Elected

The results of the 2024–2025 elections are in. The following winners began their terms in April at the conclusion of the American Physiology Summit.

PRESIDENT-ELECT

Robert L. Hester, PhD, FAPS
Professor, Department of Physiology and Biophysics, University of Mississippi Medical Center

COUNCILORS

Patricia A. Halpin, PhD, FAPS
Professor, Biology and Biotechnology, Department of Life Sciences, University of New Hampshire

My Helms, PhD
Associate Professor of Internal Medicine, University of Utah School of Medicine

Beth A. McCormick, PhD
Professor and Chair, Microbiology and Physiological Systems, University of Massachusetts Chan Medical School

MEET THE CHAIRS

New Section Chairs Elected

Meet the five new APS section chairs. Their terms began at the 2024 Summit.

Comparative & Evolutionary Physiology Section (CEPS)

Dane A. Crossley, PhD
Professor, Department of Biological Sciences, University of North Texas

Environmental & Exercise Physiology (EEP) Section

Tracy Baynard, PhD, FAPS
Associate Vice Provost, Graduate Education, University of Massachusetts Boston

Gastrointestinal & Liver (GIL) Physiology Section

Karen L. Edelblum, PhD
Associate Professor, Department of Pathology, Molecular and Cell-Based Medicine, Icahn School of Medicine at Mount Sinai

Neural Control & Autonomic Regulation (NCAR) Section

Paul Marvar, PhD
Associate Professor, Department of Pharmacology and Physiology, George Washington University School of Medicine and Health Sciences

Water & Electrolyte Homeostasis (WEH) Section

Meena Madhur, MD, PhD
Division Director, Clinical Pharmacology and Associate Professor of Medicine, Indiana University

APS thanks outgoing section chairs for their service to the Society and their sections between 2020 and 2023. The section chairs were recognized for their contributions at a special Honors & Awards Ceremony at the 2024 Summit. The outgoing chairs were:

- Lynn Hartzler, PhD, CEPS
- David Poole, PhD, FAPS, EEP
- Pradeep Dudeja, PhD, GIL
- Kamal Rahmouni, PhD, NCAR
- Kathryn Sandberg, PhD, FAPS, WEH

COMMITTEES

Now Open: Committee Applications

Don't miss your chance to get involved with APS. The Society is accepting applications for committee service, with terms beginning in spring 2025. Apply before the August 15 deadline. Members serve a three-year term that will begin and end at the American Physiology Summit in April. Committee members are appointed by the APS Council at the recommendation of the Committee on Committees. Review the list of committee vacancies at **physiology.org/committees**.

PUBLIC POLICY

APS Keeps Physiology at Forefront at NIH Division

Last July, the National Institute for General Medical Sciences at the National Institutes of Health (NIH) proposed a reorganization of its Division of Pharmacology, Physiology and Biological Chemistry that would have renamed its branches and removed the word "physiology" from the branch titles. While officials assured the community that the research topics would not change, APS members raised concerns about whether the change would limit future funding opportunities for physiologists. Agreeing with those concerns, then-APS President Rick Samson, PhD, DSc, FAPS, authored a letter on behalf of the membership requesting the name of the proposed Clinical and Systemic Sciences Branch be revised to include the word "physiology." APS learned in February that these efforts were successful, and the final branch title is Physiology and Clinical Sciences.

EXERCISE CONFERENCE

Integrative Physiology of Exercise Conference Planned for November

As the Noll Laboratory for Human Performance Research at Pennsylvania State University celebrates 50 years of discovery, APS invites scientists from around the world to State College, Pennsylvania, for a quadrennial conference dedicated to exercise physiology.

APS' Integrative Physiology of Exercise conference will be held November 20–22, 2024. Conference attendees are also invited to a special event celebrating Noll Laboratory and its half century-long commitment to the field. The conference program will include opportunities for researchers to present their original work, collaborate and network. Learn about the latest integrative and translational breakthroughs in areas such as:

- Human performance
- Insulin resistance
- Thermoregulation and aging
- Resistance
- Cardiovascular implications
- Careers in exercise physiology

Abstract submissions, awards and registration will open in June. For more information, visit **physiology.org/exercise**.

Embracing the Journey of a Science Career

BY LAURA R. MCCABE, PHD

"The path to success is rarely a straight line; it's more like a scribble, filled with twists and turns, ups and downs, but ultimately leading to where you're meant to be." —Unknown

In the realm of scientific inquiry, the journey of a researcher is akin to navigating uncharted waters. It's a journey defined by unexpected detours and unforeseen challenges, yet it is these very twists and turns that shape our expertise and character.

Challenges are not roadblocks but opportunities for growth, resilience and personal development. As I reflect on my own journey, I am reminded of the invaluable lessons learned amidst the unexpected.

My journey began in graduate school under the guidance of Gene Chang, MD, at the University of Chicago, where my passion for understanding the mechanisms underlying gastrointestinal (GI) physiology was ignited. The cutting-edge research and discoveries in this field captivated me, laying the foundation for a lifelong dedication to science.

However, life had other plans, and a curveball led me to Massachusetts for a postdoctoral position in bone molecular biology under the mentorship of Gary Stein, PhD. Despite the steep learning curve and unfamiliar territory, the supportive environment (mentors and fellow trainees) fostered an enriching experience that expanded my horizons.

After securing a tenured faculty position at Michigan State University, focused on teaching GI physiology and researching molecular mechanisms of GI adaptation, I encountered an unexpected opportunity. I found myself receiving funding for research projects examining mechanisms of bone loss. This turn of events opened new doors, and soon my laboratory was contributing to groundbreaking discoveries linking gut health to bone health and showcasing the synergies between seemingly disparate fields.

Recognizing the impact of university and federal policies on researchers, I felt compelled to be part of the solution. I became active in university governance and joined the APS Science Policy Committee, where I gained a deeper understanding of the regulatory landscape and the critical role that scientific societies play in shaping it. Collaborating with fellow APS members and engaging in additional committee work not only expanded my professional network but also provided me with unique insights and perspectives.

Assuming the role of committee chair allowed me to lead initiatives, advocate for important issues and represent the interests of our scientific community. Additionally, my service on the Science Policy Committee of the Federation of American Societies for Experimental Biology, as an APS liaison, further broadened my understanding of the collaborative efforts among scientific societies and their functions.

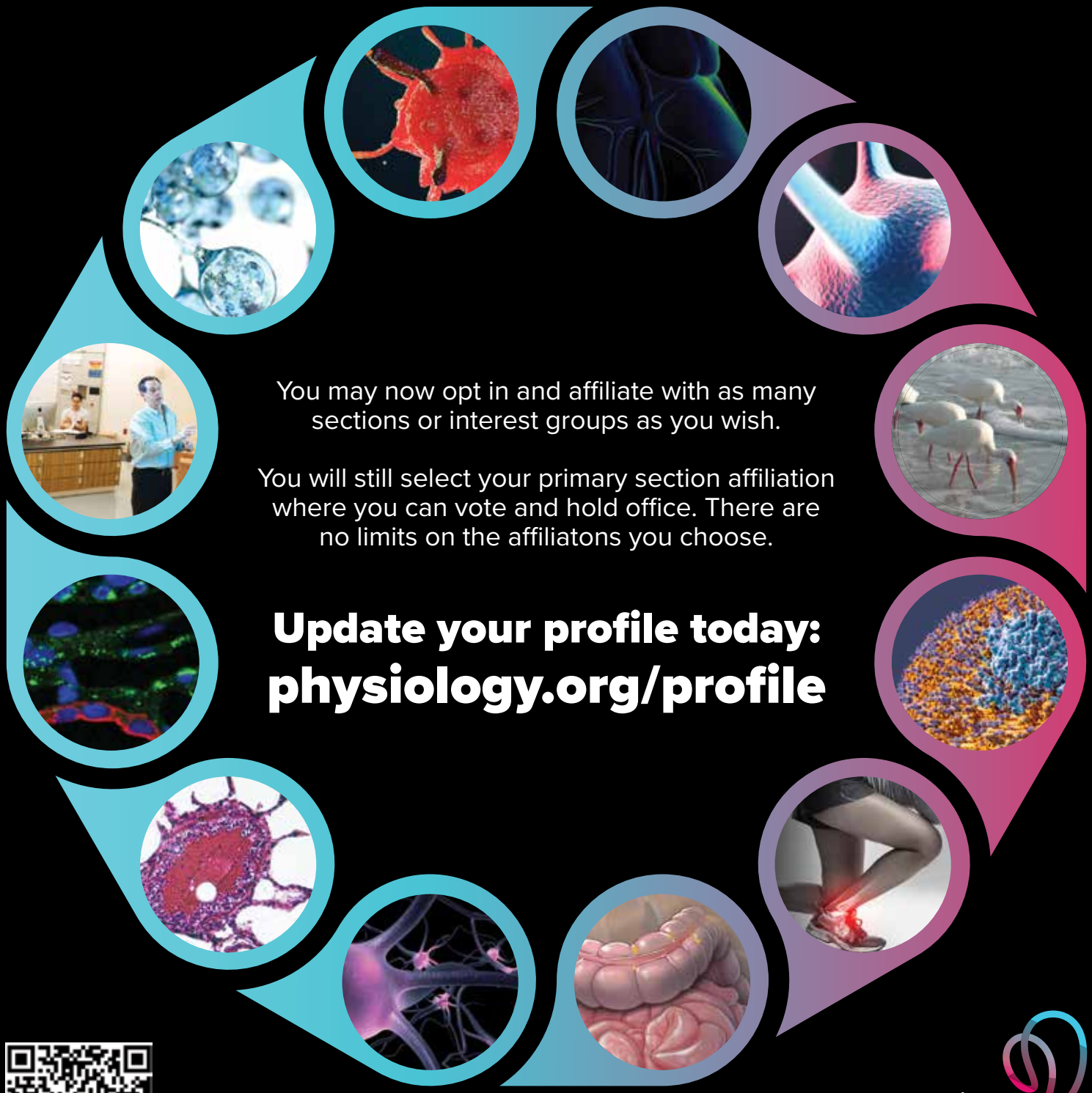
The unexpected twists in my career path continue to lead me to roles that support research through our Office of Research and Innovation at Michigan State University. As the associate vice president in research regulatory support, I oversee a dedicated team of highly trained regulatory experts. Together, we collaborate to support researchers and ensure compliance and safety in all research endeavors.

The journey of a scientist is not a linear path but a mosaic of experiences, each contributing to personal and professional growth. Embrace the twists and turns, for they are opportunities for discovery and meaningful contribution to the greater good.

Laura R. McCabe, PhD, is associate vice president in the Office of Research and Innovation at Michigan State University, where she oversees research regulatory support. She is also MSU Foundation Professor in the Department of Physiology.

Illustration by Brett Affrunti

APS Members May Now Affiliate with More Sections



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

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

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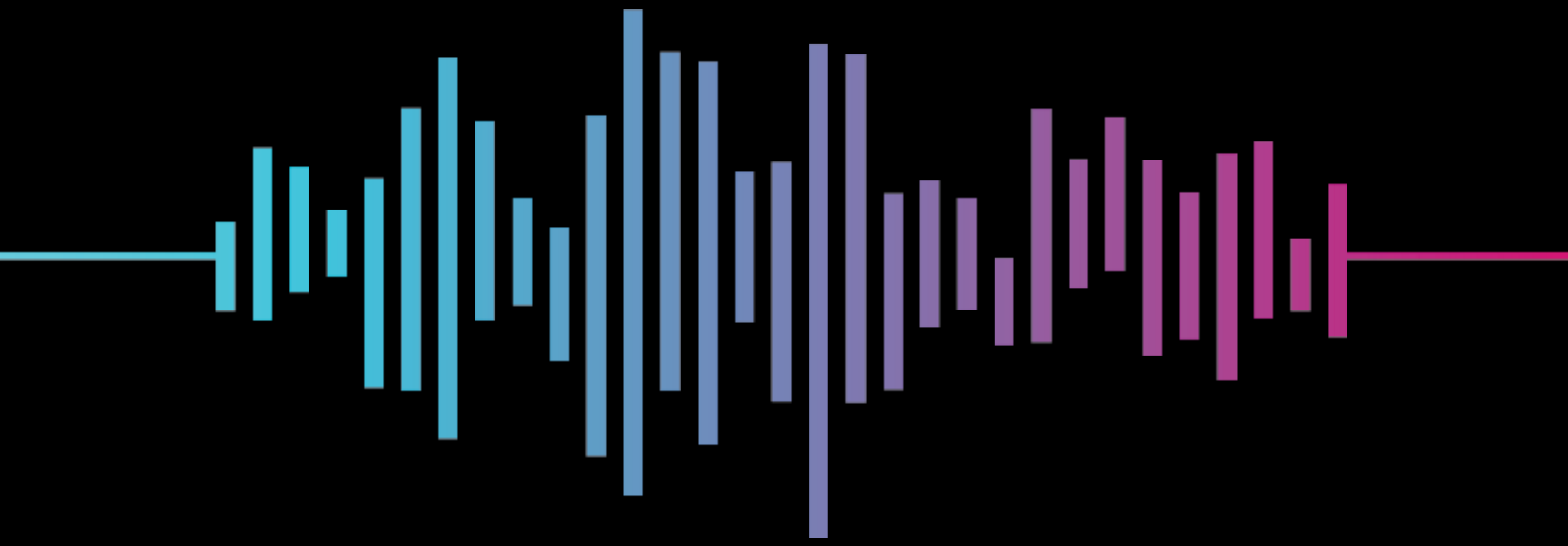

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