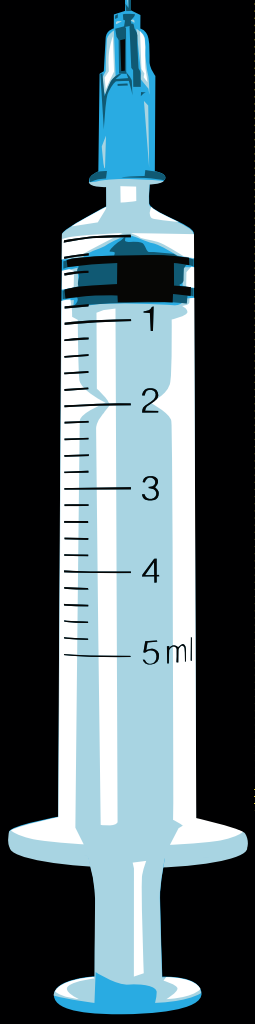
THE Physiologist MAGAZINE
NOVEMBER 2021

# INSULIN TURNS 100

The discovery of insulin in 1921 sparked a revolution beyond improving diabetes care.



# 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**

american physiological society®

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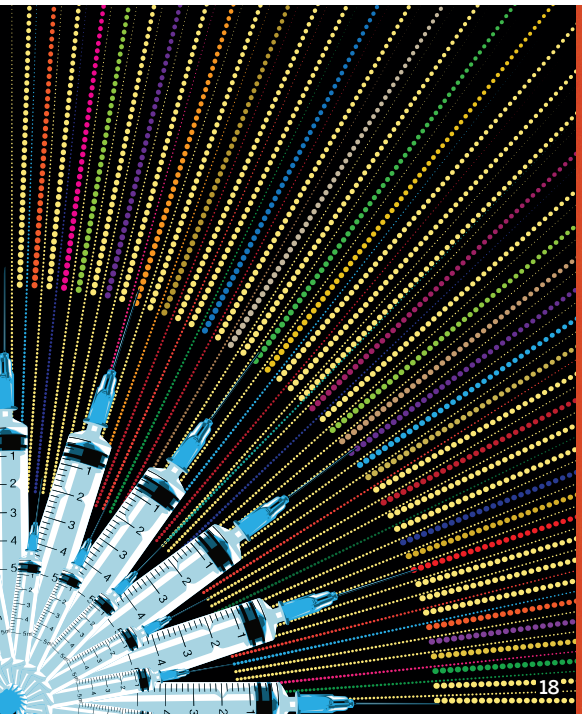
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Cover illustration by Daniel Hertzberg

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# GRADUATE PHYSIOLOGY & BIOMEDICAL SCIENCE CATALOG

The American Physiological Society (APS) is pleased to announce our new **Graduate Physiology and Biomedical Science Program Catalog**. The catalog is a resource for your students and mentees as they contemplate graduate school and the next step in their education and careers.

This online directory provides undergraduate biology and life science students and early-career physiologists with graduate program profiles that facilitate their search for the ideal institution. We encourage you to share this catalog with your undergraduate and postbaccalaureate students to help grow the next generation of physiologists.

Check out the catalog today at physiology.org/GraduatePhysiology.

## Interested in listing your program?

Contact **Jacob White** for more information.

Jacob White
APS Development & Strategic Partnerships Manager
jwhite@physiology.org
301.634.7991

# A New Resource for Career Success

BY SCOTT STEEN, CAE, FASAE

Like most APS members, I belong to a number of professional societies. I am a fellow of, and have been a member of, the American Society of Association Executives (ASAE) for more than 30 years. Within ASAE, I have chaired committees, given dozens of talks, written articles and more. ASAE is my professional home, an invaluable community, a place where I can give back and a critical resource for my career and professional development.

Although needs may change, learning is a lifelong process. Every year, I try to develop new skills and improve as leader. And every three years, I am required to renew my Certified Association Executive (CAE) credential, proving that I have completed a set number of professional development hours. The time I spend engaged in professional and career development obviously has a personal benefit, but as important, it makes me a more effective and capable leader for APS.


While the roles of scientific researcher and educator may be different, the need for continuous professional and career development is the same. APS members engage in a whole host of activities that go beyond science. They must communicate effectively, inspire, lead groups, chair meetings, manage change, build consensus, promote themselves and their work, bring in grant money, mentor young colleagues, build networks and facilitate collaboration, to list just some of the skills necessary for a successful scientific career.

During the past two years, we have been engaged in an in-depth process to evaluate and expand the value we provide to our members. While APS offers extensive scientific resources, we realize all of our members, regardless of career stage, would benefit from expanded career and professional development offerings as well.

Over the summer, we asked hundreds of members—via discussions, surveys and polls—to help us better understand their career wants and needs. The feedback we received was invaluable. As a result, we are excited to launch a brand-new initiative this year: the APS Career Gateway.

Initially, The Gateway will launch as an online professional development portal, but it will expand to include seminars, webinars, mentoring, career coaching and more. The online portal will provide APS members with an ever expanding library of critical leadership and career advancement content, focused on three career tracks: researchers, educators and trainees. At launch, topics will include having difficult conversations, building and managing a team, science communication, inclusive teaching, designing curriculum and syllabus, seeking funding, rigor and reproducibility, and more.

The Gateway will also become the new home for our jobs board, which will be reimagined and expanded in the coming months.

You can find the Career Gateway portal at **www.physiology.org/CareerGateway**, with more than 60 different content pieces—articles, blog posts, interviews, symposia and videos. We encourage you to check back often for new resources that we're in the process of developing to meet your needs. As we continue to expand and enhance the portal in the coming months, I look forward to hearing from you about the resources and improvements you would like to see in the future. Email me at **ssteen@physiology.org** to share your ideas.

**Scott Steen, CAE, FASAE, is executive director of the American Physiological Society.**

# Help Move Physiology Forward



**YOU** have the power to help shape the future of physiology.

Whether you volunteered your time, served in a leadership role, gave a donation or all of the above this past year, thank you for supporting the continued growth of the American Physiological Society (APS).

We hope you'll continue to be a champion for our organization, physiology's future and research pioneers because your contribution is crucial as we strive to launch innovative programs and grow our premier scientific community.





Contribute online at
physiology.org/giving
or mail checks to:

American Physiological Society
c/o Rameela Patel
6120 Executive Boulevard
Suite 600
Rockville, MD 20852-4911



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# The Physiologist MAGAZINE

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Read the comparative physiology blog

# Life Lines

by

# Dr. Dolittle

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**lifelinesblog.com**

Interested in contributing?
Email communications@physiology.org.

## Back in the classrooms, back in the labs (with COVID-19 cautions and restrictions). See what physiologists are working on, thinking about and succeeding in.

**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.**

**Dr. Peying Fong 方白嬰**
@PeyingFong

Monarch found another milkweed plant.

7:52 PM • Sep 7, 2021

**Kristen Engevik**
@thekengevik

Me trying to hold to onto my experimental plans during a tropical storm

10:02 AM • Sep 13, 2021

**Prof. Stan Andrisse**
@Prof_Andrisse

Very proud of my @HowardU research team @taylordoesneuro @AOseiN1 and others. Today, we were notified of two publications being accepted. This is #5 for 2021 not including my book. Links coming soon. #TheGrindIsReal #HustleHard #BlackInSTEM #Prison2Pro

7:33 PM • Sep 1, 2021

**Jen Heemstra**
@jenheemstra

There is no "one" career path that is perfect for you. Rather, there are many career paths that can fit with your skills and interests, and the goal is to find and pursue "one" of them.

8:12 AM • Sep 7, 2021

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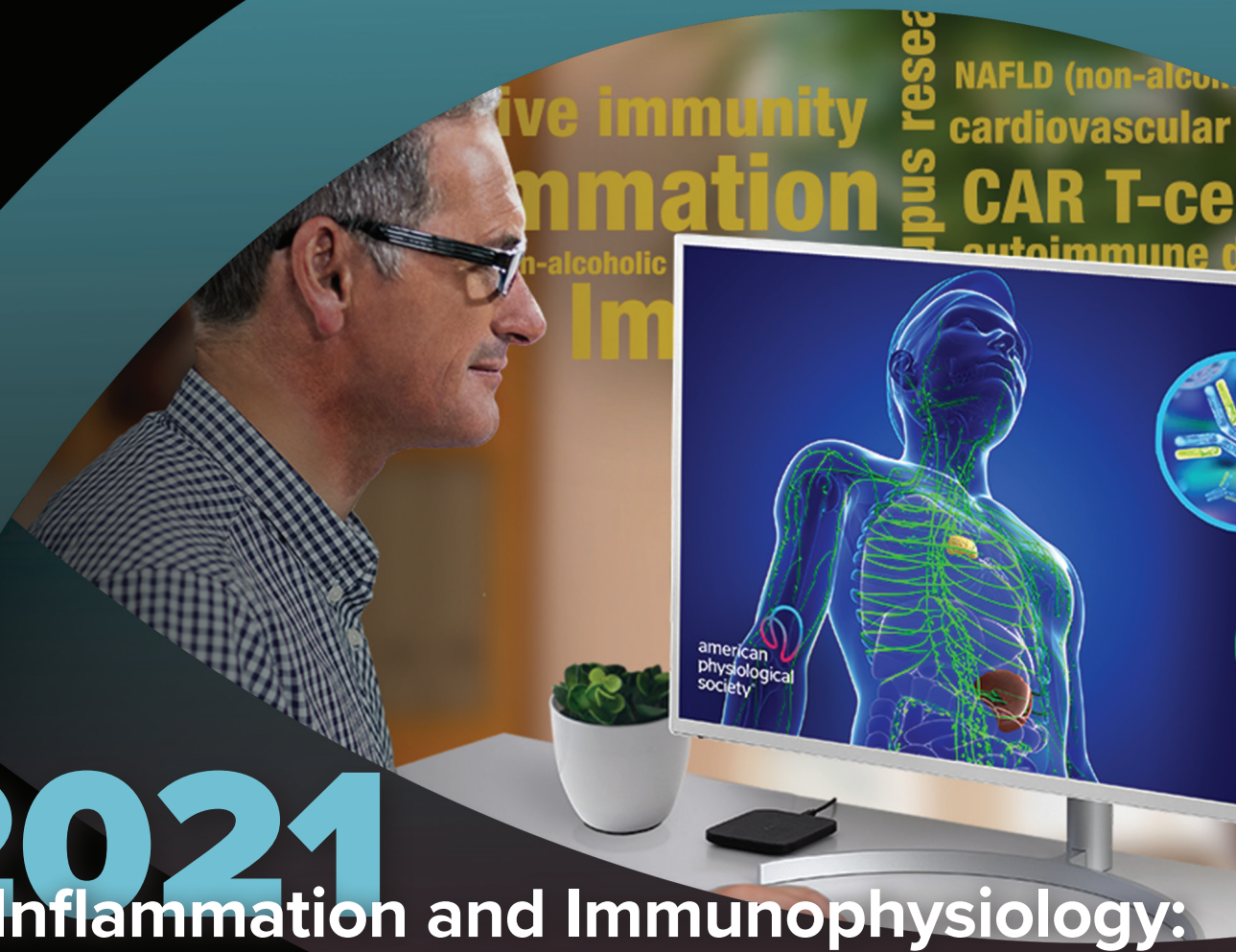
inside scientific

American Autoimmune Related Diseases Association, Inc.




# 2021 Inflammation and Immunophysiology: An Exploration of Pathophysiology

The American Physiological Society is excited to announce our new webinar series covering fundamental principles, late-breaking research and novel discoveries in the field of inflammation and immunophysiology.

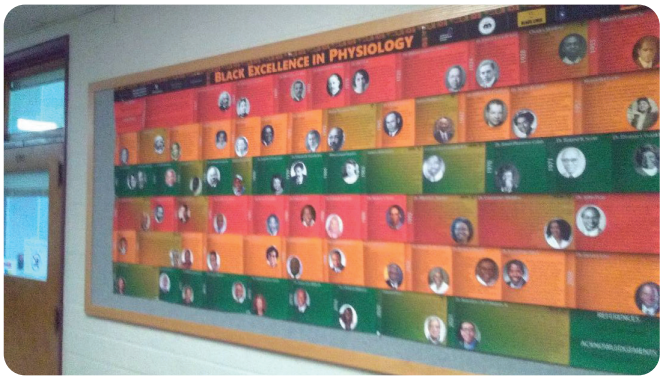
Research topics covered in this series will include:

- Regulation of inflammation via lymphatic microvasculature
- Cardiovascular consequences of inflammation
- Innate versus adaptive immunity
- Mechanisms of cancer immunology and advanced treatments
- Mechanisms of autoimmune diseases and treatments
- Non-alcoholic fatty liver disease (NAFLD) and steatohepatitis (NASH)
- Aging and inflammation

**Register today at:**
**physiology.org/webinars/immunophysiology**

**Anna Leal, Ph.D.**
@AnnaHikes

Thank you @BlackInPhysio @VanderbiltU @HowardUniv @APSPhysiology for the poster outside my A&P lab @CentenaryLA.




3:54 PM • Sep 2, 2021

**Brittney Borowiec, PhD**
@this_is_brit

First lecture goals achieved:
✅ No unexpected tech whammys
✅ Explained course breakdown
✅ Good chat engagement
✅✅✅ Introduced the cat to everyone

1:59 PM • Sep 9, 2021

**Annie Cuskelly**
@anniecuskelly

Back in the lab; lockdown edition!!! Thanks @APSPhysiology for my new mask. My PCRs are curving nicely and hope has been renewed that this thesis may one day get finished.


12:26 AM • Sep 14, 2021

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# LAB NOTES

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

**RESEARCH FIZZ**

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### Childhood psychosocial stress is linked with impaired vascular endothelial function, lower SIRT1 and oxidative stress in young adulthood

Young adult women who faced adverse childhood experiences were found to have impaired endothelial function and lower sirtuin 1 levels—proteins that combat inflammation and oxidative stress—when compared with age-matched controls.

***American Journal of Physiology-Heart and Circulatory Physiology*, September 2021**

**https://doi.org/10.1152/ajpheart.00123.2021**

**STATS & FACTS**

# 1982

**The year a fully synthetic human insulin earned approval by the U.S. Food and Drug Administration, the first genetically engineered product to do so.**

***Nature Portfolio***

**MENTORING Q&A** | POSTDOC OPPORTUNITIES

# Selection Process

## How to find the right postdoc fit for you.

Each issue, we ask a trainee member to pose their career questions to an established investigator and mentor. Here, Jessica L. Faulkner, PhD, assistant professor in the Department of Physiology at the Medical College of Georgia at Augusta University, asks William F. Jackson, PhD, FAPS, professor of pharmacology and toxicology at Michigan State University, questions about interviewing for a postdoc and developing programming through the APS Trainee Advisory Committee.

**Q: When hiring a graduate student/postdoc, what qualities have you learned to look for?**

**A:** Excitement with research, a strong research pedigree, strong letters of recommendation and good communication skills. I also like to have other people interview candidates as I always see potential where other

Illustrations by Kagan McLeod

people might see potential problems.

**Q: What factors did you consider when selecting the academic institution for your first faculty appointment?**
**A:** For me, there was not much choice. There were few open positions, and I took the position that was available and offered to me. In retrospect, I may have been better off taking a second postdoc, which was not typical back in the day. Today, I would look for a supportive environment where there is a consistent history of development of early-career faculty, where there is a tradition of collaboration among the faculty and where there is a vibrant graduate program.

**Q: What is your advice for someone's first three months starting up their own lab? Looking back on that time for you, what would you have done differently?**
**A:** This is a great question for which I do not think that there is a single answer. First, unless your postdoctoral mentor was an early-career faculty member who was still active in the lab, don't try and recreate your mentor's lab. Get in the lab, get experiments going that will drive your research forward, and, if you have the resources, hire a good lab technician—they are worth their weight in gold! In retrospect, I spent too much time getting all aspects of my lab set up and not enough time actually gathering data. This delayed the appearance of my first independent publication.

**Q: As a member of the APS Trainee Advisory Committee, I am curious what you think the committee could do to improve the career interests of your trainees?**
**A:** I think that the committee-sponsored programs at the APS annual meeting have been great and should continue. Keep getting the word out and recruiting more students and postdocs to your group and stay in contact with former members who have transitioned to independent careers, whatever those may be.

**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.**

## Mentorship vs. Sponsorship

Mentoring and sponsoring physiologists are critical components to strengthening the field of physiology. But what is the difference between the two?

**Mentorship:** Usually a personal, long-term relationship that is often described as transformative. It is one that requires time commitments by both the mentor and the mentee.

**Sponsorship:** Very much focused on career advancement. Associated with a power relationship between the sponsor and protégé and often benefits the sponsor as well as the protégé. In addition, sponsorship can be a transactional relationship, meaning sponsorship does not require a long-term relationship whereas the sponsor provides an opportunity for the protégé. This has also been described as a "strategic relationship." The sponsor plays the role of an advocate for the protégé and may recommend them for awards or key positions.

*The above definitions were created by the Women in Physiology Committee, which works to actively increase the participation and promote the success and leadership of women in physiology and the Society. Committee members are developing a framework to promote both mentorship and sponsorship, plus goals and strategies to advance gender equity and career development. Stay tuned!*

STATS & FACTS

# 1.4 million

**The number of people with type 1 diabetes in the U.S. who use insulin.**

U.S. Centers for Disease Control and Prevention

RESEARCH FIZZ

**Nucleus type-specific DNA methylomics reveals epigenetic 'memory' of prior adaptation in skeletal muscle**

Exercise leads to epigenetic changes in muscle fiber and non-muscle fiber nuclei and may last for up to three months after training is discontinued.

***Function*, August 2021**

**https://doi.org/10.1093/function/zqab038**

STATS & FACTS

# ~187,000

**The number of children and adolescents living with type 1 diabetes in the U.S. in 2018.**

U.S. Centers for Disease Control and Prevention

Right: iStockphoto

RESEARCH FIZZ

**Sphingosine-1-phosphate interactions in the spleen and heart reflect extent of cardiac repair in mice and failing human hearts**

Sphingosine-1-phosphate signaling plays an important role in physiological inflammation during cardiac repair in mice.

*American Journal of Physiology-Heart and Circulatory Physiology*, August 2021

https://doi.org/10.1152/ajpheart.00314.2021

STATS & FACTS

**34.2 million**

**The number of people in the U.S. living with diabetes mellitus.**

U.S. Centers for Disease Control and Prevention

RESEARCH FIZZ

**Exercise under heat stress: thermoregulation, hydration, performance implications and mitigation strategies**

This review discusses strategies to improve the effects of heart stress and dehydration on exercise performance in the heat. Future research directions are also explored.

*Physiological Reviews*, October 2021

https://doi.org/10.1152/physrev.00038.2020

POLICY IQ | ANIMALS IN RESEARCH

# Talking about Animals in Research

When scientists interact with congressional offices on Capitol Hill, their messages usually emphasize why research is critically important to our future health and economic prosperity. However, advocates for physiology often bring another message, one that is focused on ensuring that scientists can continue to access the most appropriate experimental methods for their research, including animal models.

Many people continue to have questions and concerns about whether using animals in biomedical research is necessary and ethical. When these concerns are brought to Congress by those who oppose animal research, the result can be the development of legislation and other measures that would restrict or eliminate the use of animals in research (see "The Power of the Purse" sidebar). Scientists who work with animal models have a deep understanding of why animal research is important and how it is regulated to ensure that animals are treated humanely. Sharing this information with congressional offices is key to ensuring that scientists will continue to have access to the most appropriate experimental methods for their research.

The idea of meeting with a member of Congress or their staff on any topic can be intimidating, but with the right preparation, conversations can flow smoothly.

"Part of our training as scientists is to be very cautious about discussing our work with animals, and so it can feel awkward to bring up the topic. But with practice, it gets easier to weave into a broader discussion of the value of research," says Sonnet Jonker, PhD, FAPS, chair of the APS Animal Care and Experimentation (ACE) Committee.

Here are some tips for talking about animal research in an advocacy setting:

**Prepare yourself well for the conversation.** If you are meeting with a congressional office that has a record of support for animal rights, remember that as a scientist and a constituent you have the credibility and expertise to provide another perspective, but you might not change any minds. Be prepared to agree to disagree. "These meetings are rarely contentious, despite differences of opinion on these issues," says ACE Committee member Eryn Dixon, PhD. "Sitting down and having a transparent conversation about our needs as scientists is met with understanding and appreciation of the work we do every day and the caliber of research we are striving to continue in the future."

**Start by introducing yourself and describing your research.** Be sure to include the broader relevance of your work to human or animal health or the environment. Avoid using overly technical language, and assume you are talking to a professional colleague but not a fellow

Left and above: iStockphoto

scientist. Once you know what you want to say, practice saying it out loud, preferably to someone who can give you feedback. Saying the words out loud a few times can help you hone your messages.

**Discuss how you use many different approaches in your research.** This should include animal models and non-animal methods. Efforts to replace the use of animals with other methods are often described as alternatives, when in fact researchers already incorporate non-animal methods whenever it is possible to do so effectively.

**Share information about how animal research is reviewed**. This includes both scientific and ethical considerations. Explain how animals are cared for. Most congressional staff are not familiar with how animal research protocols are developed and the level of care that animals receive in a research setting. "It can be enlightening for congressional staff to learn about all that goes into an animal research project, from the experimental design to the protocol approval to the veterinary care that is available to all animals," says past ACE Committee Chair Jeff Henegar, PhD.

**Ask if they have any questions.** Be prepared to address any concerns they might have about why animals are used in research. If you can't answer a question, seek out the information and follow up with them. Offer to be a resource if they have questions in the future. You might also consider inviting the member of Congress or their staff to tour your lab. They make regular visits to their home states or districts and are eager to see where and how federal grant money is being spent to benefit their constituents.

**Follow up with a brief email.** In your note, be sure to thank them for their time. This is also an opportunity to reiterate your messages and make sure they know how to contact you for any future communications.

Advocating for animal research is key to ensuring that scientists will continue to have access to the best experimental models in the future. More information on how to get started is available on the APS Animal Research webpages at **www.physiology.org/AnimalResearch**.

## The Power of the Purse

Each year during the annual appropriations cycle, members of Congress allocate funds to federal agencies and programs, including those that fund research. As part of this process, they write a report that includes directions for how the agencies may use the funds, and sometimes more importantly, what they may not be used for.

Examples of recent legislative proposals involving animals include:

- Urging federal agencies to accelerate efforts to replace non-human primates and other animals in research with alternative non-animal research methods in federally funded research (National Institutes of Health).
- Requiring research agencies to show their progress toward adoption of non-animal alternative methods by issuing a public report on the numbers of vertebrate animals used in research funded by the agency (National Institutes of Health).
- Prohibiting the use of federal funds for research studies involving dogs or cats that are assigned to pain categories D or E, or increasing the layers of approval needed to conduct research using dogs or primates in any pain category (VA Medical and Prosthetic Research Program).

Because these measures are considered as part of yearly funding bills, some have become law in previous years, while other provisions were removed during last-minute negotiations only to be reintroduced the following year. APS continues to monitor these proposals and share information with Congress about how such restrictions would impact research.

STATS & FACTS

# <1 year

**The life expectancy of a child after diagnosis with "juvenile" diabetes before the availability of insulin.**

"The Discovery of Insulin"

RESEARCH FIZZ

**More than breathing air: Evolutionary drivers and physiological implications of an amphibious lifestyle in fishes**

The reviewers introduce a scoring system to characterize variations in amphbiousness and highlight important unanswered questions about the evolutionary physiology of amphibious fish.

*Physiology*, September 2021

https://doi.org/10.1152/physiol.00012.2021

STATS & FACTS

# ~1550 B.C.

**The earliest known written description of diabetes, found in an ancient Egyptian medical text known as the "Ebers Papyrus."**

*World Journal Diabetes* 2016

Right: iStockphoto

RESEARCH FIZZ

### Low dietary fiber promotes enteric expansion of a Crohn's disease-associated pathobiont independent of obesity

This study suggests that diet may play more of a role in the risk for gut infection than body mass. Eating more fiber could be the key to prevention.

*American Journal of Physiology-Endocrinology and Metabolism*, September 2021

https://doi.org/10.1152/ajpendo.00134.2021

STATS & FACTS

# 5

### The number of common insulin formulations available to prescribe to dogs and cats.

American Animal Hospital Association

RESEARCH FIZZ

### Energy metabolism design of the striated muscle cell

This review explores the design of the energy metabolism system in striated muscle tissue.

*Physiological Reviews*, October 2021

https://doi.org/10.1152/physrev.00040.2020

UNDER THE MICROSCOPE

# Rapid Fire Q&A

My N. Helms, PhD, talks about how she "cheats" at selfies, the seemingly simple invention she wished she had made and her healthy go-to snack.

Helms and a "stolen" succulent selfie.

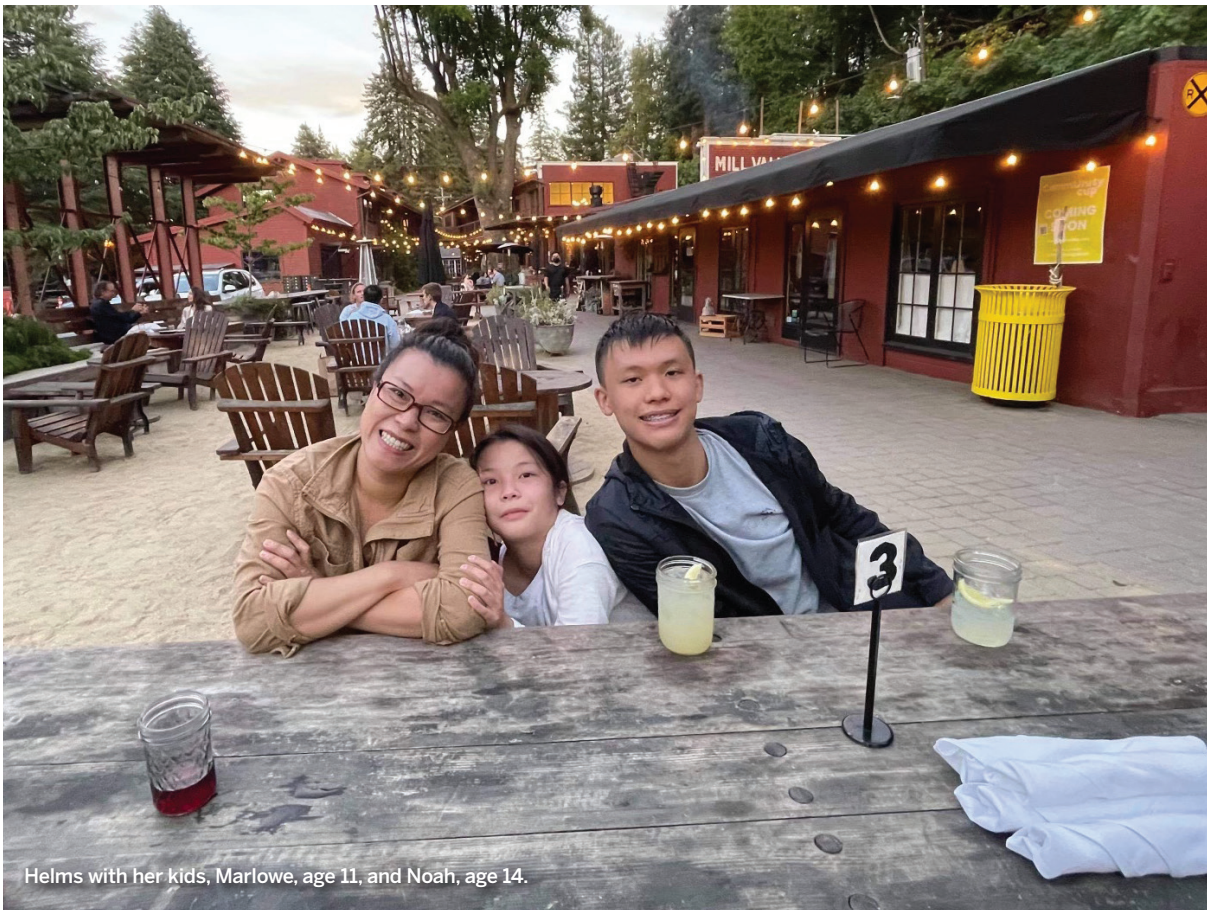
**Q: What do people call you?**
**A:** "My" is pronounced as "me-ay."

**Q: How has the pandemic changed the way you work?**
**A:** I now approach every experiment and deadline as if I will not have an opportunity to come back and repeat or revise due to possible campus shutdown.

**Q: If you could meet any scientist (living or dead) who would it be and why?**
**A:** I would have to say astrophysicist Neil deGrasse Tyson because I actually have tickets to see him when he starts touring again after COVID-19.

**Q: If you were a model organism, which model organism would you be?**
**A:** Drosophila, because they're so fly!

**Q: Briefly, what do you wish the general public understood about science or research?**
**A:** I actually think public understanding of science is at an all-time high. I would just encourage everyone to use Google Scholar and PubMed as primary sources



Helms with her kids, Marlowe, age 11, and Noah, age 14.

Helms loves the mountains in Telluride, Colorado.

**Q: Most valuable quality in a colleague?**
**A: Ability to pair wines with dinner.**

of information in addition to reading Facebook comments if they are not already doing so.

**Q: No. 1 guilty pleasure?**
**A:** Serving as reviewer 2 or 3.

**Q: Most influential scientist on your career?**
**A:** My approach to science and problem-solving is a complex blend of Aniko Naray-Fejes-Toth, MD, (Dartmouth College) and Douglas Eaton, PhD's (Emory University) positive influences during my training.

**Q: Favorite science-related TV show (fictional or factual)?**
**A:** The original "MythBusters" with Adam Savage and Jamie Hyneman.

**Q: The scientific discovery or invention (made by someone else) that you wish you had made?**
**A:** Post-it notes!

**Q: Favorite way to spend a free hour in quarantine?**
**A:** Preparing a 60-minute dinner recipe.

**Q: Tell us a surprising fact about you.**
**A:** I pose for selfies in front of other peoples' succulents because I can't keep any plants alive! (see photo, facing page, top)

**Q: Favorite part of your job?**
**A:** Working with people who are passionate about their science.

**Q: Least favorite part of your job?**
**A:** Completing annual Institutional Animal Care and Use Committee and environment, health and safety online certifications.

**Q: Title you'd use on your autobiography?**
**A:** "My N. Helms, PhD: Buy the Book."

**Q: How would you describe your job to a child?**
**A:** We try to figure out what keeps your body working perfectly and then give that knowledge to the whole world.

**Q: Favorite charities you support?**
**A:** Aside from APS and parent-teacher associations, I like to support organizations that provide emergency food and shelter in my community.

**Q: One thing every researcher/scientist should try at least once in their life?**
**A:** Go against the dogma!

**Q: Next book on your reading list?**
**A:** "When We Cease to Understand the World" by Benjamin Labatut.

**Q: Favorite TV show, movie series or podcast to binge-watch/listen?**
**A:** "Law and Order SVU" because everything is wrapped up nicely in about the time it takes to fold a couple loads of laundry. And with more than 21 seasons, it's hard to run out of binge material!

**Q: Favorite musician/musical artist/band?**
**A:** My kids on the piano—especially when they play Elton John!

**Q: Go-to snacks to get you through long days working from home?**
**A:** Juicing (carrots and ginger)

**My N. Helms, PhD, is an associate professor of internal medicine in the Division of Respiratory, Critical Care and Occupational Pulmonary Medicine at the University of Utah in Salt Lake City. She has been a member of APS since 2001 and is currently serving as the chair of the Cell & Molecular Physiology Section and as Councilor for the Epithelial Transport Group.**

**PUBLISH WITH POLISH** | SPRUCING UP DATA

## Permission Needed to Use Non-author Figures in Papers

Figures are critical to relaying scientific information for any paper. This becomes especially important with Articles in PresS (AiPS), which posts a raw accepted image before any figure editing can occur. Using freelance artists and services such as BioRender is becoming increasingly popular to create attractive, professional figures. However, using such services comes with some caveats to prevent delays in handling related to image permissions.

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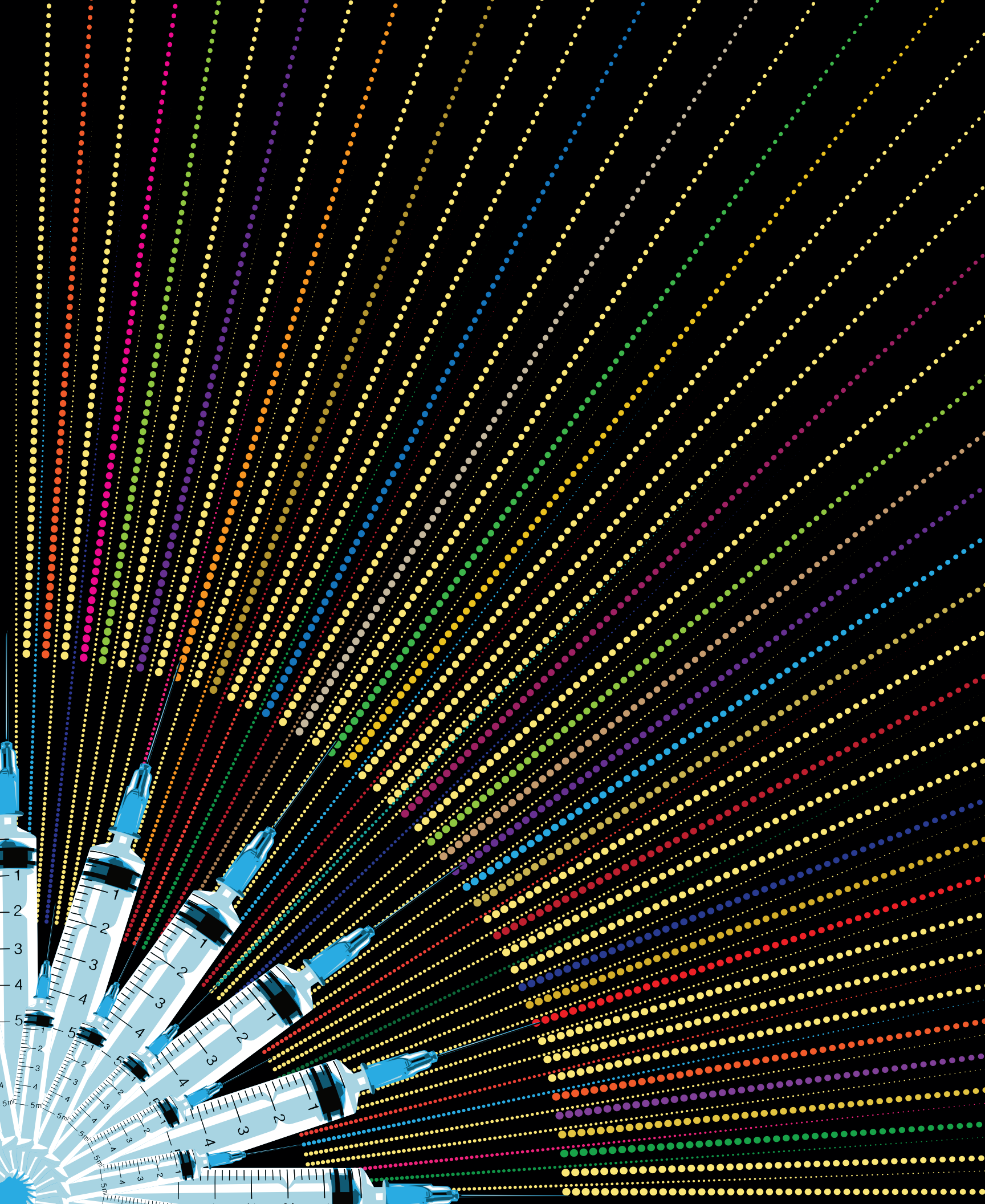


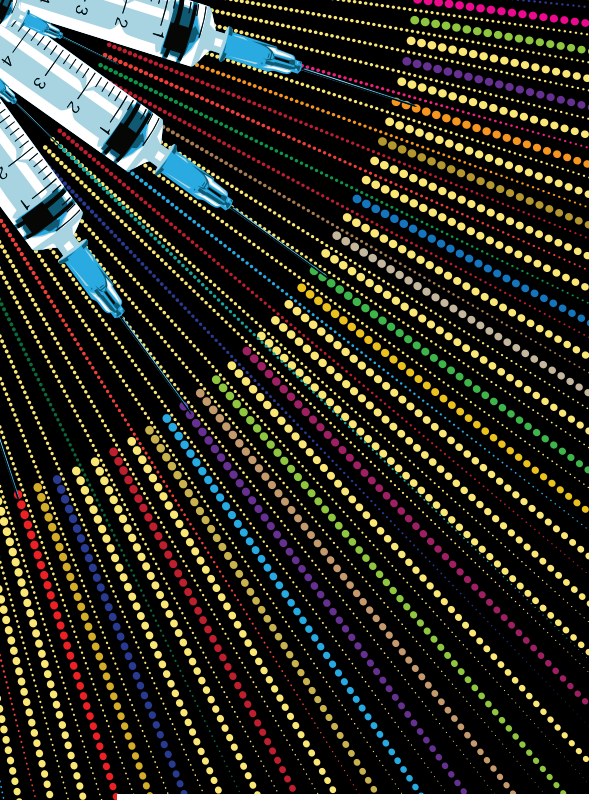
# INSULIN TURNS 100

The discovery of insulin in 1921 sparked a revolution beyond improving diabetes care.

BY JENNIFER L.W. FINK

One hundred years ago, four men and a few dogs changed the course of history. Frederick Banting was an unknown orthopedic surgeon who developed an interest in the pancreas and diabetes while preparing a medical school lecture. John Macleod, the ninth president of the American Physiological Society (APS) and a professor of physiology at the University of Toronto, was "unimpressed with Banting's range of knowledge about diabetes and the pancreas," according to the Science History Institute, but he allowed Banting to use his lab and assistant, Charles Best.

Illustration by Daniel Hertzberg



"Macleod gave them 10 dogs, supplies and took off for the summer," says Jay Dean, PhD, chair of the APS History of Physiology Interest Group and a professor in the Morsani College of Medicine, Molecular Pharmacology and Physiology at the University of South Florida.

In a few months, Banting and Best isolated insulin from dogs and demonstrated that insulin injections could reverse high blood glucose levels. Biochemist James Collip helped them purify the resulting insulin extract so it could be used to treat diabetes in humans.

> **"The discovery of insulin wasn't just great for type 1 diabetes; it was proof of concept for the idea that, if you understood the science of disease, you could develop medicines to treat the disease."**
>
> **—Daniel Drucker, MD, PhD**

The team presented their findings to the wider diabetes research community for the first time on December 30, 1921, at the APS meeting in New Haven, Connecticut. Banting and Macleod were later awarded the 1923 Nobel Prize in Physiology or Medicine for the discovery of insulin.

The men's work "sparked a revolution in the scientific basis of medicine," says Daniel Drucker, MD, PhD, professor of medicine at the University of Toronto and a senior scientist at the Lunenfeld-Tanenbaum Research Institute at Mount Sinai Hospital in Toronto. "If we go back 100 years, we couldn't really address, with medicine, the underlying reason for a disease," Drucker says. "The discovery of insulin wasn't just great for type 1 diabetes; it was proof of concept for the idea that, if you understood the science of disease, you could develop medicines to treat the disease."

A century later, scientists are still building on the work of these men and those who came before and after them, including Nicolae Paulescu, a Romanian physiologist who may well have discovered insulin before the Canadian team of four. (Paulescu, in fact, wrote a letter to the Nobel Committee, emphasizing his achievements, after Banting and Macleod were awarded the Nobel.)

Type 1 diabetes is no longer a death sentence, and clinicians and casual observers now understand that insulin resistance plays a role in type 2 diabetes, obesity and cardiovascular disease. Ongoing research continues to reveal improved diabetes treatments, as well as previously unimagined links between insulin and overall health.

As Max Petersen, MD, PhD, and Gerald Shulman, MD, PhD, FAPS, wrote in the abstract of a 2018 *Physiological Reviews* article, "The 1921 discovery of insulin was a Big Bang from which a vast and expanding universe of research into insulin action and resistance has issued."

## BIOMARKER FOR METABOLIC HEALTH

Early researchers identified the muscles, liver and fat tissue as insulin-responsive and recognized their role in metabolism. In fact, muscles are the main site for deposition of the glucose we ingest, and this deposition is a key response to insulin. Accordingly, muscles are major determinants of blood glucose levels, says Amira Klip, PhD, FAPS, senior scientist at Canada's SickKids Research Institute

and professor at the University of Toronto. However, over the past decade or so, there's been increasing recognition that insulin receptors exist on most cells of the body, "even in cells where we didn't know of any insulin action," says C. Ronald Kahn, MD, head of the Section on Integrative Physiology and Metabolism at Joslin Diabetes Center and the Mary K. Iacocca Professor of Medicine at Harvard Medical School in Boston.

Insulin receptors have been identified on white blood cells and in the brain. The kidneys and blood vessels are now known to be insulin-responsive, and ongoing research is investigating whether insulin resistance may directly contribute to hypertension.

"Insulin has a small but very important vasodilatory action, and there's a lot of research on whether the vessels become insulin resistant when there is insulin resistance elsewhere in the body and if there's a resulting lack of vasodilation that is part of hypertension," Klip says. "There's controversy on how important that step is in the onset of insulin resistance, but it certainly contributes to the overall picture of type 2 diabetes."

Clinicians have documented a connection between diabetes, neurodegeneration and neuropsychiatric disorders, including depression and anxiety, Kahn says. "We still really don't know yet how important insulin action or insulin resistance is in some of these diseases."

Kahn and others are researching how insulin regulates gene expression changes in the brain, in hopes of understanding the physiologic link (if one exists) between insulin resistance and neurologic disease. To date, his studies with mice have revealed that "insulin in the peripheral blood regulates the expression of more genes in the brain than in the liver and muscle—the two most classic insulin-sensitive tissues—combined."

Given insulin's action throughout the body, Dominic D'Agostino, PhD, associate professor in the Morsani College of Medicine, Molecular Pharmacology and Physiology at the University of South Florida, believes that "insulin is probably the most important metabolic biomarker."

"We think that hyperinsulinemia is the canary in the coal mine," he says. "In type 2 diabetes, high levels of insulin happen way before blood glucose gets out of control, yet insulin measurements are not part of routine bloodwork. We're doing research now to hopefully demonstrate that it's something that needs to be tracked longitudinally over time concomitantly with continuous glucose monitoring (CGM)—and then, you may be able to prevent type 2 diabetes before it occurs."

## Rising Costs Keep Insulin out of Reach for Many

In the 100 years since insulin was discovered, access to the lifesaving diabetes drug has increased as the price of the drug has skyrocketed. In the past 15 years, prices nearly tripled, according to the Endocrine Society, a leading research and policy advocacy group. The result is that many people who need insulin most—those who are low-income, underinsured or uninsured—are priced out of accessing it.

Other groups of people being squeezed by high insulin costs, according to the Endocrine Society, are those with high-deductible health plans, beneficiaries using Medicare Part B to purchase insulin delivered using a pump, Medicare beneficiaries in the Part D donut hole (prescription coverage gap), and people 26 and older who are no longer eligible for coverage through their parents' insurance.

Today, 7.4 million people in the U.S. treat their diabetes with insulin. When people can't afford it, they are sometimes forced to ration insulin—leading to hospitalizations or other dangerous complications from comorbidities associated with diabetes—to pay for other costly medications, transportation, housing or utilities.

The American Diabetes Association estimated in 2017 that people with diagnosed diabetes incur average yearly medical expenditures of approximately $16,750, with roughly $9,600 directly attributed to diabetes. Many of those dollars are likely used for insulin.

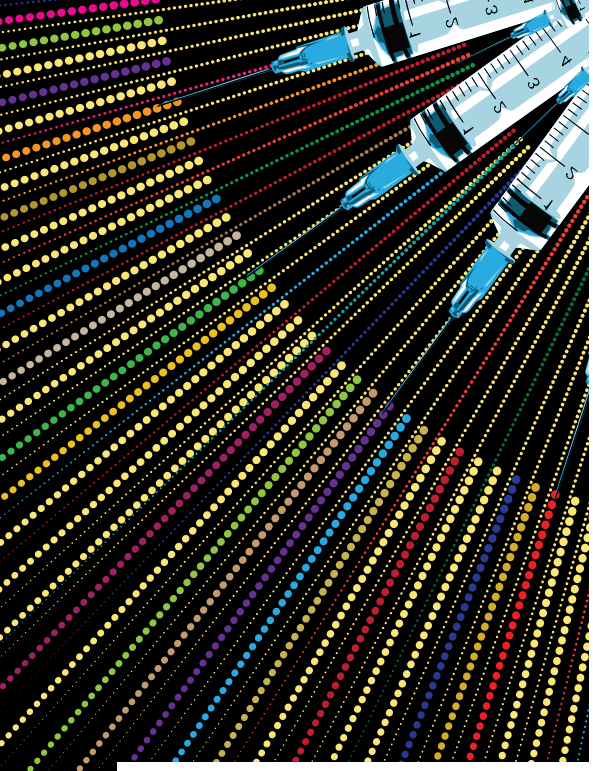
The Endocrine Society says reasons for high insulin costs are complex and include:

- Complexity of the supply chain, making it difficult to identify specific causes of rising costs.
- Difficulty navigating decentralized programs to decrease out-of-pocket costs.
- Lack of transparency among insulin manufacturers and insurance providers.

There are ways to lower the cost of insulin, however. These include:

- Improving access to patient assistance programs.
- Limiting future list price increases to the rate of inflation.
- Allowing government negotiation of drug prices.

Making insulin affordable is a tall order with millions of lives depending on a resolution.



## NEW TREATMENTS FOR TYPE 1 DIABETES

Since insulin was discovered, regular insulin injections have been the standard treatment for type 1 diabetes. Clinical advances, such as the invention of long-acting insulin and implantable insulin pumps, have decreased the number of pokes patients must experience and have led to improvements in blood glucose control. Yet, regular injection of insulin remains, a century later, the primary treatment for type 1 diabetes.

**"If everyone in your family has type 2 diabetes by the age of 50, it may be a good idea for you to start monitoring insulin and glucose with CGM at age 40."**

**—Dominic D'Agostino, PhD**

"I think there are still tremendous opportunities to advance the state of diabetes therapies," Drucker says. "Fred Banting himself, in the 1920s, said that insulin is not a cure for type 1 diabetes. It will keep people alive, but it will not make the disease go away."

Some researchers are actively studying the immunology of type 1 diabetes, "trying to tame the immune system," Drucker says. Scientists know there's a link between insulin and inflammation, but don't understand how the immune system responds to insulin or how insulin resistance exacerbates inflammation.

"The whole immune system responds to insulin in a way," Klip says. "This is a very hot area that begs for new discoveries because it could lead to using anti-inflammatories in a very selective way to contribute to the treatment of diabetes."

Researchers who work with stem cells are attempting to create beta cells that can produce insulin in response to blood glucose levels, while evading detection by the body's immune system. In the meantime, engineers continue work on automatic glucose-sensing insulin delivery devices that act as an artificial pancreas.

"At this point in history, I'd say mechanical approaches to diabetes treatment have gone a bit faster than the biological approaches; I didn't think that would happen," Kahn says. "I would have predicted that biology would beat engineering."

Scientists are also working to create "smart insulin," which will only work in the body when blood glucose levels are elevated. "There's been very exciting progress in that area," Drucker says. "The science looks very promising, and clinical testing is already underway. I'm pretty confident we'll see the development of smart insulin, and that type of innovation will make life much easier for people with diabetes."

D'Agostino, meanwhile, is exploring the history and application of specialized diets to help manage type 1 diabetes. "Before insulin, a very calorie- and carbohydrate-restricted ketogenic diet was the only treatment for diabetes. Frederick Madison Allen published a book—that influenced Banting—called 'Total Dietary Regulation in the Treatment of Diabetes,' and he had success in extending the lives of people with type 1 diabetes for another year or two with this diet," D'Agostino says.

Though diet has long been a cornerstone of diabetic management,

"if I were to get on a stage 10, or even five, years ago and say people with type 1 diabetes should implement a low-carbohydrate ketogenic diet, I would be thrown off the stage," D'Agostino says. Yet, emerging research shows that people with type 1 diabetes who eat a very low-carb ketogenic diet require less insulin and achieve better glycemic control and less glycemic variability.

Expect more discussion of ketogenic diet as an intervention for diabetes. "Right now, it's a very hot topic at the American Diabetes Association for both type 1 and type 2," D'Agostino says.

## ADVANCES IN TREATING TYPE 2 DIABETES AND INSULIN RESISTANCE

Efforts to understand the pathophysiology of insulin resistance have already resulted in new treatments for type 2 diabetes—and may soon lead to new treatments for obesity, short bowel syndrome and fatty liver disease.

Frederick Sanger's efforts to understand the structure of insulin garnered the 1958 Nobel Prize in Chemistry and unlocked the possibilities of genetic manipulation. Later, peptide sequencing of the glucagon gene led to the realization that glucagon-like peptide 1 (GLP-1) controls blood glucose and insulin production—a discovery that led to the creation of GLP-1 agonists, which are now a standard of care for type 2 diabetes. Researchers have also found that GLP-1 controls hunger, and in June 2021, semaglutide was approved by the U.S. Food and Drug Administration for chronic weight management.

"The beauty of GLP-1 therapy is that, beyond helping people control diabetes and body weight, it also reduces heart attacks, strokes and rate of death," Drucker says. "It's actually quite an advancement."

Dipeptidyl peptidase 4 (DPP-4) inhibitors, which are medications that prevent breakdown of GLP-1 in the body, are currently used by hundreds of millions of people to control type 2 diabetes, and GLP-2 inhibitors are being developed as a therapy for short bowel syndrome, Drucker says.

"Any one of these discoveries alone would have been like winning the lottery," he says. "Having four to five discoveries become clinically meaningful and useful as a disease therapy is like constantly buying lottery tickets and winning every time."

Of course, identifying and reversing insulin resistance before it causes significant health problems is the ultimate goal. That's one reason why health insurance companies are expressing interest in techniques to measure insulin in the blood, as emerging research suggests that insulin levels spike well before glucose levels.

"If everyone in your family has type 2 diabetes by the age of 50, it may be a good idea for you to start monitoring insulin and glucose with CGM at age 40," D'Agostino says, "so you can take actionable steps through dietary intervention, exercise and drugs to prevent that from leading to overt diabetes."

## THE NEXT 100 YEARS

Despite the advances made over the past century, additional mysteries remain to be unraveled.

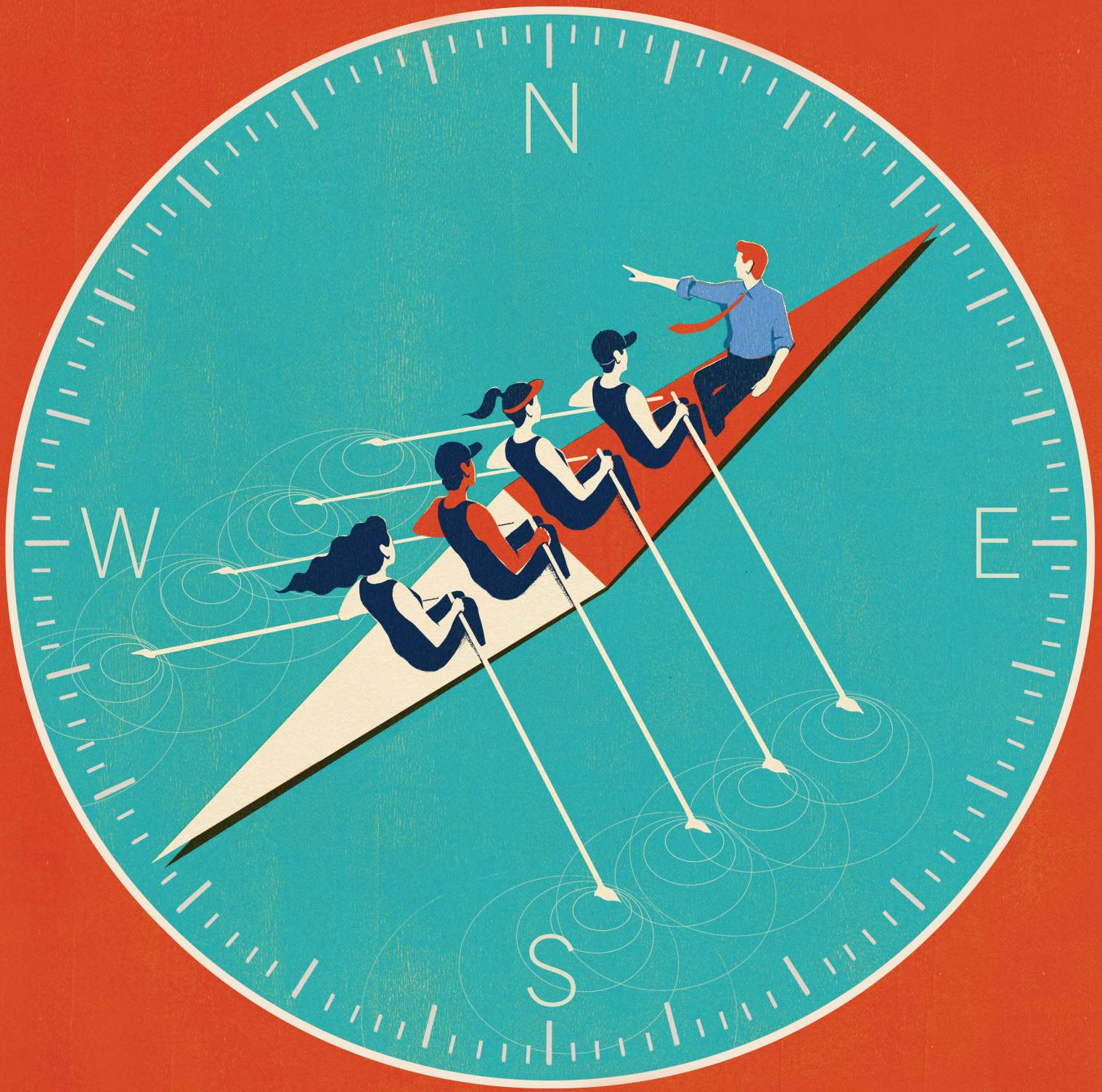
"One of the mysteries still ongoing is once insulin is in the blood, how does it cross into the various tissues in which it has to act?" Klip says. "How do cells organize all the signals that insulin sends so they can respond in an appropriate and proportional way?"

Klip expects that future research will include scrutiny of the location of key molecules, their interactions, the role of mechanical motors and physical changes of the membrane "skeleton" within various cells—including muscle, fat, liver and brain cells—which will almost certainly lead to additional investigation and innovation.

"One of the many amazing things about insulin is how it's sort of led to the creation of scientific fields before people even knew those fields existed," Kahn says. "Insulin has really been at the forefront, whether you're interested in basic science, clinical science or applications to new technologies."

**"One of the many amazing things about insulin is how it's sort of led to the creation of scientific fields before people even knew those fields existed."**

**—C. Ronald Kahn, MD**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Science education often doesn't teach you how to be a manager. Learn how to motivate and lead from these exemplars.

**BY SCOTT SLEEK**

# LEADERS' EDGE

Early in his career, Jeremy Boss, PhD, had no training manual to help him navigate the administrative duties he was taking on. So he wrote one himself.

In 2003, the Emory University immunologist produced "Academic Scientists at Work: Navigating the Biomedical Research Career," with his then-colleague Susan H. Eckert, PhD, in response to the lack of direction he felt he needed to handle many of his management challenges—coaching underperforming students, running meetings, hiring and firing staff.

Illustration by Dan Bejar

**"You're budgeting, you're hiring, you're recruiting people and dealing with performance problems, you're mentoring and giving career advice. You're basically required to be the executive team, the top management team, the supervisory team, admin, HR. And you're learning all this on the fly."**

**—Alison Antes, PhD**

"We watched how others approached these problems, and if you went to enough people, you could come up with a set of answers to how you solve them," says Boss, who now chairs the Department of Microbiology and Immunology at the Emory University School of Medicine in Atlanta. "But it was very clear there was no source of information."

Many new lab directors find themselves unprepared for the logistical, personnel and budgetary obligations that come with the job. They must balance enforcing policies and standards, overseeing data integrity, securing funding, supervising lab technicians and mentoring their students and postdoctoral fellows. But traditional scientific training affords them little preparation for leading and motivating other researchers, says Alison Antes, PhD, an organizational psychologist who studies biomedical research ethics at Washington University in St. Louis.

"You're trained to be in a lab collecting data, then you transition, and now you're managing other people who do science," she says. "You're budgeting, you're hiring, you're recruiting people and dealing with performance problems, you're mentoring and giving career advice. You're basically required to be the executive team, the top management team, the supervisory team, admin, HR. And you're learning all this on the fly."

Despite the dearth of guidance on leadership and management in science, many researchers have honed some model skills to help their labs thrive, Antes' research has shown. In 2019, she and her colleagues asked nearly 1,500 deans, department chairs and research administrators to nominate the scientists at their institutions who epitomize professionalism and integrity. The nominations helped Antes' team build a cohort of "research exemplars"—highly accomplished investigators in diverse scientific fields.

They interviewed these exemplars, asking them about the practices they use to foster rigorous research among the people working in their labs. As reported in *PLOS One* in April 2019, these leaders mentioned vital practices such as thoroughly cross-checking data and findings, storing data appropriately and enforcing standard operating procedures. But the approaches they cited most consistently involved so-called "people skills"—training, mentoring and uniting their research teams. They endeavor to be approachable and to create a non-threatening work environment. They want their team members to feel comfortable and safe in asking questions, raising concerns and reporting mistakes.

This leadership style invokes the concept of psychological safety, an idea championed by Amy Edmonson, PhD, the Novartis Professor of Leadership and Management at Harvard Business School in Boston. Edmonson's research shows that work teams perform at their best when they fear no punishment or humiliation for voicing their ideas, asking questions and owning their mistakes.

"Research involves obstacles and challenges, especially when you're trying to collect data from humans," Antes says. "And if you have a psychologically safe environment, then people feel comfortable telling you that there's a problem to solve, as opposed to not bringing it up and being reluctant to have those kinds of conversations."

The laboratory of Christopher Minson, PhD, director of the Human Cardiovascular Control Laboratory at the University of Oregon, exemplifies the model of a safe and collaborative work environment. Minson not only strives to be supportive and available, but he aims to recruit trainees and staff who share those traits. He is always impressed with applicants who have participated in team sports, played in bands or worked in some other group that requires cooperation and collaboration.

"What I say to my students is that no one is ever successful in a vacuum," he says. "I think it's really true. If you're left to your own devices, you may have a little bit of success, but you really need good people, a good team, good communication."

Exemplars also communicate expectations and standards clearly. And they confront performance issues directly and supportively. "People want honesty," Boss says. "They don't want to be yelled at. They don't want to be criticized. But they also want to know how they can fix their shortcomings."

What are other effective leadership steps that physiologists can use to create psychological safety and robust science? Here are a few:

**Hold regular meetings**

Meetings create the opportunity for lab staff to share and critique data they've all collected. A participant in Antes' study called the lab meeting the most important event of the week because team members show their raw data for others to critique. Meetings also ensure that everyone clearly understands their responsibilities and next steps.

Meetings have become especially critical in the face of the COVID-19 pandemic, Minson says. Much of the activity in his lab froze in spring 2020

**"Everybody has the opportunity to interview with applicants, provide feedback. And everybody's got to be involved in writing grant proposals. The goal of the lab is to do science, and we need money to do that. I ask everybody to participate both for help and as a training experience."**

**—Jeremy Boss, PhD**

when campuses across the country closed. Staff and trainees worked remotely, making it difficult to track work productivity and progress. Team members could no longer have the spontaneous, collaborative conversations that spark new ideas and help drive the research forward.

In response to those changes, Minson scheduled weekly meetings over Zoom so that lab staff could report on their accomplishments, ongoing projects and long-term objectives. "We were just losing track of what people were doing, where they were going," he explains. "So the idea was just to have something to help them stay focused and accountable."

**Encourage shared ownership and decision-making**

Many principal investigators (PIs) interviewed in Antes' study said they have all their team members collaborate on study plans and establish a role for each individual. Having multiple individuals working on a project ensures the team analyzes data thoroughly and spots any gaps. Some PIs include their teams in designing compliance protocols and submitting study plans to institutional review boards.

Boss, who studies the regulation of gene expression in the immune system, says involving his students and postdoctoral fellows in all decisions and operations—from hiring to garnering funding—broadens their training. "Everybody has the opportunity to interview with applicants, provide feedback," he says. "I actually rely on them to do that. And everybody's got to be involved in writing grant proposals. The goal of the lab is to do science, and we need money to do that. I ask everybody to participate both for help and as a training experience."

**Supervise and guide appropriately**

Many PIs emphasize frequent, if not daily, interactions with team members to help identify and solve problems in data collection. Some mentioned having "open door" policies with their students and fellows. PIs with large teams or labs oversee managers or coordinators to provide some of the supervisory support, but still interact regularly with all members of the team.

Minson has created a co-mentoring approach with John Halliwill, PhD, FAPS, head of the University of Oregon's Department of Human Physiology, which Minson says broadens the guidance his students receive. In essence, he says, the students get two mentors with different but buttressing personalities.

"I'm very much an idea-generating, jam-session kind of mentor, whereas Dr. Halliwill is more

**Minson scheduled weekly meetings over Zoom so that lab staff could report on their accomplishments, ongoing projects and long-term objectives. "We were just losing track of what people were doing, where they were going," he explains. "So the idea was just to have something to help them stay focused and accountable."**

detail-oriented," Minson explains. "He likes spreadsheets and likes his schedule blocked off to meet with people. I'm like, 'Come to my office and talk.' Certain people like my form, and certain people like his form. What's worked is that students can work with both of us."

Boss emphasizes the importance of listening to individual team members to understand any struggles they're having and help them build solutions and succeed. "When you take a student in your lab, you're making a commitment for many years to work with that student, so it's important to listen to what they say and, if they are having trouble, help them through it."

Boss says he strives to understand the different motivations that each team member carries, so he can tailor his interactions with them in a way that draws out their best work.

"I always thought, blindly, that all you needed was good data and you're completely motivated," he says. "That was my motivation, but it's not everybody's motivation. Some need to be appreciated that they had the data. They need to be recognized that they had the data. They needed to be brought into the fold more, to have more of a say."

## EMBRACING HUMILITY AND GENEROSITY

Many early-career investigators recognize the importance of these leadership concepts but struggle to put the ideas into practice, Antes says. Now, she is pioneering a program to prepare scientists for the management side of their work. With a $2 million grant from the National Institute of General Medical Sciences, the program will train early-career investigators in leadership and administration. Senior and mid-career scientists will contribute to the curriculum, which will be based on the findings Antes collected from the research exemplars.

"One of the main projects I want them to do," she says, "is to create a lab manual they can leverage to think about their expectations, their philosophy about the lab environment, their basic data management requirements. They can use that as a living document to share it with people working with them."

Boss believes the ultimate form of leadership involves humility and generosity. "You have to love when someone else is successful—actually more successful than you," he says. "You have to enjoy allowing people to fully develop."

# Family Ties

For some, physiology is more than their passion and their career path; it's a part of their family. Some physiologists have family connections, whether the love of science was passed from parent to child, shared with siblings or helped them find their romantic partners. Physiology runs in their blood and in their family. Here are just a few of their stories.

# A Triple Dose

**BY LINDSEY ALEXANDER**

Kristen Engevik, PhD, has a beloved photo of her two older sisters, Mindy, the oldest, and Amy, the middle child. They are both in pigtails, sitting on the floor playing with a toy medical kit. "I like to think this is where it fully originated. I wasn't around yet, so they were just waiting for me to show up on the stage," Kristen says.

The three Engevik sisters all went on to become gastrointestinal physiologists. This happened "completely by luck," Mindy says. Mindy and Amy are assistant professors at Medical University of South Carolina. Kristen is a postdoc at Baylor College of Medicine in Houston. All three earned their PhDs from University of Cincinnati's systems physiology and biology program.

Bottom left: A young Mindy gives younger sister Amy an injection with their toy medical kit. Right photo, left to right, Kristen, Mindy and Amy during Digestive Disease Week in Washington, D.C. Bottom, left to right, Amy, Kristen and Mindy in the Faroe Islands.

Amy says there were inklings, if not about physiology, about the girls all becoming research scientists. "We grew up in a rural country town, so our parents always encouraged us to be outside playing in the wilderness. … I remember my friends would be talking about all the cartoons, and we rarely watched TV growing up. We just had very different pursuits as kids I think than most people," Amy says.

As kids, they were "really into tadpoles and frogs and rock identification and plant identification," Mindy says.

"I really liked trying to find mushrooms on different trees," Kristen says. Their small town of Julian, California, had a population of about 1,000, further contributing to their bond. "I spent all my time with Kristen and Amy—we had all these adventures together, so I think that also made us really close and similar," Mindy says.

Sharing a field offers many fringe benefits: Mindy appreciates the editing. Amy likes that it triples their networks. Kristen calls their sisterhood "my help center" for manuscript edits, PowerPoint reviews and suggestions on what antibiotic concentration to use.

"It's also a good place to vent," Mindy says, laughing. Not to mention built-in collaborators: In the past two years in varying combinations of writers, the Engeviks have co-written 16 papers together.

Things can get awkward for the Engeviks, such as in cases of mistaken identity. For instance, National Institutes of Health reviewers initially rejected Amy's fellowship application because they said she'd already done her dissertation on the gut. Hers was on the stomach. They had confused her with Mindy.

There was also that time at a poster competition when alphabetical order placed Mindy and Amy side by side. "We show up and we're literally wearing the exact same thing," Mindy says, recalling their navy dresses, yellow cardigans and black flats. (They now coordinate in advance.)

Overall, however, the sisters wouldn't trade it. "I love being one of the three," Amy says.

# A Brothers' Bond

**BY MEREDITH SELL**

Education was emphasized in the Rouabhi household. Growing up in Iowa City, Iowa, brothers Mohamed Rouabhi, MD, and Younes Rouabhi each caught the learning bug at home.

In elementary school, Younes picked up a book of science experiments and begged his mom to buy supplies. "She said, 'No, but we can make our own,'" Younes recalls. So they crafted their own petri dishes and Younes wandered the house swabbing the phone, door handles and toilet seat for bacteria.

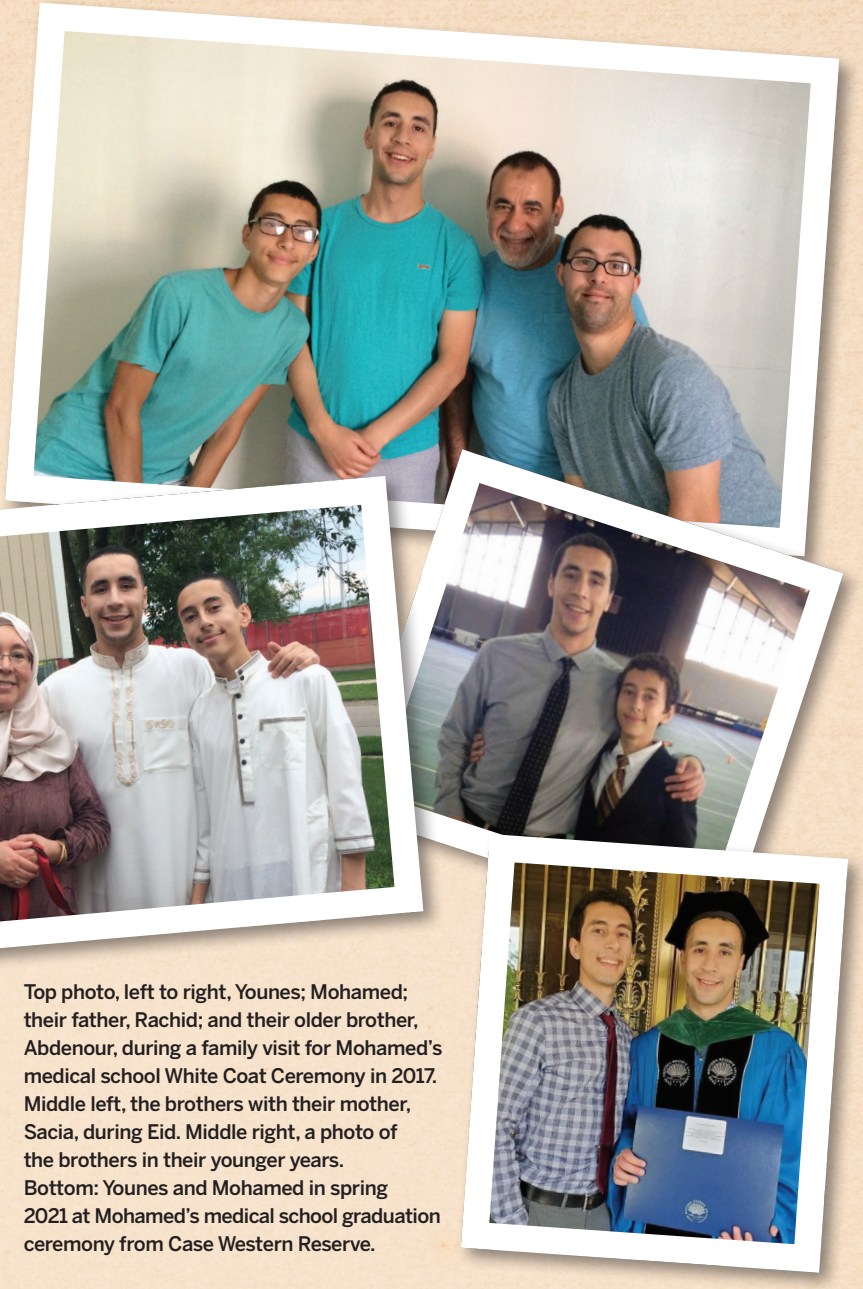
Meanwhile, Mohamed was fascinated by the human body. Their other brother, who was a year older than Mohamed, had Down syndrome, and Mohamed remembers observing the differences between the two of them. "He used to be the biggest kid, the tallest and the strongest of anybody, and early on, I passed him up," Mohamed says. "He started not being able to be as fast and ... stay as energetic as I was." The difference bothered Mohamed; he wanted to understand it.

The Rouabhis' curiosity remained piqued beyond grade school, and both brothers are now pursuing careers in science. Mohamed earned his bachelor's in human physiology at the University of Iowa, graduated from medical school at Case Western Reserve University in Cleveland, and is currently in his first year of residency in internal medicine at Washington University in St. Louis. Younes is in his junior year as an undergraduate biomedical engineering major at the University of Iowa and in the past couple of years has developed a stronger interest in human physiology.

"When we hit the part of the [biology two] class which talked about the human organ systems and how they all worked in tandem with one another, I remember being absolutely floored and stunned about how it all worked so cohesively," Younes says.

His desire to do more experimental research involving physiology led Younes to pursue a 2021 APS Summer Undergraduate Research Fellowship (SURF) in the lab of Kamal Rahmouni, PhD, at the University of Iowa's Carver College of Medicine, where Mohamed was also a SURF fellow several years earlier.

While Younes hasn't settled on a career path yet, Mohamed appreciates having his younger brother following in some of his footsteps. He offers advice and hopes to help his brother do better in classwork and research than he did. Younes, along with feeling a sense of competition with his big brother, is grateful to be able to look to Mohamed for guidance and encouragement. "It's something I'm really lucky to have as an undergrad and as a sibling," he says.



Top photo, left to right, Younes; Mohamed; their father, Rachid; and their older brother, Abdenour, during a family visit for Mohamed's medical school White Coat Ceremony in 2017. Middle left, the brothers with their mother, Sacia, during Eid. Middle right, a photo of the brothers in their younger years. Bottom: Younes and Mohamed in spring 2021 at Mohamed's medical school graduation ceremony from Case Western Reserve.

# Blood Lines

**BY JOHN LOEPPKY**

As a child, Michael Hall, MD, spent his summers a bit differently than his peers did. While other kids were working or at summer camps, Michael was "measuring sodium in dog urines," he says, helping out in the lab of his father, past APS President John Hall, PhD.

Michael says working with his dad had a lot to do with the career he chose as a cardiologist. He called that lab time "a fun perk," but John remembers that his son sometimes needed a little bribery.

"He had a really weak stomach as a little kid," John says, "so I had to tell him I would buy him a milkshake or something."



The pair's professional relationship has come a long way in the intervening years, from time spent on each other's research projects to co-authoring academic papers. John is the Arthur C. Guyton Professor and Chair of the Department of Physiology and Biophysics at the University of Mississippi Medical Center, a position named after his mentor. Michael is associate professor of medicine, physiology and biophysics and the associate division director for the Division of Cardiovascular Diseases.

One recent collaboration is the 14th edition of the "Guyton and Hall Textbook of Medical Physiology." John had collaborated on two previous editions of the text—which guides many medical students' studies each year—with Guyton in a professional relationship that lasted more than 30 years. The elder Hall says his son's involvement has brought a "clinical perspective" to compliment the already present academic foundation.

As for how the father-son duo worked together, John says Michael required less revision than his own attempts more than 20 years ago. "When I wrote my first chapter for the book, Dr. Guyton looked at it for about a day. And he brought me back and he said, 'This is really great; the writing is wonderful. You did a really good job on the writing, but I need you to cut it by 50%.' And I said, 'Well, what 50% do you want me to cut?' And he said, 'You know, I don't care.'

"His point was that it's not written as a reference book; it's not written for professional physiologists, that it's written in a way that provides the critical information that medical students need."

Michael has one piece of advice for working with family: Make sure that the career you share is an area of interest rather than just a natural progression. "In a family environment like that, it can't be a forced deal. Fortunately, I was never pressured; it was something I enjoyed."

**Top, future heart researcher Michael, age 9, at a science fair. Left, Michael graduating from medical school at the University of Mississippi Medical Center and being hooded by his dad. Right, the Halls in 2020 with their collaboration, the 14th edition of the "Guyton and Hall Textbook of Medical Physiology." Bottom, the Halls with medical students at a meeting in Ribeirão Preto, Brazil.**

# Love & Laughter

**BY BRITTANY KING**

Back in 2010, a physiologist, a physician scientist and a bunch of other scientists were in an online chatroom burning through topics, when the physician, who often tested on lab mice, said humans are the only acceptable model organism to test hypothesis. The chatroom erupted in disagreement, even from the physiologist who mostly studied humans.

That argument, and other online chats about their work, laid the groundwork for Melissa Bates, PhD, and Michael Tomasson, MD, to form a friendship and eventually a romantic relationship. The married couple have published papers together, borrowed ideas from one another's approach to science, and currently lead a science lab together at the University of Iowa.

Turns out Tomasson's flippant comment back in that chatroom was just that: "I really just said it to stir the pot," he laughs. At the time, he was seeing patients with blood cancer where he was very focused on cancer biology at a genetic and molecular level. Meanwhile, Bates' work focused on the entire organism. Open to learning a new way of looking at his work, Tomasson began to join Bates at several American Physiological Society meetings, where he realized his work with cancer patients could benefit from a physiologist approach.

"In physiology we use different levels of interrogation," Bates explains. "It has been fun to know Michael and have this conversation of, 'I know you think you're a cancer biologist, but you're actually a physiologist because you're studying how a system responds to a stress.'"

While Tomasson often works with patients who are near the end of their life, Bates works with premature infants at the beginning of their lives. At first, they thought their work could never overlap, but as Bates began to look at the sleep pattern of infants and Tomasson the sleep pattern of his patients, they found that breathing was a commonality that both groups struggled with.

They used their separate observations to create a collaborative new research area, understanding how sleep apnea contributes to blood cancer in adults and children. "When you bring people together that approach science from different perspectives, you actually do more powerful science," Bates says.

Today, in their lab, they promote students learning from one another, showing them there isn't just one way to approach scientific work. "It's natural to want to listen to other people talk on the same subject you're interested in, but we're coming at it from a different perspective," Tomasson says. "Medical residents are missing the whole-organism approach. There's a need for physiologists in medical education to help them understand the scientific method and how to do basic statistics. That crosses disciplines."

When they're not in the lab together, the two enjoy bike riding, hiking and watching independent films. They also have a cocktail group they join on Fridays. "The only reason our partnership in science works is because there are clear boundaries in what happens at home versus what happens at work," Bates says.


Top left, Bates and Tomasson. Right, Tomasson with their niece, Brynleigh, who, with her parents, got "stuck" living with Bates and Tomasson during the pandemic for eight months. Bottom, Bates and Tomasson's lab teammates.

# Colleagues to Spouses

**BY MEREDITH SELL**

The first time Paola Casanello, PhD, encountered Luis Sobrevia, PhD, she wasn't thinking about love or romance; she was thinking about nitric oxide.

In the late 1990s, Casanello was a midwife in Chile working in a neonatal intensive care unit, where most of the babies had been born preterm and had respiratory insufficiency because their lungs weren't fully developed. At that time, nitric oxide was commonly used to treat premature babies' lungs, but there wasn't clear scientific understanding of why it seemed to help. Were there secondary effects? Could it be harmful?

Driven by these questions, Casanello attended a workshop about nitric oxide at the University of Concepcion in Chile. She remembers being surprised by how many fellow Chileans were experts on nitric oxide, a novel research topic. Sobrevia, an associate professor at the university, was one of them.

Within a couple years, Casanello pursued a master of science in physiology at the University of Concepcion and began working in Sobrevia's lab. They had similar research interests: fetal physiology, the impact of maternal health (especially gestational diabetes and obesity) on fetal development, and the placenta. Their relationship was professional; they were colleagues, scientific collaborators.

It wasn't until fall 2001 that, Casanello says, "we began looking at each other in a different way." They had traveled to Bristol, England, to present research at a physiology conference, and one evening, on a walk together in the city, they were caught in a downpour. They rushed inside a church to escape the rain and ended up in the crypt, listening to live jazz, eating soup and talking to each other as a church event went on around them. After a while, a couple sitting near them handed them a drawing: a rough portrait of Casanello and Sobrevia beside each other. To Casanello, it felt like a sign.

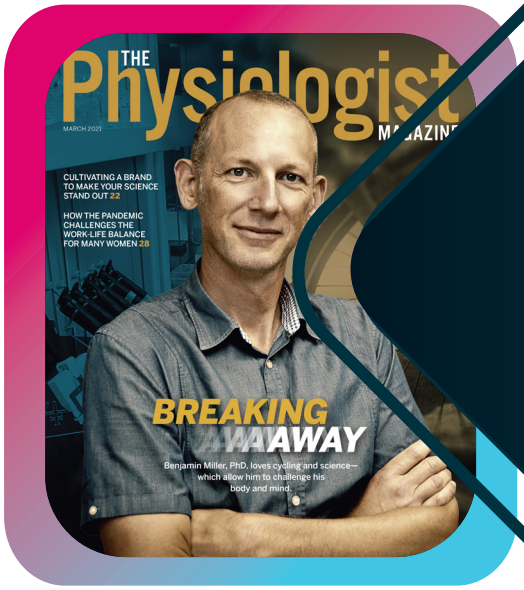
They started dating, and four years later, in December 2005, they married. Along the way, Casanello earned her PhD in physiology and both of them took professorships at Pontificia Universidad Católica de Chile in Santiago.

They now have two children, a 14-year-old daughter and 11-year-old son. The family is spending 2021 in the Netherlands, where Casanello and Sobrevia are visiting professors at the University of Groningen, enjoying an academic sabbatical. They split the housework and often share notes on their research, which has helped them address different research challenges. "It feels like having my own permanent expert reviewer at my shoulder," Sobrevia says.


**Top, the rough portrait a stranger in Bristol, England, drew of the two scientists before they started dating. Right, while dating, they traveled to Verona, Italy, to attend the 37th Annual Scientific Meeting of the European Society for Clinical Investigation. Bottom left, now with children, in 2011, the couple visit the house of Chilean poet Pablo Neruda, in Isla Negra, Chile.**








**Share your thoughts by December 31.**

SCAN ME

# First Annual Readers Survey

We relaunched *The Physiologist Magazine* in 2019 to put the spotlight on **YOU**: the smart, innovative, curious and creative people who are on the frontiers of scientific discovery and our understanding of life and health.

## We Want to Hear from YOU

- What do you think of the magazine?
- How can we improve?
- What do you want to learn more about?

Share your thoughts at **physiology.org/TPMSurvey**.

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## Czubryt Named Executive Director of Research

Michael Czubryt, PhD, has been named executive director of research for St. Boniface Hospital in Winnipeg, Canada. He is a professor in the Department of Physiology and Pathophysiology at the University of Manitoba, Canada, and principal investigator of the Molecular Pathophysiology Laboratory in the Institute of Cardiovascular Sciences at St. Boniface's Albrechtsen Research Centre. Czubryt is a member of the APS Cardiovascular Section's Steering Committee and has been a member of the Society since 2010.

## Johnson, Reckelhoff Receive American Heart Association Hypertension Research Award

**Alan Kim Johnson, PhD, FAHA**, and **Jane Reckelhoff, PhD, FAPS**, are recipients of the prestigious 2021 Excellence Award for Hypertension Research from the American Heart Association's Council on Hypertension. The award recognizes researchers whose work has had a major impact in the area of hypertension and has improved treatment and a greater understanding of high blood pressure.

Johnson is the F. Wendell Miller Distinguished Professor in the departments of Psychological and Brain Sciences, Pharmacology and Neuroscience, and Health and Human Physiology at the University of Iowa. His work on the neural basis of thirst and sodium appetite has led to studies demonstrating that the integrity of the anteroventral third cerebral ventricle region of the brain is necessary for expression of many forms of hypertension. He has been a member of the Society since 1979.

Reckelhoff is a Billy S. Guyton Professor and chair of the Department of Cell and Molecular Biology at the University of Mississippi Medical Center. Her research focuses on mechanisms responsible for sex differences in blood pressure control and renal disease, postmenopausal hypertension and control of blood pressure and renal function in polycystic ovary syndrome. Reckelhoff has been an APS member since 1992 and was the 89th president of the Society.

## Pluznick Receives Early-career Achievement Award from Alma Mater

**Jennifer Pluznick, PhD**, is the 2021 recipient of the University of Nebraska Medical Center (UNMC) Graduate Studies Alumni Council's Early Career Achievement Award. The award honors alumni from the graduate studies program who have made distinguished contributions early in their career. Pluznick, an associate professor of physiology at the Johns Hopkins School of Medicine in Baltimore, earned her PhD in renal physiology from UNMC in 2005. Her research focuses on G-protein coupled receptors in the kidney. Pluznick has been a member of APS since 2002.

## OPPORTUNITY KNOCKS

**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.**

### TENURE-TRACK ASSISTANT PROFESSOR IN KINESIOLOGY OR EXERCISE SCIENCE

**LOYOLA MARYMOUNT UNIVERSITY, LOS ANGELES**

The Frank R. Seaver College of Science and Engineering invites applicants with expertise in kinesiology and/or exercise science for a tenure-track position as assistant professor in the Department of Health and Human Sciences beginning fall 2022.

**Read more at www.physiology.org/loyolamarymountu.**

APS LEADERSHIP

## Sections, Interest Groups Welcome New Chairs

New chairs of several APS sections and interest groups took the helm this fall. The Society welcomes these new leaders:

Environmental & Exercise Physiology Section
**David C. Poole, PhD**
Professor, Kansas State University, Manhattan, Kansas

Gastrointestinal & Liver Physiology Section
**Pradeep K. Dudeja, PhD**
Professor of Physiology/Medicine, University of Illinois at Chicago

Comparative & Evolutionary Physiology Section
**Lynn Hartzler, PhD**
Associate Professor, Wright State University, Dayton, Ohio

Neural Control & Autonomic Regulation Section
**Kamal Rahmouni, PhD**
Professor, University of Iowa, Iowa City

Water & Electrolyte Homeostasis Section
**Kathryn Sandberg, PhD**
Professor and Director, Center for the Study of Sex Differences in Health, Aging & Disease
Georgetown University, Washington, DC

Translational Physiology Interest Group
**Colin N. Young, PhD**
Assistant Professor, George Washington University, Washington, DC

Epithelial Transport Interest Group
**Arohan R. Subramanya, MD**
Associate Professor of Medicine and Cell Biology, University of Pittsburgh School of Medicine

CALL FOR ABSTRACTS

## Submit Your Abstract and Present at the Final Experimental Biology!

After a 60-year history, the 2022 Experimental Biology (EB) meeting in Philadelphia (April 2–5) will be the last EB. APS and its four other host societies—American Association for Anatomy, American Society for Microbiology and Biochemistry, American Society of Investigative Pathology and American Society for Pharmacology and Experimental Therapeutics—are planning a special in-person experience for attendees to mark the occasion and showcase your science. We hope you will join us at this meeting, which promises to be an informative, exciting and fun send-off.

Abstract submission is now open. EB welcomes research in all areas of experimental biology, in particular anatomy, biochemistry and molecular biology, investigative pathology, pharmacology and physiology. Visit **www.experimentalbiology.org/abstract-topic-categories** to see the list of research categories and submit your best work.

RESOURCE

## FASEB Launches Data-sharing Resource for Researchers

The Federation of American Societies for Experimental Biology (FASEB) has introduced DataWorks!, a new resource designed to accelerate and enhance research discoveries in the life sciences through data sharing and accessibility. The initiative features four components that will help promote data reuse best practices, including:

- A hub for community conversations that explore data reuse barriers and solutions.
- A Fellows program to help research teams hone their data management and sharing skills.
- A data help desk and knowledgebase to offer guidance and peer mentoring.
- An annual grand challenge prize to recognize research teams that accelerate discovery through data sharing and reuse.

"FASEB DataWorks!, through its array of unique offerings, will support a critical need in the biological and biomedical research fields related to data sharing and reuse, thereby creating new types of collaborations and accelerating and enabling discoveries," says FASEB President-elect Kevin C. Kregel, PhD, FAPS, an APS member and executive vice president and provost at the University of Iowa.

READERS SURVEY

## Share Your Thoughts in *The Physiologist Magazine* Readers Survey

Our goal with *The Physiologist Magazine* is to put the spotlight on you: the smart, innovative, curious and creative people who are on the frontiers of scientific discovery.

Now, we want you to think about us, as in the revamped two-year-old magazine. Please take part in our readers survey and share your thoughts. What do you think of the magazine? How can we improve? What do you want to learn more about? Which topics and scientists should we feature?

Share your thoughts by December 31 at **www.physiology.org/TPMSurvey**.

# DATES & DEADLINES

## AWARDS

**Visual Career Abstract Award** (Deadline: November 5)

**Annual Marion J. Siegman Lectureship Award** (Deadline: November 14)

**Arthur C. Guyton Educator of the Year Award** (December 1)

**Beverly Petterson Bishop Award for Excellence in Neuroscience** (December 7)

**CANTROL Environmental Systems Predoctoral Research Award** (December 7)

**CANTROL Environmental Systems Postdoctoral Research** (December 7)

**Cardiovascular Section Clinical Science Young Investigator Award** (December 7)

**Cardiovascular Section New Investigator Award** (December 7)

**Cardiovascular Section Outstanding Postdoctoral Trainee Award** (December 7)

**Cardiovascular Section Outstanding Graduate Student Trainee Award** (December 7)

**Cardiovascular Section Research Recognition Award** (December 7)

**Central Nervous System Section New Investigator Award** (December 7)

**Central Nervous System Section Research Recognition Award** (December 7)

**Central Nervous System Section Van Harreveld Memorial Award** (December 7)

**Comparative & Evolutionary Physiology Section New Investigator Award** (December 7)

**Comparative & Evolutionary Physiology Section Research Recognition Award** (December 7)

**Comparative & Evolutionary Physiology Section Scholander Award** (December 7)

**Comparative & Evolutionary Physiology Section Travel Award sponsored by Dr. Dolittle** (December 7)

**Comparative & Evolutionary Physiology Section Travel Award sponsored by Novo Nordisk Foundation** (December 7)

**Data Sciences International Physiological-Omics Trainee Research Award** (December 7)

**Drs. Lou Stephenson and Margaret (Peg) Kolka Women in Physiology Postdoctoral Research Award** (December 7)

**Drs. Lou Stephenson and Margaret (Peg) Kolka Women in Physiology Predoctoral Research Award** (December 7)

**Endocrinology & Metabolism Section New Investigator Award** (December 7)

**Endocrinology & Metabolism Section Research Recognition Award** (December 7)

**Environmental & Exercise Physiology Section CANTROL Environmental Systems New Investigator Research Award** (December 7)

**Environmental & Exercise Physiology Dr. Charles (Tip) Tipton Postdoctoral Research Award** (December 7)

**Environmental & Exercise Physiology Dr. Charles (Tip) Tipton Predoctoral Research Award** (December 7)

**Environmental and Exercise Physiology Section Early Career Research Award** (December 7)

**Environmental & Exercise Physiology Section New Investigator Award** (December 7)

**Gastrointestinal & Liver Physiology Section Distinguished Research Award** (December 7)

**Gastrointestinal & Liver Physiology Section New Investigator** (December 7)

**Gastrointestinal & Liver Physiology Section Research Recognition Award** (December 7)

**Gastrointestinal & Liver Physiology Section Trainee Poster Awards** (December 7)

**Gatorade Sport Science Institute Postdoctoral Research Award** (December 7)

**Gatorade Sport Science Institute Predoctoral Research Award** (December 7)

**Horace W. Davenport Distinguished Lectureship** (December 7)

**Juan Carlos Romero and Water & Electrolyte Homeostasis Section Postdoctoral Research Recognition Award** (December 7)

**Leonard Share Award of the APS Water & Electrolyte Homeostasis Section** (December 7)

**Martin Frank Diversity Travel Award** (December 7)

**Neural Control & Autonomic Regulation (NCAR) Data Sciences Outstanding Graduate Student Award** (December 7)

**Neural Control and Autonomic Regulation (NCAR) Michael J. Brody Young Investigator Award** (December 7)

**Neural Control & Autonomic Regulation Section (NCAR) New Investigator Award** (December 7)

**Neural Control & Autonomic Regulation (NCAR) Research Recognition Awards** (December 7)

**Nike Loren G. Myhre Postdoctoral Research Award** (December 7)

**Nike Loren G. Myhre Predoctoral Research Award** (December 7)

**Partnership for Clean Competition Anti-doping Postdoctoral Research Award** (December 7)

**Partnership for Clean Competition Anti-doping Predoctoral Research Award** (December 7)

**Physiological-Omics Distinguished Lectureship Award** (December 7)

**Physiological-Omics Groups ADInstruments New Investigator Award** (December 7)

**Renal Section New Investigator Award** (December 7)

**Renal Section Postdoctoral Excellence in Renal Research Awards** (December 7)

**Renal Section Predoctoral Excellence in Renal Research Awards** (December 7)

**Renal Section Research Recognition Awards** (December 7)

**Respiration Section New Investigator Award** (December 7)

**Respiration Section Outstanding Trainee Award** (December 7)

**Respiration Section Research Recognition Awards** (December 7)

**Teaching Section Research Recognition Award** (December 7)

**Underrepresented Minority Postdoctoral Research Award** (December 7)

**Underrepresented Minority Predoctoral Research Award** (December 7)

**Virenda B. Mahesh Award of Excellence in Endocrinology** (December 7)

**Water & Electrolyte Homeostasis Section New Investigator Award supported by Data Sciences International** (December 7)

**Water & Electrolyte Homeostasis Section Portland Press Predoctoral Research Recognition Award** (December 7)

**Water & Electrolyte Homeostasis Section Research Recognition Award** (December 7)

**William Galey Professional Skills Training Scholarship Award** (December 11)

**Arthur C. Guyton Awards for Excellence in Integrative Physiology** (December 14)

**Cell & Molecular Physiology Section New Investigator** (December 14)

**Cell & Molecular Physiology Section Research Recognition Award** (December 14)

**Dean Franklin Young Investigator Award** (December 14)

**Giles F. Filley Memorial Awards for Excellence in Respiratory Physiology & Medicine** (December 14)

**Lazaro J. Mandel Young Investigator Award** (December 14)

**Shih-Chun Wang Young Investigator Award** (December 14)

**Translational Research Award** (December 14)

**APS Early Career Advocacy Fellowship** (December 18)

**Robert W. Berliner Award for Excellence in Renal Physiology** (December 31)

**ADInstruments Macknight Innovative Educator Award** (January 10)

**Dale J. Benos Early Career Professional Service Award** (January 24)

**Dependent Support Travel Award** (January 10)

**Cell & Molecular Physiology Section Robert Gunn Student Awards** (January 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**

# DATES & DEADLINES

## CALLS FOR PAPERS

**Cross-journal Call** (December 31, 2021)
- Deconstructing Organs: Single-cell Analyses, Decellularized Organs, Organoids and Organ-on-a-Chip Models

***American Journal of Physiology-Cell Physiology***
- 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)
- Skin Homeostasis: Peptides, Hormones, Proteases and More (July 1, 2022)

***American Journal of Physiology-Endocrinology and Metabolism*** (December 31, 2021)
- 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*** (no expiration)
- Adaptations of Physiologic Systems to Promote Cancers
- The Chronification and Treatment of Visceral Pain
- Coronavirus Disease (COVID-19) and Digestive System
- Gastrointestinal Issues in Neurological Diseases
- Microbiome-based Therapeutics and Their Physiological Effects
- The Physiology of Cellular Organelles

***American Journal of Physiology-Heart and Circulatory Physiology***
- New Developments in Translational Microcirculatory Research (November 30, 2021)
- Getting It Right (no expiration)

***American Journal of Physiology-Lung Cellular and Molecular Physiology*** (December 31, 2021)
- Electronic Cigarettes: Not All Good News?
- Extracellular Vesicles in Lung Health, Disease and Therapy
- "Morphology Is the Link Between Genetics and Function": A Tribute to Ewald R. Weibel
- Joint Call for Papers with Physiological Reports: The Pathophysiology of COVID-19 and SARS-CoV-2 Infection
- Senescence in the Lung

***American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*** (December 31, 2021)
- Don't Deny Your Inner Environmental Physiologist: Investigating Physiology with Environmental Stimuli

***American Journal of Physiology-Renal*** (December 31, 2021)
- Mechanisms of Renal Electrolyte Transport and Ion Channel Regulation in Honor of Dr. Gerhard Giebisch

***Journal of Applied Physiology*** (December 31, 2021)
- Long-term Recovery from SARS-CoV-2 (COVID-19)
- Physical Activity and the Brain

***Journal of Neurophysiology*** **(JNP)** (December 31, 2021)
- Vestibular and Oculomotor Function in Health and Disease: A Tribute to W. Michael King, PhD
- Visual, Vestibular and Somatosensory Interactions for Visuomotor Responses: A Tribute to Jerry Simpson

***Physiological Genomics*** (December 31, 2021)
- Comparative Physiological Genomics
- The Effects of Viral Infection
- Extracellular Vesicles: Role in Physiology and Pathophysiology
- Precision Medicine and Complex Disease

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

## MEETINGS & EVENTS

### CONFERENCES

**Experimental Biology 2022**

Conference dates: April 2–5, 2022, Philadelphia
- Abstract deadline: November 30
- Abstract-based awards deadline: November 30

**More details: www.physiology.org/EB**

## WEBINARS

**APS-Fauna Bio Industry Research Webinar** November 9, 2021

### INFLAMMATION AND IMMUNOPHYSIOLOGY WEBINAR SERIES

**Immunophysiological Mechanisms that Limit Dissemination of Microbial Signals from the Intestine** November 11, 2021

### DIVERSITY, EQUITY AND INCLUSION (DEI) WEBINAR SERIES

**Celebrating Native American Heritage Month: Honoring Cultural Diversity and Values** November 17, 2021

### PHYSIOLOGY EDUCATORS COMMUNITY OF PRACTICE (PECOP) WEBINAR SERIES

**What Do We Keep? Lessons Learned from Remote Teaching and Learning?** November 18, 2021

**More details: www.physiology.org/webinars**

# APPLY FOR SOCIETY AWARDS

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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**.

November **5**

### Visual Career Abstract Award

*$50 gift card.* A competition encouraging students to produce a visual abstract as a graphical representation for the education of others on the diversity of careers in the field of physiology.

November **14**

### Annual Marion J. Siegman Lectureship Award

*$1,000 honorarium.* Honors an established investigator who has made outstanding contributions to the contractile process of muscle biology.

December **18**

### Early-career Advocacy Fellowship

A two-year program engaging early-career investigators in advocacy activities and providing skills to become long-term advocates for scientific research. Participants will be mentored by members of the APS Science Policy Committee.

January **15**

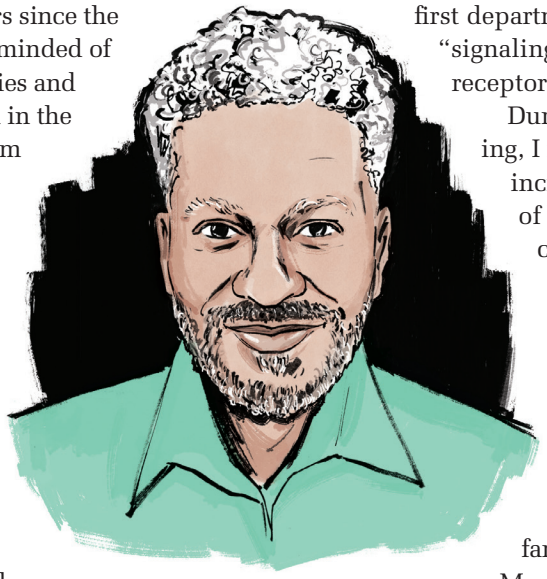
### Porter Physiology Development Fellowship

*$28,300 stipend.* Honors students of diverse background interested in pursuing full-time studies toward a PhD in the physiological sciences.

# Grandmothers' Experiences Inspired My Physiology Career

BY DEXTER L. LEE, PHD

As we celebrate the 100 years since the discovery of insulin, I am reminded of the many scientific discoveries and advances that have occurred in the field of diabetes research. I am also reminded of my late grandmothers: Ruthie Hall and Jewel Lee.



As a teenager, I learned that both grandmothers lived with diabetes. Although I didn't completely understand the physiological mechanisms and predispositions of diabetes as an early teen, I did know that both grandmothers took daily shots of insulin. The thought of giving myself an injection of insulin daily still is hard to comprehend and would require more courage on my behalf.

Nevertheless, they did not express fear, nor did I hear them complain about the daily injections, and they were very careful that I did not witness their daily administration of insulin. When I gained the courage to ask about the insulin shots, both would tell me, "It's something that you become accustomed to" or "it becomes a part of your daily routine." My frequent inquiries about the injections were quickly redirected toward topics around my well-being.

**"These indelible impressions of the impact of diabetes, coupled with the desire to help my dear grandmothers, ignited my interest in physiology."**

These indelible impressions of the impact of diabetes, coupled with the desire to help my dear grandmothers, ignited my interest in physiology. Although I grew up near both grandmothers, the journey on a career in physiology took me many miles from them; however, each time I would read or hear topics about insulin and/or diabetes, I would see both of their faces. I could relate to the effects of diabetes, which helped me to develop a sense of purpose and a desire to advance the field forward.

As a graduate student, my dissertation research centered around diabetic dyslipidemia and coronary artery disease. In fact, my first departmental seminar topic was "signaling mechanisms of insulin receptor susbstrate-1 (IRS-1)." During my graduate training, I realized that diabetes increased the susceptibility of both grandmothers to cardiovascular diseases. My grandmother Ruthie passed away when I was 19 years old, but she never discouraged me from going many miles away to pursue my dreams. I can still hear her saying, "go as far and as high as you can." My grandmother Jewel was placed on dialysis and lived a few more years before passing away. Although she may not have understood all of the methods, results and discussion in my dissertation, she was impressed with my research and told me she was proud of me.

As we look forward to the new frontier of insulin research, I can only imagine how my grandmothers would have preferred a nasal spray of insulin over a daily injection. Perhaps other life experiences may have inspired previous, current and future physiologists to pursue careers in diabetes research or related areas. I encourage all to find and follow a passion for their career pursuits in physiology.

**Dexter L. Lee, PhD, is an associate professor of physiology at Howard University in Washington, D.C. He is also an APS Councilor.**

Illustration by Brett Affrunti

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**WHERE** is physiology?
**WHY** does it matter to you?

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**#ISpyPhysiology**

# APS annual meeting at EB 2022

For over 60 years, Experimental Biology (EB) has been the world's largest interdisciplinary meeting in the life sciences, covering biochemistry and molecular biology, anatomy, pharmacology, physiology and pathology. The 2022 meeting marks the end of an era and will be the last EB meeting. We'll appreciate our past, look forward to the future and plan to go out with a BANG! You won't want to miss out.

The American Physiological Society (APS) annual meeting at EB is being held April 2–5, 2022, in Philadelphia. Present your research, network with colleagues, advance science and build your career.

Register, submit your abstract and learn more at **apsebmeeting.org**.

**Abstract submission deadline**: November 30
**Early-bird registration deadline**: February 7

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EB Experimental Biology

2022 PHILADELPHIA APRIL 2–5