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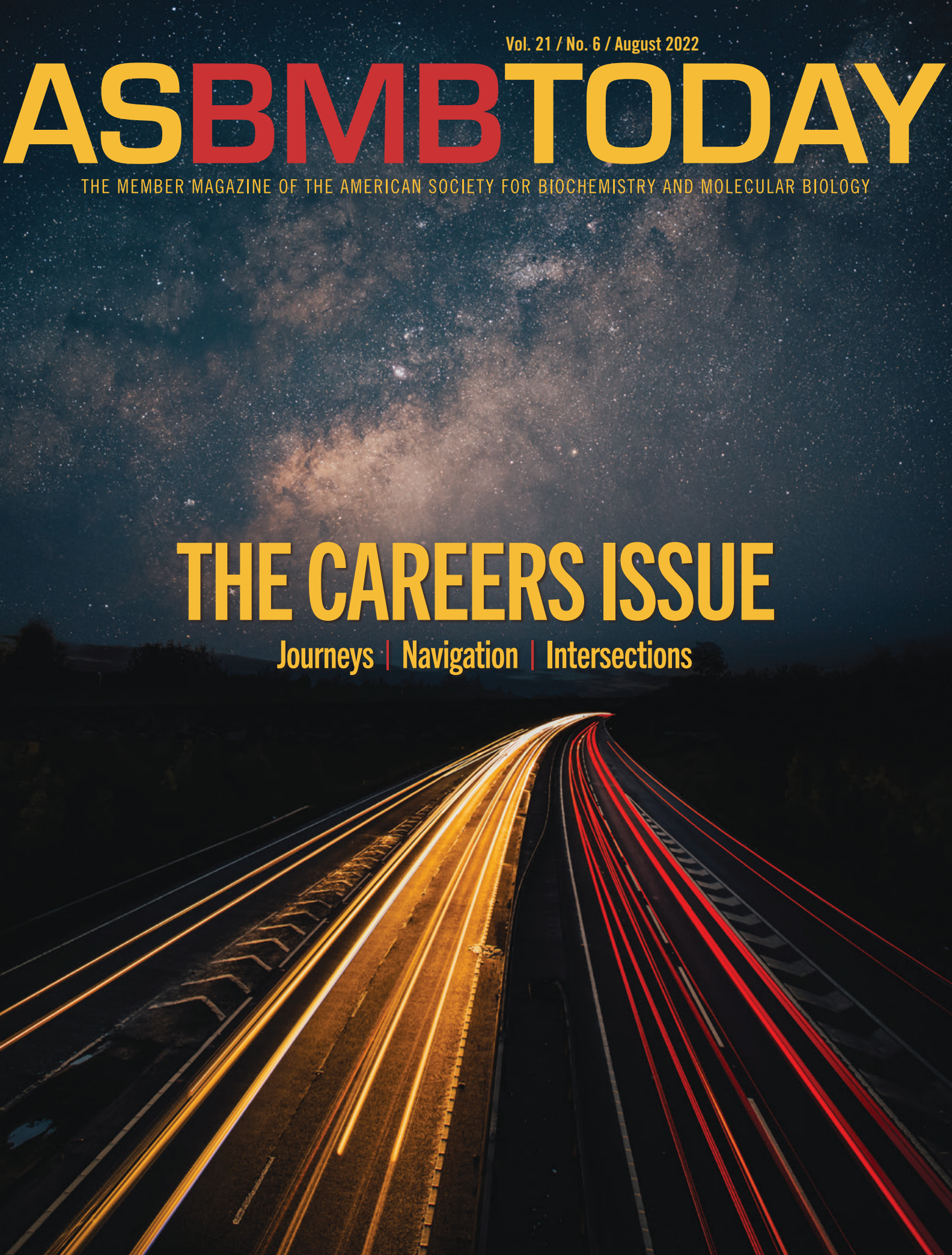
ASBMB TODAY

THE MEMBER MAGAZINE OF THE AMERICAN SOCIETY FOR BIOCHEMISTRY AND MOLECULAR BIOLOGY



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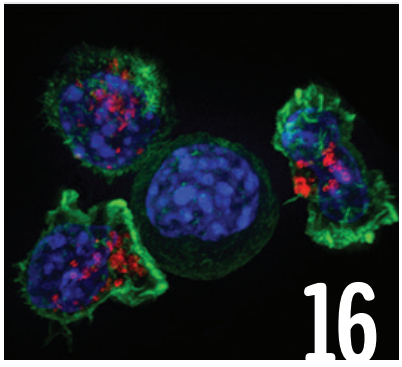

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ASBMBTODAY
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This is your society

By Ann Stock

It is an honor and a privilege and, if I'm to be honest, also a bit daunting to assume the role of president of the American Society for Biochemistry and Molecular Biology. I joined the society, then the American Society of Biological Chemists, as a graduate student in the 1980s. I have participated in several capacities through the years, never envisioning myself as president; yet here I am.

Perhaps it's not so surprising. My scientific pedigree includes two ASBMB presidents. My graduate and postdoctoral advisers held the role: Daniel E. Koshland Jr. in 1973 and Gregory A. Petsko from 2008 to 2010. In addition to being exceptional scientists and fantastic mentors, both served or continue to serve the scientific community in numerous ways, and by example, they instilled the value of service in their trainees. A commitment to service is part of my scientific heritage.

I hope that contributing to the community is part of every scientist's identity. Not only does it benefit the community, but it also can be personally rewarding to contribute beyond the boundaries of one's own research. I suspect this is one of the many reasons you joined the ASBMB. Would you like to become more involved in society activities? If so, I'd like to help you explore how.

But before delving into future service, I want to reflect on the past. Barbara Gordon retired in early 2021 after almost 50 years with the society — 18 as executive director. Her enthusiasm and dedication to the ASBMB are well known to all who have had the pleasure of meeting her. Barbara was named an ASBMB fellow this year, becoming the first affiliate member to be so honored. We wish her well in her retirement.

And I want to express tremendous gratitude to Toni Antalis, our immediate past president, who shepherded the ASBMB through the two challenging years of pandemic. Despite the physical isolation and the tedium of seemingly endless Zoom meetings, the ASBMB has maintained remarkable momentum on recent initiatives. It's reassuring that we can count on Toni's continued guidance as we navigate ahead.

The pandemic has highlighted the importance of both basic and applied scientific research and the community of scientists who rapidly reoriented their work and collaborated effectively in response to emerging needs. The BMB discipline, with its mechanistic focus, was at the core of diagnostic and therapeutic advances. However, the pandemic also illustrated the need for increased understanding of science and the scientific process in both public and government sectors. Government funding of scientific research must be a priority. Appropriate training of the next generation of bioscientists

for diverse careers will ensure a robust pipeline for the scientific workforce, and the pipeline needs to be broadened by promoting diversity, equity and inclusion.

A 2020 survey of ASBMB members indicated that, aside from funding, the professional issues of greatest concern were the public perception of science (including science literacy and how to communicate to the public); work–life balance; and diversity, equity, inclusion and justice in the scientific community.

The ASBMB has initiatives addressing all of these areas and provides ways for members to participate. However, members are not always aware of those initiatives or how to engage in them.

For example, the top concern of members was the public perception of science; 41% of respondents ranked it first.

However, 22% indicated elsewhere in the survey that they were unaware of ASBMB-supported science outreach activities or that they could participate in them; 29% indicated that they were unaware of advocacy activities such as our annual Capitol Hill Day and our Advocacy Training Program or that they could participate in them; and 29% indicated that they were unaware of the ASBMB's Art of Science Communication course or that they could participate in it.

I, myself, have not always been knowledgeable about what the ASBMB does. For years, I paid my dues, published articles in the Journal of Biological Chemistry, attended an occasional annual meeting and flipped through the latest issue of ASBMB Today if time allowed. It wasn't until I joined committees that I began to appreciate what the ASBMB is about.

I became a Council member in 2008 and have been continuously involved since that time as a member of the Education and Professional Development Committee, or EPD; the Finance Committee; and the Accreditation Steering Group. I've gotten to know the ASBMB. I've been integrated into an amazing network of people, and I've learned a lot that can be applied directly in my academic research career. My desire to teach initially motivated me to pursue a graduate degree, and participation in the EPD reconnected me with my interest in education. Through EPD activities, I've learned of challenges and best practices in education, knowledge that I apply routinely in my role teaching medical students, as coordinator of my center's summer undergraduate research program, as co-director of a T32-funded graduate training program and as chair of our university's academic planning committee. Certainly, I've given some time, but I've received far more in return.

In future messages, I plan to introduce you to the ASBMB committees through interviews with committee chairs. We'll focus on some of the society's many initiatives and provide a personal perspective from the scientists who steer ASBMB activities. I hope some of these topics will align with your passions. Perhaps you'll want to become more engaged with the society by connecting with committee members or volunteering to serve on a committee yourself. In March, prior to the annual ASBMB election in June, we solicited nominations, including self-nominations, for open positions on committees. We are eager to broaden representation and welcome your participation.

So get involved and get in touch. The ASBMB is your society. Its impact is determined by what we do together.

(Read the ASBMB Today interview with Ann Stock on page 28.)

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Ann Stock (stock@cabm.rutgers.edu) is a professor of biochemistry and molecular biology at the Robert Wood Johnson Medical School at Rutgers and resident faculty member at the Center for Advanced Biotechnology and Medicine. She became the ASBMB's president in July.

Tse–Dinh named to Florida academy

Yuk-Ching Tse–Dinh, a biochemistry professor and director of the Biomolecular Sciences Institute at Florida International University, has been named a member of the Academy of Science, Engineering and Medicine of Florida.

Tse–Dinh studies the enzymatic mechanism and activities of DNA topoisomerases, which control the coiling or relaxation of DNA during replication or transcription.

TSE–DINH

As a graduate student she identified the covalent bond between bacterial topoisomerases and their DNA target. Later, she identified the transcriptional control mechanism for excess negative DNA supercoiling to increase the level of topoisomerase I in E. coli, and she has studied how topoisomerase I in E. coli and mycobacteria suppresses R loops in transcription elongation under stress. More recently, her lab has worked on topoisomerases as a potential antimicrobial target.

After earning her Ph.D. in biological chemistry at Harvard University, Tse–Dinh became a principal investigator in the central research and development arm of the chemical company DuPont, where she spent six years before returning to academia. After 24 years at New York Medical College, she moved to Florida International University in 2012 as the founding director of its Biomolecular Sciences Institute. She has served on the editorial board of the Journal of Biological Chemistry.

The Academy of Science, Engineering and Medicine of Florida was founded in 2018 by faculty at the University of Central Florida. Its membership is open to all members of the National Academies of Science, Engineering and Medicine who live and work in Florida and to other accomplished scientists, doctors and engineers in the state by member nomination.

Llinás named distinguished professor

Manuel Llinás, a professor of biochemistry and molecular biology and of chemistry at the Pennsylvania State University, has been named a distinguished professor in recognition of his exceptional record of teaching, research and service to the university community and beyond.

Llinás studies Plasmodium falciparum, the deadliest of several Plasmodium species that cause human malaria. The parasite's life cycle is marked by a number of major developmental changes that make it difficult to target with drugs or vaccines; most will miss some fraction of the parasites that are present. Llinás and his team have used whole-genome approaches such as transcriptomics and chromatin immunoprecipitation to understand the regulation of gene expression at these various stages of parasitic infection. The lab is particularly interested in a switch committing an asexual life stage to develop into sexual gametocytes, which are required for mosquito transmission. In addition, they are exploring the roles of genes unique to P. falciparum and are using metabolomics to define novel aspects of parasite biochemistry in order to identify new candidate drug targets and metabolic vulnerabilities.

LLINÁS

Llinás earned his Ph.D. in Susan Marqusee's lab at the University of California, Berkeley, using biophysical techniques to study folding and misfolding of proteins including lysozyme and the prion protein. He conducted postdoctoral research with Joseph DeRisi at the University of California, San Francisco, where he began to explore gene expression in malaria parasites. He started his faculty career at Princeton University in 2005 and joined the Penn State faculty in 2013. A year ago, Llinás received the 2021 Penn State Faculty Scholar Medal for Outstanding Achievement.

ASM names academy fellows

The American Society for Microbiology has announced its 2022 class of fellows of the American Academy of Microbiology, an honorific organization of the society's most prominent members.

American Academy of Microbiology fellows are recognized for their outstanding contributions to microbiology. The academy acts as a think tank within the American Society for Microbiology. Five of the new fellows are also members of the American Society for Biochemistry and Molecular Biology: Carol Carter, Rebecca Dutch, Steven Hahn, Yoshizumi Ishino and Margaret Phillips.

Carol Carter is a professor at Stony Brook University Renaissance School of Medicine in the department of microbiology and immunology, with a secondary appointment in physiology and biophysics. Her lab studies virus–host interactions in the HIV replication cycle.

Before joining the faculty at Stony Brook, Carter earned her Ph.D. at Yale University and was a postdoc at the Roche Institute of Molecular Biology, a corporate research institute in New Jersey that at the time had a large postdoctoral training program. She studied reoviruses initially but transitioned to studying retroviruses during the HIV epidemic in the 1990s. She became interested in host–pathogen interactions as a druggable target: Although viruses rapidly acquire resistance to antiretrovirals, host proteins are much more stable. In addition to studying viral replication, her lab has worked with collaborators to identify small molecules that can inhibit the assembly, trafficking and release of viruses.

Rebecca Dutch is a professor of molecular and cellular biochemistry at the University of Kentucky College of Medicine, where she also serves as vice dean for research. Her research focuses on the synthesis, folding and proteolytic processing of glycoproteins from membrane-enveloped viruses as well as molecular details of replication, assembly and spread. The lab works on proteins from paramyxoviruses, such as Hendra and Nipah viruses, that are required for fusion between the viral envelope and the cell membrane and also studies several other viruses.

Dutch earned her Ph.D. in biochemistry at Stanford University and was a postdoc at Stanford and later at Northwestern University, where she studied membrane fusion by paramyxoviruses. She has been a faculty member at the University of Kentucky since 2000.

Steven Hahn is a professor in the basic sciences division at the Fred Hutchinson Cancer Center in Seattle. His lab studies eukaryotic transcription mechanisms in yeast: Over the years, they have investigated transcriptional activators, the binding patterns of various transcription factors and the structural biology of large transcription machines, particularly RNA polymerase II and related multiprotein complexes.

Hahn earned his Ph.D. in biochemistry at Brandeis University and was a postdoc at the Massachusetts Institute of Technology before joining the faculty at Fred Hutch. He is a former Howard Hughes Medical Institute investigator.

Yoshizumi Ishino is a professor at Kyushu University's department of bioscience and biotechnology. From 2014 to 2019, he held a secondary appointment at the NASA Astrobiology Institute, which is based at the University of Illinois Urbana–Champaign. His

ASM names academy fellows (CONTINUED)

research focuses on DNA replication and repair in archaea and application of metagenomics to develop new technologies for genetic engineering. In 1987, he was the first researcher to find the clustered repeat DNA sequences with regularly interspaced repeats, or CRISPR, in E. coli.

Ishino earned his Ph.D. at Osaka University's Research Institute for Microbial Diseases and was a postdoctoral researcher at Yale University, studying translation enzymes. He began his independent career at the biotechnology research laboratories of the Bioproducts Development Center of Takara Shuzo, a commercial research and development institute. He later joined the Biomolecular Engineering Research Institute. He joined the faculty at Kyushu University in 2002 as a professor of protein chemistry and engineering.

Margaret Phillips is the chair of the biochemistry department at the University of Texas Southwestern Medical Center. She studies pyrimidine biosynthesis in malaria and other protozoan pathogens, and her lab has developed potent and selective inhibitors of malaria metabolic enzymes that reached clinical stages as potential treatments for malaria infection.

Phillips earned her Ph.D. in pharmaceutical chemistry at the University of California, San Francisco, and pursued a postdoc there in the department of biochemistry. She has been a member of the UT Southwestern faculty since 1992 and is a member of the National Academy of Sciences and a fellow of the ASBMB.

Upcoming ASBMB events and deadlines

AUGUST

1	Transcriptional regulation and RNA Pol II conference early registration deadline
2	Epigenetics and genome stability abstract submission deadline and early registration deadline
14–18	**Mass spectrometry in the health and life sciences conference**
15	Discover BMB workshop and interest group proposal deadline
18	Transcriptional regulation and RNA Pol II conference poster abstract deadline
28	Transcriptional regulation and RNA Pol II conference registration deadline
29	Epigenetics and genome stability conference registration deadline

SEPTEMBER

8	Discover BMB abstract and travel award submission site opens
8	Discover BMB registration site opens
15	ASBMB accreditation applications due
28–Oct. 2	**Epigenetics and genome stability conference**
29–Oct. 2	**Transcriptional regulation and RNA Pol II conference**

OCTOBER

1	Student Chapter Outreach Grant fall deadline
15	Discover BMB early-decision abstract submission deadline

ASPET announces new leadership

Four members of the American Society for Biochemistry and Molecular Biology recently took leadership roles in the American Society for Pharmacology and Experimental Therapeutics: Namandjé Bumpus, Xinxin Ding, Lawrence Boise and Maurine Linder.

Namandjé Bumpus, a professor and director of the department of pharmacology and molecular sciences at Johns Hopkins University School of Medicine, has been elected president of ASPET. Her term will begin July 1.

Bumpus studies the metabolism of antiviral drugs used to treat HIV and hepatitis by the cytochrome P450 family of liver enzymes. Her lab uses pharmacogenomic and metabolomic approaches to understand why some antivirals cause drug-induced acute liver failure. The research team hopes these studies will lead to the development of future therapies that don't carry the same risk of toxicity.

Bumpus earned her Ph.D. at the University of Michigan–Ann Arbor and was a postdoctoral researcher at Scripps Research. Her previous honors have included the Richard Okita Early Career Award in Drug Metabolism and the John J. Abel Award in Pharmacology from ASPET, a young investigator award from the American Society for Clinical Pharmacology and Therapeutics, and the Presidential Early Career Award for Scientists and Engineers.

Xinxin Ding, a professor and head of the department of pharmacology and toxicology at the University of Arizona College of Pharmacy, has been elected secretary/treasurer of ASPET.

Ding's research focuses on genetic and environmental risks for chemical toxicity. Recently, he has published on how inhaled naphthalene, which is used in moth balls, can cause genotoxicity and how bioactivation of toxicants in one organ can cause toxicity in another organ.

Ding earned his Ph.D. at the University of Michigan Medical School. He started his faculty career at the University at Albany and then worked at the State University of New York Polytechnic Institute before moving to Arizona in 2017.

Lawrence Boise, a professor of hematology and medical oncology at Emory University School of Medicine and associate director for education and training at the Winship Cancer Institute, is to become secretary/treasurer for the society's division of cancer pharmacology.

Boise studies myeloma, a cancer of B cells. His lab conducts translational research to understand how gene expression in cancer cells governs their sensitivity to Bcl2 inhibitors, proteasome inhibitors and other classes of drug.

Boise earned a Ph.D. in pharmacology at the Medical College of Virginia and was a postdoc at the University of Michigan and the University of Chicago. Before joining the faculty at Emory, he was a professor and director of a graduate program in microbiology and immunology at the University of Miami Miller School of Medicine.

Maurine Linder, a professor and chair of the department of molecular medicine at Cornell University College of Veterinary Medicine, has been elected chair of the society's division for molecular pharmacology.

Linder studies the activity of DHHC acyltransferases, which carry out the post-translational modifica-

ASPET announces new leadership (CONTINUED)

tion protein S-palmitoylation. Her lab is interested in how palmitoylation affects signaling and how DHHC enzymes are themselves regulated through post-translational modification.

Linder earned her Ph.D. at the University of Texas at Dallas and was a postdoc and later an instructor at the University of Texas Southwestern Medical Center. She was a professor at Washington University School of Medicine before joining the faculty at Cornell in 2009.

IN MEMORIAM

Michael Stitelman

Michael Stitelman, a respected member of the Yale Medical School clinical faculty and a practicing psychiatrist in Branford, Connecticut, died Oct. 6, 2021. He was 80.

During his 50-year career, Stitelman regarded himself as a "community psychiatrist," according to a tribute written by his wife, Jane, who described him as a doctor who could provide a safe and welcoming space for his patients.

After earning a bachelor's degree in math and science at Harvard University, Stitelman enrolled in the Albert Einstein College of Medicine of Yeshiva University, a research-intensive medical school. During a fellowship at Yale University School of Medicine, he met his wife while at a training site for the psychology department. He went on to complete residencies at the University of California, San Francisco, School of Medicine and the Veterans Hospital in San Francisco.

At Yale, Stitelman offered an annual class focused on academic research called Science — A Reading Group, reflecting his lifelong interest in biology. The course summary read, in part:

"All the molecules of our biology are becoming known in exquisite detail and some of this will relate directly to our practice. Examples include better drugs, better imaging, and better laboratory tests. But it's quite a leap to go from molecules to people, thought, and social engagement. I believe that if we want to use the molecular knowledge, we would do well to ground ourselves in the basics. The stories have never-ending complexity but use general themes and methods that pervade and recur, so reading a selection of recent papers should enhance our understanding of the range of science and its use."

His wife described Stitelman as kind and selfless. During the COVID-19 pandemic, he transitioned to virtual meetings with his patients, and even after he suffered the health problems that later led to his death, he continued to see patients and prescribe medicine to ensure their well-being. He even worked after being admitted to the intensive care unit, providing final patient check-ins and telehealth visits.

Stitelman's eclectic interests included a love of musical instruments such as the veena, mandolin, guitar, ukulele and piano. While he was not an expert musician, his neighbors fondly remember him playing the mandolin on walks to the park. His interest in multiple instruments reflected his desire to keep learning and enjoy the process of learning.

In March 2021, Jane and Michael Stitelman marked 50 years of marriage. They had three sons, and Jane Stitelman remembered the enthusiasm with which her husband would gather his children for nighttime science lessons or bring them to the Branford science fair to volunteer as teenagers. All three sons, unsurprisingly, made their way into fields related to science and medicine. Stitelman's role as a grandfather had ignited a new kind of joy, his wife wrote, that included parading around the house playing the ukulele and dressing like a superhero.

— Nicole Lynn

Meet the 2022 ASBMB Advocacy Training Program delegates

The fourth cohort learned how to advocate for science policy this summer

By Mallory Smith

Ten delegates participated in the American Society for Biochemistry and Molecular Biology's rebooted Advocacy Training Program over the summer.

The ATP is a three-month externship (running from May to August) that provides hands-on science policy and advocacy training and experience. The ASBMB public affairs department runs the program.

In 2018 and 2019, the society trained 32 ASBMB members in three cohorts, providing the foundational knowledge, skills and tools they needed to advocate in their local communities and to their legislators. The program was on hiatus in 2020 and 2021.

Rick Page is chair of the ASBMB Public Affairs Advisory Committee and a professor at Miami University.

"We are tremendously excited to have the ATP back up and running. The ATP lets us extend our advocacy efforts beyond the group of scientists that comprise the PAAC — and even more importantly trains the next generation of science advocates," he said.

This summer's program featured nine sessions across a wide range of science policy topics, including the appropriations process and the role the executive branch plays in shaping science, and featured several guest lecturers.

Nick Rhind, a PAAC member and professor at the University of Massachusetts Medical School, said, "The ATP embodies many of the core goals of the PAAC — advocacy, outreach and training — and strengthens the PAAC's support of issues important to the ASBMB membership by training the next generation of advocates and amplifying the ASBMB's public voice."

Sarina Neote, the ASBMB's public affairs director, encouraged more scientists to be involved in science policy and advocacy.

"Congressional members and federal agencies need to hear more from scientists on policies that guide and influence scientific research. The Advocacy Training Program teaches delegates how to be effective advocates for science and how to engage policymakers in important legislative discussions on how to ensure the American research enterprise continues to thrive."

The program directs each delegate to choose an advocacy topic that interests them. Each week, the delegates apply what they have learned to their chosen topic. This program structure facilitates an individualized learning experience in science policy with the support of the ASBMB and participants' cohort peers.

Learn more about the delegates and their advocacy topics below.

Ankita Arora

Ankita Arora is a postdoctoral research fellow at the University of Colorado Anschutz Medical Campus, where she is working to decipher rules that govern RNA transport in brain cells. She is also a science policy and advocacy enthusiast, an active National Science Policy Network member and an ASBMB Today contributor.

"Precision medicine is the future of healthcare, yet its growth had been thwarted by the lack of diversity in genomics databases. Currently, over 20% of the genetics data comes from individuals with non-European ancestry," Arora said. "The path ahead to increase enrollment of underrepresented groups into genomics databases is to (1) increase access and (2) address mistrust amongst the most vulnerable due to the unethical nature of previous studies, such as the Tuskegee syphilis study. It's important for me to move toward a diverse, equitable future of healthcare while keeping the lessons learned from history in perspective."

M. Cortez Bowlin

Marvin "Cortez" Bowlin is a first-generation college graduate and Ph.D. student from Southwest Mississippi. As a graduate student at the University of Alabama at Birmingham, he organized the Birmingham

March for Science in 2017, which gave him firsthand experience with both the complexities of working to bridge the gap between stakeholders and policymakers and the distressing lack of involvement in good policy advocacy by individuals uniquely positioned to make meaningful progress.

"Graduate students and trainees experience exceptional stress as a result of producing a majority of published academic research, yet struggling to afford the average rent for apartments in their area. Without adequate incomes, graduate students can become highly stressed by financial insecurity. These stresses can bleed into research activity and result in costly errors, catastrophic mistakes, data misrepresentation and/or poor experimental design and analysis," he said. "As a delegate of the ASBMB ATP, I advocated for policy changes on an institutional and societal level so that future graduate students will receive proportionate compensation that will allow them to focus on problems concerning their research rather than problems of housing, food and basic necessities."

Roxanne Evande

Roxanne Evande is a third-year Ph.D. candidate at the University of Delaware. Her research explores the cellular mechanisms of the human papillomavirus E2 protein. Her policy and advocacy background include currently serving on the Graduate Student Government Executive Board.

"The ATP program has allowed me to advocate for issues that affect scientists around the country. I chose to explore ways to better measure potential and merit in STEM grant applications because potential is often measured by how many publications the individual has, how many years they've conducted research or the institution they attend," Evande said. "I hope to investigate if there are better methods of assessing merit and career potential to allow more individuals to receive funding to conduct their studies."

Ryan Feathers

Ryan Feathers is a Ph.D. student at Cornell University, where he studies the biochemical mechanisms that drive cargo transport inside cells. He graduated in 2015 from Oklahoma State University, which is where he discovered a passion for science education and outreach.

Feathers said: "Students who are underrepresented minorities are less likely to attend a university that prepares them for the challenge of navigating the path to post-baccalaureate education. My advocacy project aimed to increase accessibility to information about graduate programs and opportunities that provide a competitive advantage in the application process. My main goal was to develop a strategy that effectively advocated for scientists from diverse backgrounds."

Cedric Lansangan

Cedric Lansangan is a first-year Ph.D. student at Loma Linda University in Southern California. He is an aspiring physician–scientist taking the long way around to earning an M.D.–Ph.D. dual degree. He also currently is generating support and resources for establishing a physician–scientist outreach program — that is, when he isn't bonding with his flock of pet birds or watching everything Marvel and Star Wars.

"Physician–scientists are in extremely short supply in an era when translating bench-to-bedside innovations and vice versa has never been more critical. The physician–scientist's chimeric nature to merge the often-disparate worlds of clinical medicine and basic science research has historically led to the HPV vaccine, penicillin and cancer chemotherapy, to name a few," he explained.

Lansangan said the ATP helped him "to advocate for increased funding and/or numbers of physician–scientist outreach programs such that awareness of, opportunities for, and preparedness toward such a career path are as widespread as possible, particularly among women and those groups who are historically underrepresented in medicine."

Lance Li

Lance Li is a rising senior and biology major at Georgetown University. Li is particularly interested in legislation proposing to increase funding for high-risk, high-reward scientific research in the U.S. and advance scientific innovation.

"Freedom of diverse intellectual collaboration promotes interdisciplinary research approaches, which

accelerates scientific research and shines new light on complex biological mechanisms. My advocacy focuses on increasing research funding for grounded radical ideas — such as the National Institutes of Health's high-risk, high-reward grant — to continuously expand the edge of our understanding in research methodology, collaborative modes and education styles," he said.

Lien Nguyen

Lien Nguyen earned her Ph.D. in neuroscience from Yale University and is today a postdoc at Brigham and Women's Hospital, where she also serves on the communication and advocacy committees of the postdoctoral leadership council. She sought to apply the lessons learned from the ATP to advocate for better work environments and career development for fellow postdocs.

Nguyen said: "My transition from student to postdoc in 2020, right in collision with the COVID-19 pandemic, has made me acutely aware that scientists are human beings first — we worry, grieve and become anxious or depressed just like everyone else, which in turn affects our lives and our research. Therefore, I decided to advocate for better working and living conditions for postdocs, starting with higher salaries commensurate with our qualifications and responsibilities. I believe that, just like everyone else, happy, healthy, well-supported scientists produce the most impactful science."

Emily Pitsch

Emily Pitsch is a fourth-year biochemistry Ph.D. student at the University of Utah. She recognized her passion for advocacy work when disputing local and state proposals for invasive development in Utah's mountains.

"I decided to advocate for funding for science instruction training for teachers in Utah's public schools. Providing instructors with the tools to teach and understand science subjects will improve student proficiency and give them the opportunity to pursue science later in life," Pitsch said.

Chelsea Rand–Fleming

Chelsea Rand–Fleming is starting her fourth year as a chemistry and biochemistry Ph.D. student at Auburn University. She has a B.S in chemistry, serves as president of the local Young Chemists Committee chapter, and participates in outreach with the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers.

"My whole life I've been surrounded by veterans: my parents, uncles, aunts, siblings and now my husband. The transition from the military to the civilian world can be quite a difficult process," she said. "Introduction of more funding to introduce veterans to (science, engineering, technology and mathematics) programs and careers will effectively alleviate the high veteran unemployment rate and improve the segue between military and civilian life."

Aishwarya Sriraman

Aishwarya Sriraman earned a master's in biotechnology with a concentration in biodefense from Johns Hopkins University in 2019 and since has been an ORISE research participant at the U.S. Army Medical Research Institute of Chemical Defense, where she is in a group using robotics and in vitro laboratory techniques to discover and develop treatments for organophosphorus nerve agent intoxication. This experience helped her gain a unique perspective on lpolicies that affect the daily functions of a team passionate about solving meaningful problems.

She said: "We owe it to ourselves and our future to work toward a world with fewer threats and disease outbreaks. We must view our Strategic National Stockpile as a dynamic system, evolving to represent the circumstances of the world at that time. I advocated to ensure that its contents are regularly monitored and updated with the most optimal medical countermeasures so that we can be prepared to fight future chemical and biological threats and outbreaks."

Mallory Smith (msmith@asbmb.org) is an ASBMB science policy manager. Follow her on Twitter" @MalScienceGal.

Discover BMB | 2023

Call for proposals

Essential, mission-driven programming at Discover BMB

By Kirsten F. Block

Scientists are lifelong learners. While scientific meetings are a one-stop shop for learning about research, they also are where we learn how to become more competitive in the workforce, how to create more inclusive learning and professional environments, and how to foster public trust in scientists and the scientific process. In other words, meetings are where we go to learn how to become better scientists, better contributors to the scientific community and better members of society at large.

In March, the American Society for Biochemistry and Molecular Biology will hold its first stand-alone annual meeting in many years. We're calling the meeting Discover BMB, and, for reasons I'll explain below, it will offer daily programming dedicated to careers and professional development as well as best practices for science outreach and diversity, equity, accessibility and inclusion.

Importantly, all of that programming will be designed by members. And, to be clear, this is a call for proposals.

Standing room only

There never seems to be quite enough time in a scientific conference to see everything you want to. Between catching the latest science and catching up with old colleagues, the days can feel both long and short, invigorating and exhausting.

For many years, the ASBMB held its annual meeting at the Experimental Biology conference, at which attendees could tap into a number of sessions hosted by the five host societies. Attendees also could take advantage of the short talks at EB Career Central in the exhibit hall.

Amid the din of exhibitors showing off the latest products and attendees presenting their posters, flocks of attendees leaned in to listen to talks about the art of the interview and about how to take those first steps into a science policy career.

Each time I walked by EB Career Central in Philadelphia earlier this year, I saw attendees sitting on the floor when chairs were at a premium, and I was reminded of just how eager attendees are to learn, to grow their skills, and to think about what's next for both their science and their careers.

Don't take my word for it

While planning for #DiscoverBMB, we invited our 2022 graduate student and postdoc travel awardees to weigh in on what the ideal conference would look like to them. The themes we heard from them were "networking" and "learning new things."

So what, you might ask, are those new things? Certainly, some of those are science, but others are skills and

Stuart Ravnik, associate dean at the University of Texas Southwestern Graduate School, leads a science storytelling workshop at the 2022 ASBMB annual meeting.

career advice.

Nearly all the people we asked indicated they typically attend at least a couple of career-development sessions when they go to a meeting, and many said they'd like a meeting that offers career-development programming daily.

They mentioned, for example, such topics as becoming a better mentor, funding their research, sharing science on social media and engaging in science outreach.

Travel awardees also shared a desire to learn more about careers — particularly careers outside of academia — and about career decision-making, career transitions and career outcomes.

Sharing the stage at the 2022 ASBMB annual meeting are, from left, Anita Corbett and Marlene Belfort, winners of the society's 2021 and 2022 Mid-Career Leadership Award, respectively; Lea Vacca Michel, winner of the 2022 Early-Career Leadership Award; and Adriana Norris, a member of the ASBMB's Science Outreach and Communication Committee.

Aligned with our mission

When planning our annual meeting, we must ensure that the programming decisions we make are aligned with the ASBMB mission, which is "to advance the science of biochemistry and molecular biology and to promote the understanding of the molecular nature of life processes."

One of the ways the society advances the field is by promoting diversity, equity, accessibility and inclusion in the scientific workforce. We recently published a set of core values relating to DEAI (see page 66), and in it we vowed, among other things, to support members "in their DEAI efforts at their respective institutions and out in the world."

At #DiscoverBMB, we'd like to offer lots of sessions that will arm our members with strategies and practical advice for achieving their DEAI goals.

Back to the mission statement: The second part quoted above is about science education and literacy. The ASBMB has an increasingly robust science communication program, but it's what our members do in their communities that matters most. With politicization of science and misinformation on the rise with devastating consequences, we need an army of scientists doing this important outreach work.

It's more important than ever to make science accessible to the public and put a human face on scientists. This is why we'd like to provide hands-on workshops and other sessions that will equip members with the skills and tactics they need to make a real impact locally.

Here's where you come in

Many members of the society have expertise in transferrable skills that give scientists an edge in the job market and on the career ladder. Our members have compelling stories about their professional journeys, which form the heart of an effective career panel. Our members are courageous leaders in the DEAI space and have experience creatively communicating science to the public. In all, our members have so much to share, and that's why I'm writing this today.

If you would like to organize a career development, outreach or DEAI panel or workshop, I hope you will submit a proposal through the ASBMB website. The deadline is Aug. 15.

The relevant ASBMB committees will review submissions and create a robust program.

Think broadly and creatively about the types of content you'd like to share. Generally, your session may take one of two formats: panel or skill-building workshop. If you intend to propose a panel, you will need to tell us who might serve on the panel and how this format will support your key takeaways for the session. If you want to propose a skill-based workshop, you must include some sort of active-learning component.

Feel free to contact me if you have any questions, and thank you in advance for helping us meet the needs of our community.

Kirsten F. Block (kblock@asbmb.org) is the ASBMB's director of education, professional development and outreach. Follow her on Twitter: @kfblock.

A bridge over TRIBled cancer

By Connor O'Hara

Prostate cancer is a leading cause of cancer-related deaths for men in the U.S., and the American Cancer Society predicts over 30,000 deaths from prostate cancer this year. Doctors use several strategies to combat this deadly disease.

Androgen, a male steroid hormone, plays a pivotal role in the initiation and progression of prostate cancer, so ablation or blocking of androgen signaling is one common treatment. The drug enzalutamide, an inhibitor of the androgen receptor, is a popular clinical choice for the treatment of prostate cancer. However, the treatment has limited efficacy.

"Enzalutamide is a popular drug, but resistance almost always develops," researcher Jagadananda Ghosh said. "This prompted us to explore the underlying molecular mechanisms so that we can find a way to overcome this problem."

A team led by Ghosh and Jitender Monga at the Henry Ford Health System in Detroit recently published a paper in the **Journal of Biological Chemistry** with news about a novel protein, Tribbles 2, or TRIB2, that scientists have found to be a functional biomarker of prostate cancer and a potential target for new, alternative therapies for enzalutamide-resistant, or ENZ-R, cancer that could extend the lives of patients.

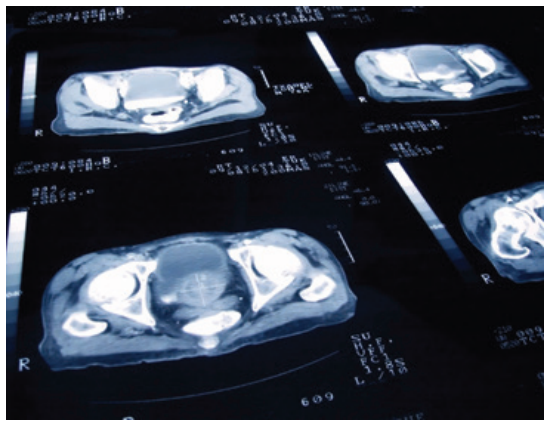
To better understand the mechanism of ENZ-R, the team used both cell-based and animal models to characterize the expression of this protein and others related to the survival and phenotype of prostate cancer.

The pseudokinase TRIB2 regulates wing pattern and development in the fruit fly Drosophila and has analogs found across several species including humans, where it engages with intracellular signaling hubs to host a variety of growth and survival mechanisms. In a comprehensive gene array, the team found that TRIB2 is greatly overexpressed in ENZ-R prostate cells, and these cells also show elevated expression of an anti-apoptotic protein, Bcl-xL. When the team inhibited TRIB2 in the animal models using genetics and pharmacology, they saw a dramatic reduction in viable ENZ-R prostate cells and reductions in tumor volume.

To understand how TRIB2 promoted this drug resistance and caused these changes in survival and growth, the researchers characterized the expression of luminal cell, neuroendocrine and stemness markers. They found that cells overexpressing TRIB2 were depleted in luminal cell markers but rich in those associated with neuroendocrine and stemness phenotypes. They reproduced this result in tumor xenografts and documented using immunohistochemical staining.

"TRIB2 emerges as a new driver for trans-differentiation of prostate cancer cells from adenocarcinoma to neuroendocrine and to confer resistance to enzalutamide," Ghosh said.

From this work, the team proposes that inhibiting AR signaling may have a negative impact on development of highly resistant and lethal prostate cancer cells. They have seen that kinase TRIB2 is not just a biomarker for ENZ-R cells but also functions



in developing drug resistance. By comparing the phenotypic profile of these cells with ENZ-sensitive cells, they could identify a switch toward prostate cancer in the ENZ-R cells that display stemlike and neuroendocrine features, a potential cause of the resistance.

The dynamic plasticity of these cells in response to therapy may provide researchers with opportunity to alter treatment strategies and address this AR-independent resistance mechanism.

"We are working to dissect the regulation and role of TRIB2 using various in vivo models," Ghosh said, "and we're formulating strategies to interrupt the activity of TRIB2 to develop a new targeted therapy for aggressive, lethal prostate cancer."

DOI: 10.1016/j.jbc.2021.101556

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Is location everything?

Probing the cellular function of cholesterol

By Aswathy N. Rai

Cholesterol is an essential structural component of cell membranes, where it also can regulate cellular processes.

Researchers know that cholesterol regulates the structure and function of integral proteins in the plasma membrane, such as ion channels and G protein–coupled receptors. Evidence indicates that cholesterol in the inner leaflet of the plasma membrane regulates cellular signaling by binding to signaling proteins. However, no techniques exist that allow site-specific control of cholesterol levels.

In a recent study in the **Journal of Lipid Research**, Wonhwa Cho and his team at the University of Illinois Chicago describe a new technique to precisely control cholesterol levels. Cho believes the method will benefit biomedical research to improve treatment of cholesterol-associated diseases.

"Many years ago, we discovered and published that cholesterol in the inner leaflet of the plasma membrane can activate cellular processes leading to cell overgrowth," Cho said. "Others have also reported site-specific actions of cholesterol in the cell. We thus needed a tool that can help us unambiguously elucidate the site-specific function of cholesterol."

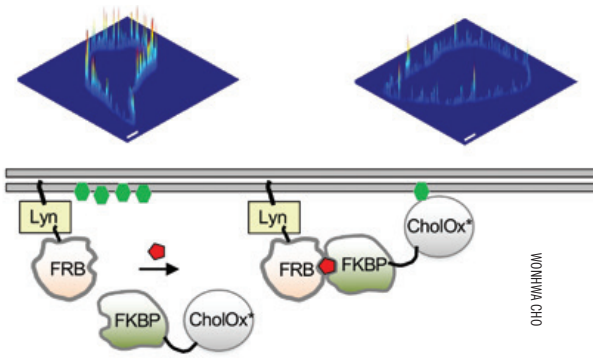
Although researchers can use standard methods such as chemical extraction and enrichment of cholesterol by methyl-beta-cyclodextrin or inhibition of new cellular cholesterol biosynthesis by statins, these techniques do not allow the spatiotemporal depletion of cholesterol, and they can be toxic to the cells.

Cho's method takes advantage of an inducible protein dimerization system and the cholesterol-depleting abilities of Streptomyces species cholesterol oxidase, an enzyme that catalyzes the breakdown of cholesterol in a two-step process. First, it must bind to the membrane; then cholesterol is converted to cholest-4-en-3-one, or cholestenone.

The researchers rationally designed a mutant of cholesterol oxidase, referred to as WVR, which displayed compromised membrane binding with no significant change in the catalytic function of cholesterol oxidase. Cho's team used the WVR mutant to design a system that artificially targets cholesterol oxidase to the plasma membrane as a spatiotemporally inducible cholesterol depletion agent.

Researchers often use protein dimer formation in response to external stimulation to understand the role of protein–protein interactions in cellular functions. The FRB–FKBP dimerization system uses rapamycin, an antifungal antibiotic that simultaneously can bind the FK506 binding protein and the FKBP–rapamycin binding domain of the mammalian target of rapamycin, known respectively as the FKBP and the FRB, resulting in heterodimer formation. Proteins of interest can be fused to FKBP or FRB, and dimerization can be induced by adding rapamycin or analogs such as rapalog.

Cho's team conjugated the mutant cholesterol oxidase to FKBP. They docked the FRB domain to the membranes using a short peptide sequence, Lyn, that targets proteins to the plasma membrane. They achieved site-specific targeting of cholesterol oxidase by adding rapalog, which induced the dimerization of FKBP–FRB and translocation of the mutant cholesterol oxidase to the plasma membrane. Site-specific depletion of cholesterol allowed Cho's team to determine unambiguously the different functions of cholesterol in the cytosolic leaflets of the plasma membrane and lysosomes.



WONHWA CHO

Site-specific depletion of cholesterol in the inner leaflet of the plasma membrane is accomplished by targeting of an engineered cholesterol oxidase.

"Cholesterol has been linked to various cancers," Cho said. "Our new tools will be very valuable in elucidating the mechanistic link between cellular cholesterol levels and oncogenic cellular process. This in turn will aid in development of new cancer drugs that modulate cholesterol-mediated oncogenic cellular processes."

DOI: 10.1016/j.jlr.2022.100178

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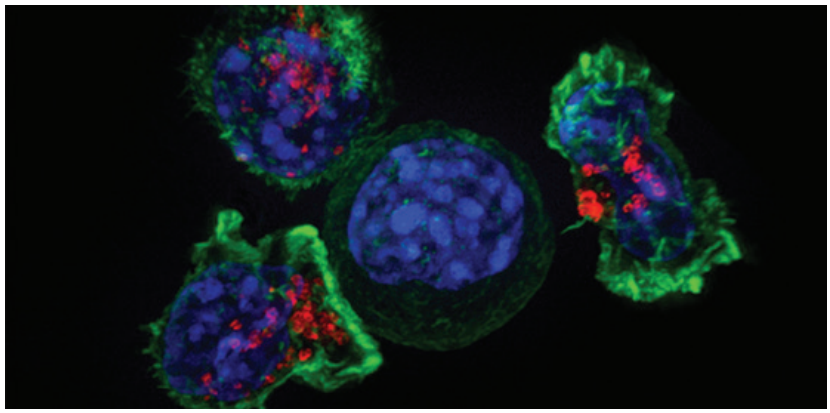
Starved for oxygen, T cells flag in cancer fight

Tumor hypoxia dramatically alters surface proteome

By Laurel Oldach



NATIONAL INSTITUTES OF HEALTH

A group of killer T cells (green and red) surround a cancer cell (blue, center). When a killer T cell makes contact with a target cell, the killer cell attaches and spreads over the target, then uses special chemicals housed in vesicles (red) to deliver the killing blow. The killer T cells then move on to find the next target.

Cytotoxic T cells exist to kill cells subverted by infection or mutation. That makes them the focus of a lot of immuno-oncology research. Although cancers must slip past immune recognition to become established in the first place, immunotherapies such as checkpoint inhibitor antibodies or T cells with modified receptors can retrain the immune system to focus on cancer cells.

So far, this has worked best for blood cancers with many cells spread throughout the body. Solid tumors have been harder to treat. The inside of a tumor differs from normal tissue in complex ways that add up to make it a very immunosuppressive environment.

In a preliminary study published in the journal **Molecular & Cellular Proteomics**, postdoc James Byrnes and colleagues in Jim Wells' lab at the University of California, San Francisco, report on their research into how the proteins on the surface of a cytotoxic T cell respond to various stimuli they might encounter in a tumor.

Using primary cells removed from human blood, the team focused on the surface proteome of cytotoxic CD8+ T cells. They investigated how interactions with T regulatory cells, which dampen T cells' response and help end an immune reaction, and oxygen limitation, a feature of many tumors, changed the cytotoxic T cell surface.

T regulatory cells are abundant in some solid tumors, and the team expected them to have dramatic effects. They were surprised to find that hypoxia had a much greater effect.

"The prevailing thought is that T regulatory cells are this super-potent immunosuppressive factor," Byrnes said. But growing CD8+ T cells with T regulatory cells changed only a targeted subset of proteins, mostly the ones that increase in abundance after activation and are involved in signaling and proliferation.

"The T-regs are reversing the activation phenotype," Byrnes said. "Hypoxia is a little more of a sledgehammer."

Oxygen starvation shifted cytotoxic T cell expression of many surface proteins: The cells reduced immune signaling receptors and increased metabolic proteins, apparently in an effort to survive using glycolysis. Other studies have shown that hypoxia can make T cells more prone to kill but also slower to multiply; on balance, they may become less effective.

The Wells lab is focused primarily on antibody engineering, Byrnes said, and these results have given them interesting leads to follow as they consider new ways to mobilize the immune cells within a tumor. "We're hoping … (to) gain biological insight into what some of these proteins are doing, as well as identify handles that we can use to therapeutically engage hypoxic T cells."

DOI: 10.1016/j.mcpro.2022.100217

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From the journals

By Isabel Casas, Anju Duley & Chloe Kirk

We offer summaries of papers recently published in the **Journal of Biological Chemistry,** the **Journal of Lipid Research** and **Molecular & Cellular Proteomics**.

A new way to study atherosclerosis in mice

Gene-editing technology can generate low-density lipoprotein receptor–deficient mice that are used widely for atherosclerosis research. However, such genetically modified mice require rigorous breeding to study atherosclerosis of complex systems. Anti-sense oligonucleotide against low-density lipoprotein receptor, or Ldlr-ASO, can generate complex genetic models to study hypercholesterolemic atherosclerosis in animals without time-consuming breeding procedures. ASOs are single-stranded small oligonucleotides (less than 50 nucleotides) that specifically bind to a complementary mRNA sequence and inhibit the translation of protein corresponding to the ASO-bound mRNA sequence.

In a recent article in the **Journal of Lipid Research**, Diego Gomes

Two approaches are better than one

Proteomics studies sets of proteins in a system such as a skin cell. Researchers need to understand what proteins make up a given organism or cell type to determine how a system functions and how to distinguish one system from another. One step beyond looking at the genome, which is largely static in a given system, proteomics shines a light onto changing protein dynamics.

Researchers can compare the proteomes of healthy and cancerous skin cells to see what proteins are changed in cancer, for example, and then predict what pathways are being up- or downregulated as well as what proteins are indicators of a cancerous cell.

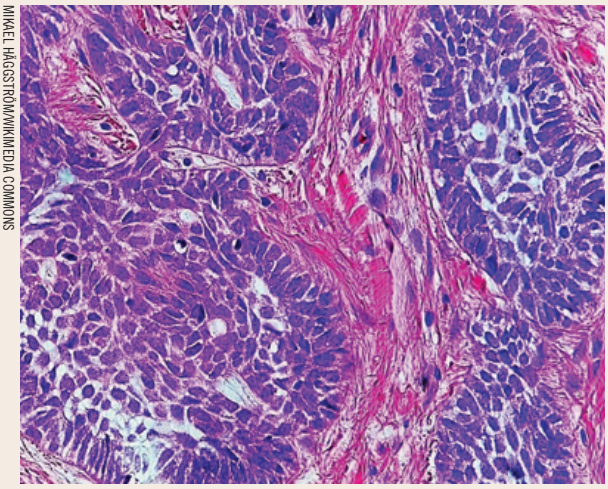
While the possibilities of proteomics research are endless, the current technology is a hindrance. In a recent study in the journal **Molecular & Cellular Proteomics**, Claudia Ctortecka and a team at the Vienna BioCenter in Austria combined two well-used analytical strategies in proteomics.

In the first, data-independent acquisition, or DIA, they fragmented all the peptides in a certain mass window and then analyzed the data. This differs from traditional data-dependent acquisition, or DDA, which isolates each peptide and then fragments each separately. Ctortecka and collaborators chose DIA because it provides more robust and similar quantification every time for the same sample and because DDA has problems merging large numbers of proteomes.

The authors combined DIA with tandem mass tag, or TMT, multiplexing, which allows researchers to run multiple samples at once by labeling each sample with different stable isotopes. TMT increases throughput of proteomics runs and the abundance of fragment ions available for peptide identification, but importantly, TMT by itself has problems with missing data points across multiple analytic runs. The researchers provide compelling data that combining DIA analysis with TMT experiments provides highly reproducible, quantitative proteome signatures that can be used to identify cell types and single protein knockouts.
DOI:10.1016/j.mcpro.2021.100177

— Chloe Kirk

MIKAEL HÄGGSTRÖM/WIKIMEDIA COMMONS

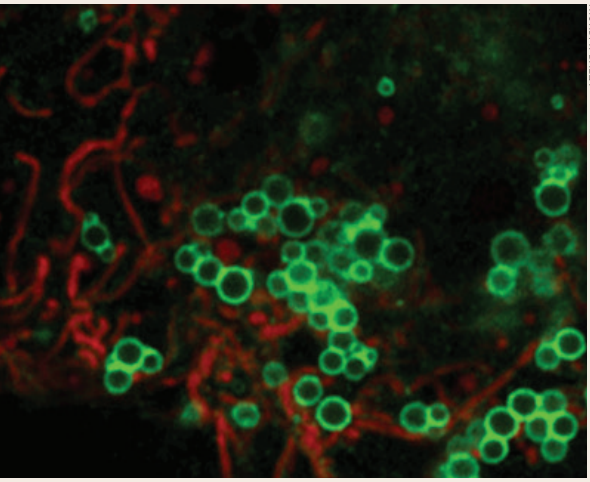


Researchers at the Vienna BioCenter combined two proteomics methods to detect signatures in skin cancer cells like those shown in this high-magnification micrograph. The cancerous cells are a darker purple than the surrounding stroma.

A metabolic role for lipid droplet–mitochondria coupling

Lipid droplets, or LDs, are dynamic organelles found in eukaryotic cells where fatty acids are stored temporarily in the form of triglycerides — the most common type of fat in our bodies. The phospholipid monolayer of LDs hosts Perilipin 5 protein. This protein, known as PLIN5, is highly expressed in oxidative tissues including skeletal muscle, liver and heart.

PLIN5 plays an important role in regulating intracellular lipid homeostasis, disruption of which can cause mitochondrial dysfunction and lipotoxicity — damage caused by accumulation of free fatty acids. PLIN5 tightly anchors mitochondria to the LD membrane via its last 20 C-terminal amino acids; this is commonly known as LD-mitochondria coupling or LDMC. Researchers have not established the role of LDMC in intracellular lipid metabolism.



NICHD/T. BALLA

Mitochondria (red) and lipid droplets (green) in a mammalian cell loaded with oleic acid.

In a recent article in the **Journal of Lipid Research**, Benedikt Kien at the University of Graz Institute of Molecular Biosciences in Austria and a team of researchers describe determining the specific role of PLIN5-mediated LDMC in intracellular lipid metabolism by overexpressing a mutant PLIN5 that disrupts LDMC. This mutant PLIN5 lacks the last three C-terminal amino acids.

The mutant PLIN5 did not alter intracellular lipid homeostasis significantly compared with the cells overexpressing the wild-type PLIN5. Various cell lines overexpressing PLIN5 mutant showed a moderate reduction of mitochondrial beta-oxidation compared to wild-type PLIN5. This signifies that LDMC has a very moderate impact on mitochondrial fatty acid oxidation.

The researchers' study showed that LDMC improves mitochondrial respiration, a process that requires oxygen to produce cellular energy. Also, PLIN5-mediated LDMC protects cells from lipotoxic damage by increasing the rate of fatty acid storage and slowing lipid breakdown in the event of increased cellular fatty acid uptake. LDMC may help mitochondria adapt to an increased demand for this uptake and oxidation as well. The study suggests that LDMC plays a vital role in preserving mitochondrial function, and cell lines overexpressing PLIN5 mutant can be used as models to investigate the effect of LDMC on other cellular functions.

DOI: 10.1016/j.jlr.2022.100172

— Anju Duley

at the University of Washington and a team of researchers describe their parallel studies of this form of atherosclerosis in two groups of mice; one group was genetically deficient in Ldlr protein, while the other group had sufficient Ldlr and received Ldlr-ASO. The researchers compared the plasma cholesterol levels, size of the atherosclerotic lesion and the extent of hepatic inflammation between the two groups.

In plasma samples, cholesterol levels in the genetically deficient mice were twice as high as those in the Ldlr-ASO treated mice. Also, male mice from both groups had higher plasma cholesterol than female mice. The genetically deficient mice developed more advanced atherosclerosis as evidenced by larger lesion areas compared to their Ldlr-ASO counterparts. However, mice treated with Ldlr-ASO showed increased hepatic inflammation. Nonetheless, Ldlr-ASO is an effective and efficient strategy to study the early stages of atherosclerotic lesions and complex genetic models of atherosclerosis.

DOI: 10.1016/j.jlr.2022.100174

A little sample goes a long way

One way to improve proteomics research is in the analysis tools. Another equally important aspect is initial sample processing. In some instances, rare cell phenotypes can occur, such as during the short mitosis cell phase. Researchers must be able to understand these short-lived cell phases, and they are difficult to analyze with traditional proteomics methods, which require lots of cells.

One method for studying rare cell phenotypes with low cell yield is fixing with formaldehyde to minimize

perturbations to physiological processes. However, this fixative causes cross-linking between proteins, requiring additional digestion or other steps that could compromise the samples.

In a recent paper in **Molecular & Cellular Proteomics**, Van Kelly and a team at the University of Edinburgh describe a new processing method of digesting low-yield samples with protease. The researchers were able successfully to characterize proteome changes across 16 cell cycle states from TK6 cells. This technique could revolutionize the way proteomics addresses rare cell phenotypes and make better use of low yield samples.
DOI: 10.1016/j.mcpro.2021.100169

Finding aqueous pores in sodium channels

Epithelial Na^+ channels, or ENaCs, belong to the (ENaC)/degenerin family, and their extracellular domains interact with other factors that regulate channel gating. These channels influence such functions as blood pressure and vascular smooth muscle and are composed of three subunits: alpha, beta and gamma.

Several studies have identified specific amino acid residues and extracellular domain structures that regulate ENaC gating; however, researchers do not yet understand the transitions that happen at a structural level. In a recent **Journal of Biological Chemistry** article, Lei Zhang and collaborators at the University of Pittsburgh describe using cysteine, or Cys, scanning mutagenesis to better understand the functional effects of Cys-modifying reagents on palm domain β10 strand residues in mouse ENaC.

The authors show that only mutants in the proximal region of β10 exhibited changes in channel activity in response to methanethiosulfonate reagents. In addition, multiple Cys mutants were activated by low concentrations of thiophilic $Cd2^+$. The researchers also identified four alpha, two beta and two gamma subunit β10 strand mutations that changed the Na^+ self-inhibition response.

The authors state this model is consistent with the structure of mouse ENaC that predicts the presence of aqueous tunnels adjacent to the proximal part of β10.
DOI: 10.1016/j.jbc.2022.101860

A novel function of a damage response protein

Cytochrome P450 enzymes, or P450s, are a superfamily of heme-containing proteins involved in cellular functions such as biosynthesis of steroid hormones, drug metabolism, cholesterol synthesis and breakdown of xenobiotic compounds. The damage response protein, or Dap1, is a heme-binding protein known to interact with several P450s and regulate P450s involved in ergosterol biosynthesis of yeast. Ergosterol is a steroid alcohol found in the cell membranes of fungi; it functions like cholesterol in animals and is a precursor for vitamin D synthesis. Researchers have found that Dap1 alters the production of ergosterol in yeasts.

In a recent article in the **Journal of Lipid Research**, Ana-Maria Gonzalez and Maximiliano Venegas at the Universidad de Chile and a team of researchers found a new role of Dap1 in carotenoid biosynthesis in the yeast Xanthophyllomyces dendrorhous. This yeast produces astaxanthin, a carotenoid that causes pink-red pigmentation in animals such as salmon, red trout and flamingos. Fisheries use astaxanthin as a dietary supplement and color additive in fish foods.

In this study, the researchers deleted a DAP1 gene in X. dendrorhous, which changed the yeast pigmentation, decreasing astaxanthin and reducing the proportion of ergosterol. This suggests that Dap1 regulates the biosynthesis of astaxanthin and ergosterol in the yeast. By showing the interaction of Dap1 with the P450s involved in the biosynthesis of astaxanthin and ergosterol, the study reveals a new role of Dap1 — the regulation of carotenogenesis. This means Dap1 might be used to enhance the production of astaxanthin in this yeast.
DOI: 10.1016/j.jlr.2022.100175

Harnessing proteomics to find biomarkers

Proteomics has revolutionized the real-world impact of research on identifying and treating diseases. Neserin Ali and a team at Lund University use their understanding of proteomics techniques to analyze acute differences between osteoarthritis disease stages.

Early-stage osteoarthritis is a degenerative joint disease affecting 5% of people between the ages of 35 and 54. Known biomarkers for osteoarthritis lack sensitivity and are not useful in tracking progression of the disease. Studies of the osteoarthritis proteome and proteomic analysis have been

Functional redundancy in mycobacteria

The tricarboxylic acid, or TCA, cycle is essential to carbon metabolism. Malate oxidation, a critical step of this cycle, is catalyzed by malate dehydrogenase or malate quinone oxidoreductase. These enzymes, Mdh and Mqo, respectively, tend to co-occur in a single bacterium, and one of them is usually primarily responsible for malate oxidation. Although these proteins are present in most bacteria, the level of functional redundancy remains unclear.

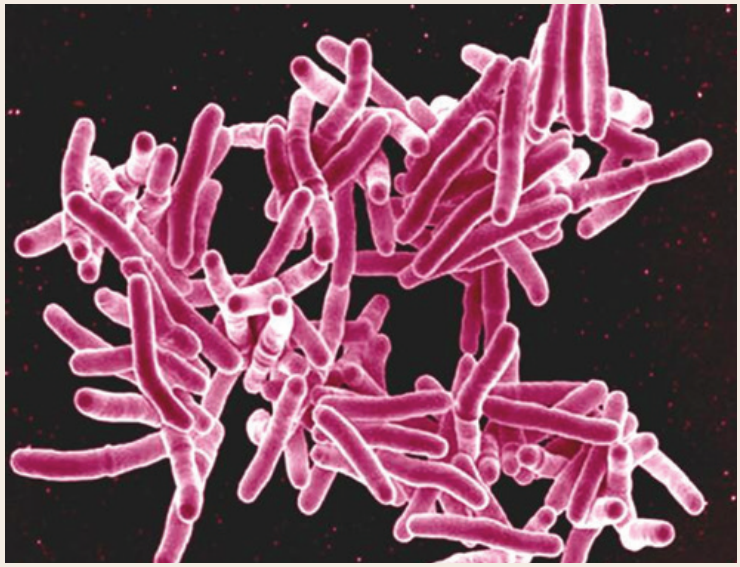
In a recent article in the **Journal of Biological Chemistry**, Liam Harold and collaborators from the University of Otago in New Zealand describe performing a bioinformatic survey of thousands of bacterial proteomes that revealed that Mqo was not as widespread as Mdh in bacteria and that it was highly conserved in mycobacteria.

The authors deleted mqo from Mycobacterium smegmatis, an environmental saprophyte — that is, it feeds on decaying matter — that lacks Mdh in its genome and found that Mqo is essential for growth on nonfermentable carbon sources. The authors also determined that mqo mutants grew more slowly on fermentable carbon sources. Complementation experiments with a heterologous Mdh from Mycobacterium tuberculosis shortened the delayed growth on fermentable carbon sources and restored growth on nonfermentable carbon sources at a reduced growth rate.

The authors conclude that Mdh is maintained in slow-growing mycobacterial pathogens for use under conditions such as hypoxia that require reductive TCA cycle activity.

DOI: 10.1016/j.jbc.2022.101859

— Isabel Casas



NIAID

A scanning electron micrograph of Mycobacterium tuberculosis bacteria, which cause TB.

hindered by low availability of osteoarthritis biological samples, as sample collection procedures are rather invasive.

In their recent paper in **Molecular & Cellular Proteomics**, Ali and collaborators describe using state-of-the-art mass spectrometry to compare early- and late-stage osteoarthritis. Their work has led to key discoveries in potential pathways that osteoarthritis is using, both by identifying the proteins upregulated in osteoarthritis and by finding new biomarkers for osteoarthritis. The researchers also found biomarkers specifically for early-stage osteoarthritis, noting that this stage of the disease looks like a "raging battlefield" of proteins, while late-stage osteoarthritis is more like the "aftermath." This work demonstrates how proteomics research can have an impact on disease diagnosis and treatment just by showing what proteins are involved.

DOI: 10.1016/j.mcpro.2022.100200

IDing new substrates for a ubiquitin ligase

The HECT E3 ligase WWP2 targets lysine residues for ubiquitination in a broad range of proteins involved in different physiological processes. WWP2 is made up of an N-terminal C2 domain, four central WW domains and a C-terminal catalytic HECT domain. The linker peptide between the middle WW domains can autoinhibit the catalytic domain of this protein, and this inhibition can be removed by phosphorylation at the tyrosine residue at position 369. Researchers have yet to determine the range

of substrates and functions of WWP2.

In a recent article in the **Journal of Biological Chemistry**, Hanjie Jiang and collaborators at Brigham and Women's Hospital describe using protein microarray technology as a platform to identify WWP2 substrates using an activated version of this ligase. This technology can assess enzyme-substrate interactions directly in a high-throughput fashion.

The authors identified several substrates, of which they validated three well-known autophagy receptors using cell-based transfection assays, and the lysine ubiquitination sites on these proteins were mapped by mass spectrometry. The authors conclude that WWP2-mediated ubiquitination of the autophagy receptors may contribute positively to the regulation of autophagy.

DOI: 10.1016/j.jbc.2022.101854

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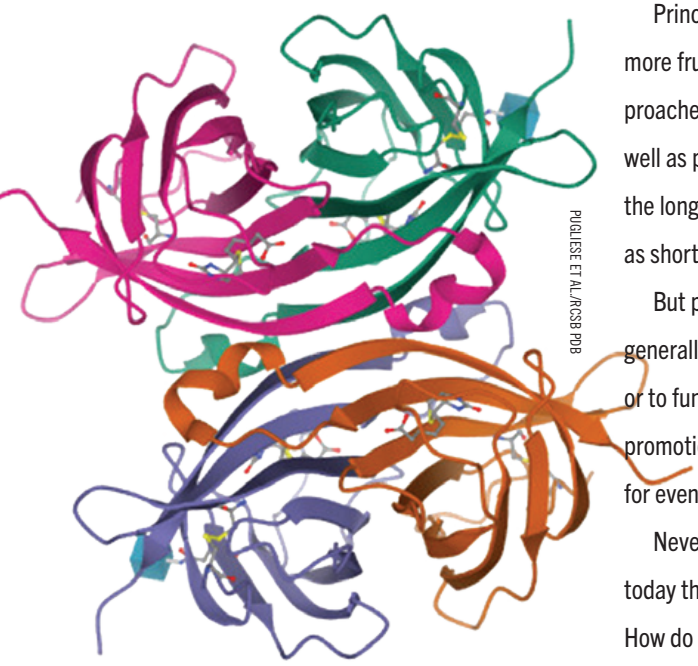
Chloe Kirk (cck22@miami.edu) is working toward her Ph.D. in biochemistry and molecular biology at the University of Miami. Her interests are science research, communication and outreach. Follow her on Twitter: @chloeckirk

High-affinity binding

How labs with two PIs operate

By Laurel Oldach

What makes people choose to work so closely together? How do scientists structure and maintain these close working partnerships, and what do they gain from them?



PUGLIESE ET AL./RCSB PDB

Like streptavidin (ribbon structure) and biotin (wireframe), some pairs of colleagues stick together for good.

As medical residents in the late 1960s, Joseph Goldstein and Michael Brown would linger in the hospital cafeteria late at night after finishing their rounds. Sitting together after a long day, they'd talk about their patients, asking: Why? What's causing the symptoms we see?

Some colleagues simply click. In science, such interactions are usually short-lived, though sometimes, as people follow their individual career paths, they find ways to work together again as collaborators.

Very rarely, two people decide to prioritize their working relationship over other opportunities, and they throw in their lots together. These partnerships can last for decades: Brown and Goldstein have run a lab at the University of Texas Southwestern Medical Center for 50 years, publishing hundreds of papers together and sharing the 1985 Nobel Prize in physiology or medicine.

Principal investigators who run labs jointly say this structure makes for a more fruitful creative process and a better distribution of heavy workloads. Approached mindfully, a joint lab can be less hierarchical, encouraging trainees as well as professors to talk over ideas in depth. And having a scientific partner for the long haul can help to even out the ebb and flow of institutional knowledge as shorter-term trainees pass through.

But professorial partnerships can be challenging to maintain. Academia generally is not set up to appreciate close working relationships between equals or to fund two investigators' salaries for a single lab. Most prizes and hiring and promotion committees valorize the individual leader, and uneven recognition for evenly split work can tank a creative partnership.

Nevertheless, according to some observers, more two-PI laboratories exist today than ever before. What makes people choose to work so closely together? How do scientists structure and maintain these close working partnerships, and what do they gain from them?

ASBMB Today interviewed five pairs of PIs who came to lead joint labs through a variety of paths. Here's what they told us.

A creative duo

When prospective postdocs interview with Tobi Walther and Bob Farese Jr. about becoming part of the Walther and Farese lab, the candidates' first question is often, "How does this work? And why would you do it?"

The broad answer: The way it works is that they co-mentor everyone. And they do it both because it's fun and because they find that they do better science together than apart. Still, Walther said, the questions can be tough to answer in detail because, in contrast to matters of scientific fact, "With questions of how to do things — how to do policy, how to run a lab — there are many gray areas."

Farese and Walther recently chronicled lessons they've learned from nearly a decade running their lab together in the Journal of Clinical Investigation. They met when Farese, then a professor, spent a yearlong sabbatical in the lab where Walther was a postdoc. They worked productively together, investigating how lipid droplets form and grow.

After Farese returned to his own lab at the University of California, San Francisco, and Walther started as a group leader at the Max Planck Institute of Biochemistry and later at Yale, they continued to collaborate. As lipid biochemists, they always were aware of the Brown–Goldstein model for running a lab jointly. "But it would be a little far to say we had some master plan," Walther said.

When an opportunity to join forces arose in 2014, the pair thought it over and decided to merge their labs in a move to the Harvard T.H. Chan School of Public Health. These days, they work in neighboring offices joined by a pocket door, and though both are heavily scheduled, they do their best to check in daily about goings-on in the lab.

KENT DAYTON/HARVARD T.H. CHAN SCHOOL OF PUBLIC HEALTH

Bob Farese (left) and Tobi Walther in their lab at Harvard. The two shared the 2022 ASBMB–Merck Award, Walther won the society's Walter A. Shaw Young Investigator Award in Lipid Research in 2013, and Farese won the ASBMB's Avanti Award in Lipids in 2016. They plan to move to Sloan Kettering in New York later this year.

They have been known to study other creative and business partnerships — including the Beatles' John Lennon and Paul McCartney.

"One of the beauties of writing a song with another person is the product comes out different than either person would do by themselves — and hopefully better," Farese said. "We experience that all the time. The work we do definitely comes out better than it would have been with one of us or the other of us."

Creativity involves generating a lot of ideas and hypotheses. But not all of them will be good. "Some people think the correctness of an idea somehow scales with the authority of the person that utters it — which is often wrong," Walther said. "My ideas can be just as stupid and wrong as someone else's."

Even so, employees tend to defer to their bosses. As peers, Walther and Farese more freely disagree over how to interpret data or the next step in a project — and this opens space in the lab's culture for others to disagree with them as well.

Lately, the lab has studied sphingolipid accumulation in frontotemporal

Shantanu Singh (left) and Anne Carpenter apply their expertise in machine learning and large imaging data sets, respectively, to guide their joint lab's research.

BEARWALK CINEMA/BROAD INSTITUTE

dementia: a subject that combines Walther's expertise in biochemistry and membrane trafficking and Farese's training in medicine. Either of them could have learned enough to lead the project on his own, Walther said. "But it's just easier to do this way. And because it's easier, it frees up creative processes that otherwise are much more difficult to access."

Complementary intuition

When computer scientist Shantanu Singh talks about how well he knows his field, he doesn't use the verbs "see" or "understand." He says "to grok," an expression coined in science fiction and beloved among geeks.

"The idea of grokking something in computer science is more than just understanding it. You're almost a part of it," Singh explained. "Maybe a less esoteric way of saying it is building intuition."

No one can develop that depth of knowledge about every field. But as co–principal investigators, Singh said, he and cell biologist Anne Carpenter apply their deep expertise in complementary fields to tackle problems from multiple angles: in their case, using machine learning and microscopy to classify cells.

Before they became peers, Singh trained with Carpenter, who directs the Broad Institute's imaging platform. He arrived as a postdoc in computer science, stayed on as a staff scientist and eventually became a senior group leader, leading a subgroup embedded in the lab.

"I joined her lab, and I refused to leave," Singh joked.

He became co-PI in 2021, and he credits Carpenter with the smoothness of the transition. With a consortium of industry and academic labs, they're constructing a database of billions of cells' responses to chemical probes and genetic manipulation.

When reviewing data, Singh said, Carpenter often has insight into whether gene clusters make sense. "And then I'll have a much better intuition about whether the statistics that we're doing or the computational methods could have caused some kind of bias."

Together, they can suggest experiments to probe results and find out which preliminary observations hold up to closer scrutiny. Carpenter said in an email, "Our partnership works so well because we have enough overlapping knowledge to be able to translate well for each other."

Team science is an important hallmark of the Broad Institute, Singh said. "Especially in this era, the low-hanging fruit is gone. … It's going to be a multilab, multiteam effort to take on the big challenges."

Finding the right institution

Some scientific partners are also life partners. That's true of Joan and Ron Conaway, who ran a lab jointly from the beginning of their faculty careers until last year.

"We used to jokingly refer to it as a mom-and-pop biochemistry shop," Joan Conaway said.

The pair, who met as graduate students, had been married for about two years by the time Joan Conaway's thesis adviser, Roger Kornberg, recommended that they team up to work on a project characterizing transcription initiation in mammalian cells. They were loath to divide the subject when the fellowship came to an end.

"The beauty of a partnership like this is that you don't have to artificially divide the work," Joan Conaway said. "You can follow the research where it goes and play off of each other's strengths."

After a brief stint at the University of Texas at Austin, where Ron Conaway

was on the tenure track and Joan Conaway was not, the pair moved to the Oklahoma Medical Research Foundation and later the Stowers Institute.

"A lot of universities and research institutes wouldn't hire two people to do the same thing," Ron Conaway said. But they were able to find two long-term homes at which they could run their lab as equals. "In that sense, we were really lucky."

The Conaways found that their working partnership was more supported at newer institutions that had greater financial flexibility and no rules preventing family members from working together.

Though their training was similar, the two have skills that played well off one another. She tended to enjoy working with — and troubleshooting — instruments. He liked writing the first drafts of grants and manuscripts based on their shared conversations.

Some opportunities over the years were poorly suited to accommodate a two-PI lab — for example, Joan Conaway was a Howard Hughes Medical Institute investigator for a time and Ron Conaway was not because the institute wouldn't sponsor both of them at once. But they thought of it as a shared recognition and trusted one another not to compete. They also trusted that the community recognized their coequal contributions.

"For a long time, people referred to us as 'les Conaways,' as a team," Ron Conaway said.

After they closed their lab at the Stowers Institute, Joan Conaway began work as a vice provost of the University of Texas Southwestern Medical Center. Ron Conaway has retired and is pursuing a longstanding interest in bioinformatics. While they find it strange to drive to work alone or to spend the day without a constant companion to bounce ideas off, the couple said, spending their days apart gives them much more to catch up on at home.

STOWERS INSTITUTE FOR MEDICAL RESEARCH

Ron and Joan Conaway recently retired after running a lab together for decades. Joan Conaway has served as the ASBMB's treasurer since 2019.

At UTSW, research partnerships abound, Joan Conaway said. "Here, it's a way of life. Some institutions really get it, and others don't."

A better training environment

Like the Conaways, Patrick Lusk and Megan King became life partners and scientific partners at around the same time, when they were both postdocs. But after working closely together at that stage, they started independent labs at Yale in 2009. Although their labs were right next door to each other and worked on related problems, they seldom interacted professionally beyond an annual badminton tournament.

Lusk and King chose to merge labs about five years ago, in part because each noticed gaps in their mentoring style that the other could help to fill. Both agree that the best training environment combines experimental rigor and challenges with support and encouragement, and as principal investigators, each struggled to hit the right balance.

"My group meetings tended to be

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>
> JOAN CONAWAY

LAUREL OLDACH

Megan King (left) and Patrick Lusk laugh while taking a zoom interview from their home office. The couple, who are married, merged their labs several years ago.

sort of nitpicky," Lusk said. Although hearing and responding to constructive criticism is a key skill for a scientist, "people aren't inspired by that. … They want to know what they're working on has value."

On the other hand, King had no trouble offering support, but pushing people didn't come naturally. "Not challenging people holds people back, because you don't provide them with the opportunity for growth," she said.

During the merger, they renamed one lab space Vermont and the other Canada, after the places they grew up, and came up with the portmanteau LusKing to help end the friendly rivalry between the groups. They relied on Elisa Rodriguez, the joint lab's manager, to combine operations such as ordering and tissue culture.

Rodriguez, who has worked with King since 2009, said that because King and Lusk are married with four children, "Obviously, they were already a team."

Like co-parenting, Lusk and King said, running a lab together requires trust, mutual respect and a shared vision. But being partnered at home opens some unique pitfalls at work.

"It is very fraught," King said. "We need to be particularly careful to ensure that we avoid triangulating and being seen as a monolith."

Lusk and King always discuss managerial decisions in private, and they work hard to present a united front when giving difficult feedback. But on scientific questions, they find disagreements useful.

"Science can be emotional," Lusk said. When trainees see him disagree with King about data "in a productive way, and everything's fine afterwards, that models the way that we think science should be undertaken."

When Lusk and King give contradictory advice about the best way forward, their graduate students make a decision with help from whichever one serves as their primary mentor. The postdocs, all of whom are jointly mentored, make a call on their own about what to prioritize. Sometimes a trainee will return to report that they did "the Patrick experiment" or "the Megan experiment." But ultimately, Lusk said, developing a sense of judgment is a core part of scientific training. In the end, trainees do their own experiments.

Unconventional models

Having two PIs isn't the only unusual thing about Omar Abudayyeh and Jonathan Gootenberg's lab at the Massachusetts Institute of Technology. They also started it right after graduate school.

Abudayyeh and Gootenberg collaborated on CRISPR as graduate students with Feng Zhang. Both were interested in mining bacterial genomes for CRISPR–Cas systems and related enzymes and in developing new gene and cell engineering technologies.

Aware that the field was booming, they were reluctant to split up their productive partnership as they approached graduation. Who would hire two postdocs for one project

— or allow a postdoc to collaborate closely with a rival lab in a competitive field? They found a solution when the McGovern Institute for Brain Research at MIT announced plans to launch a pilot program that would enable Ph.D. recipients to take a nontenured research group leader position.

Gootenberg and Abudayyeh are eager to remix academic norms. In their three years running what they call the AbuGoot lab, they have landed several National Institutes of Health grants and have spun off three companies using new CRISPR systems for diagnostics, genome editing and RNA targeting. They have found the biotechnology industry much more receptive to co-founders than academia is to co-PIs.

So far, the partnership has weathered challenges related to credit and recognition, such as the year when Abudayyeh was recognized on a "35 under 35" list and, because of editorial policies, Gootenberg was not. (Abudayyeh is quick to point out that the following year, Gootenberg landed on the same list.) Their philosophy is that any recognition either of them receives is good PR for the lab.

The two started the AbuGoot lab in 2019. To date, it remains the only lab the McGovern fellowship program supports. In answer to questions from ASBMB Today, a spokesperson for MIT wrote, "We have not developed a formal application program as of yet and we have not decided if the program will continue. We are not aware of additional labs run by two young scientists quite like this."

When the McGovern funding concludes — the program officially provides three to five years of funding, but there doesn't seem to be a formal end date — Abudayyeh and Gootenberg plan to seek opportunities to move the joint lab to a new institution. Although most departments don't hire two people at once, Gootenberg said, "In general, it's becoming more widespread, and people are understanding that unconventional academic models make sense. We have to experiment."

Prospective partners

Although the number of jointly run labs seems to be increasing, it is still by no means a common path. For researchers who aspire run joint labs, the way forward is not obvious.

University of California, San Francisco, postdoctoral researcher Zara Weinberg would like to start a lab with a graduate school colleague. Like many of the joint PIs interviewed here, Weinberg has found that thinking through scientific questions with a partner is more fun than doing the same work on one's own — and can yield better insights.

But she also observed that postdocs are under pressure to differentiate themselves in order to compete for too few faculty positions.

"There's a huge emphasis on being singularly talented," and, if you study subject X, "becoming 'the X person,'" she said. That discourages close longitudinal collaborations.

No obvious pathways lead to a joint lab management situation, and it's difficult to imagine making the funding work. Weinberg's plan, she said, is to try to find a faculty job as an individual and hope that someday — if they both stay in science, if the money doesn't run out — she and her colleague will be able to join forces.

> **"In general... people are understanding that unconventional academic models make sense. We have to experiment."**
>
> **JONATHAN GOOTENBERG**

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‘My involvement with ASBMB has made me want to do more’

A conversation with Ann Stock, the society’s new president

By Laurel Oldach

Ann Stock, a professor at Rutgers University’s Center for Advanced Biotechnology and Medicine, became president of the American Society for Biochemistry and Molecular Biology on July 1. During the ASBMB annual meeting in April, Stock sat down for a conversation with ASBMB Today.

You can’t talk about Stock’s career without discussing her lifelong research interest in two-component systems, a large family of evolutionarily related signaling systems common in bacteria. As a graduate student, before the amount of sequence identity needed to establish homology had been well established, Stock helped to identify this protein family, finding weak sequence similarities between proteins encoded by an operon she had sequenced in Salmonella and other known bacterial sequences. She has continued to study two-component systems from different angles ever since.

Stock is a fellow of the American Academy of Microbiology and the American Association for the Advancement of Science; she’s a former Howard Hughes Medical Institute investigator and has served on the ASBMB Council and committees continuously since 2008. For more on her plans as president, see the President’s Message on page 2 of this issue.

This interview has been condensed and edited for clarity.

Q. When did you decide that you wanted to be a scientist?

My initial interest in science came from my father. He actually never made it through high school; his father died during the flu pandemic of 1918, and he had to drop out to support his family, bagging groceries. That was the end of his formal education, but he loved natural history, geology, plants, visiting museums, watching “National Geographic.”

I started down a science track in college thinking that I would go into medicine. The premed advisers at University of California, Berkeley, said to volunteer at the hospital. I walked into the hospital and started down a hallway lined with patients on gurneys to get to the candy striper office. I never made it to the office.

People who go down the medical path have so much compassion, and I admire them enormously, but I realized right then and there that medicine was not for me. I went back to the university and took a job at the student learning center.

I managed to get into a lab in my senior year. Back then, biochemistry had three years of prerequisites. You’d knock on doors asking for research experi-

ence; everyone wanted to know, Have you taken the lab courses? I hadn't. Finally, in my senior-year biochemistry course, I got along really well with my teaching assistant, Mark Snyder. He dragged me upstairs and knocked on the door of his adviser, Dan Koshland — who, to me, was like a god in the field. (Author's note: Koshland, a former ASBMB president, was famous for his work in enzymology and in bacterial chemotaxis, for which he later received the Lasker award.)

I spent the latter part of my senior year doing research in Dan's lab and stayed on for a year as a technician. During that time, I was teaching freshman chemistry extension courses in the evenings. I thought I wanted to go to graduate school in order to teach, but then I got bitten by the research bug and decided I wanted a position that balanced both.

Q. You stayed on in the Koshland lab as a graduate student?

Yes. I got stuck with a project that they would stick only an undergraduate on, because it was deemed more or less undoable. When I transitioned to graduate school, I had a really hard time getting through my qualifying exam research proposal, because my committee thought the project would never work.

We were studying bacterial chemotaxis. My job was to find out the role of one of the proteins that seemed to be a master response regulator that controlled the direction of flagellar rotation.

Before molecular biology techniques were widespread, my approach was to purify the protein from wild-type cells using two-dimensional gels for isolation. I would run an isoelectric focusing gel in a tube, and then I'd push this little worm of a gel out of the tube, layer it on top of a regular SDS gel and seal it with agarose, and then run the second dimension. I managed to cut enough protein out of gels and used it to make antibodies in rabbits. It took gel after gel after gel. You can understand why my committee thought, "What if you don't get antibodies after this heroic effort?"

Once we had antibodies, we had a handle on purifying the protein, which allowed us to begin to study it. I switched over to a molecular biology approach as that became more accessible. I sequenced an operon that encoded about half of the chemotaxis proteins. When I deposited it in GenBank, it doubled the amount of sequence data available for Salmonella typhimurium, as it was known then — now it's Salmonella enterica.

We noticed weak sequence similarity between portions of two of the proteins and three other previously sequenced proteins that had nothing to do with chemotaxis but were involved in responses to osmolarity, dye uptake and sporulation. They had no apparent functional relationship to each other. Back in the day, people were used to thinking about homologous proteins as having sequence identity of 80% to 90%. No one thought that 20% to 30% sequence identity was significant. And I struggled to get the story out.

This was back in a time when a member of the National Academy of Sciences, like Dan Koshland, could just submit a paper to the Proceedings of the National Academy of Sciences. We submitted the paper, and then I presented my thesis and made what I thought was a wonderful case that these proteins were all related in terms

A lot of my career as an independent investigator has been trying to piece together what is conserved within two-component systems and what differs among them.

of carrying information to elicit a response. My committee looked at me like I was crazy. Dan got such cold feet he pulled the paper.

Q. So what happened?

He sat on it for a while. We continued to convince him. And then the paper was resubmitted.

Q. Did you have to do many more experiments?

No, actually. It was really just talking it through. I guess a few things were starting to come out; Dan was hearing more and more within the field that there might be some links between these homologous proteins. Anyway, this established the family of response regulators. Soon after, these proteins were found always to exist in systems along with one other protein from a family that had a similar 20% to 30% sequence identity. Because there were two proteins that were found together, they were called two-component signaling systems — a terrible name.

The first component turned out to be a kinase that phosphorylates itself on a histidine. Then the response regulator picks up the phosphoryl group from the histidine and transfers it to one of its own aspartates. This drives a conformational change within a regulatory domain that can be linked to almost any kind of effector domain. About two-thirds of them are DNA-binding domains and regulate transcription; some are enzymes, some are RNA-binding domains, some are protein–protein interaction domains. There's no limit to what you can hook up to this phosphorylation-activated switch.

I wanted to learn structural biology in order to further the idea that these proteins were really similar. I collaborated with Greg Petsko and eventually was lucky enough to land a fellowship that required me to do a second postdoc, so I went to Greg's lab. (Author's note: Gregory Petsko is a professor at Harvard Medical School and a former president of the ASBMB.) When we determined the structure of the Salmonella chemotaxis protein CheY, it told the whole story. It was this small alpha–beta domain in which the three most highly conserved residues all clustered together. We knew immediately that this was the active site.

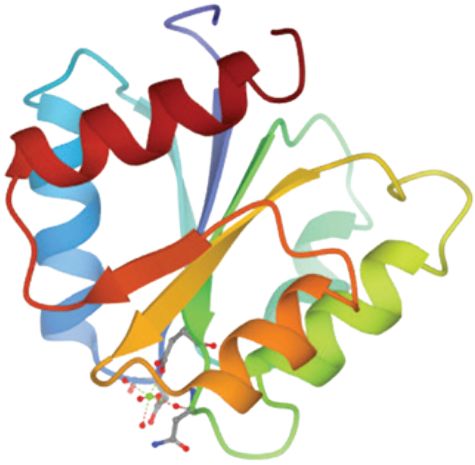
A lot of my career as an independent investigator has been trying to piece together what is conserved within two-component systems and what differs among them. We've learned that what is conserved is the enzymology: the core phosphoryl transfer and the high-energy aspartate phosphorylation that stabilizes what would otherwise be a less favorable conformation of the switch domain. Then any kind of regulation that exploits protein–protein interactions that discriminate between the two conformational states, whether activating or inhibiting interactions, is fair game for these proteins.

Q. These days, are you taking a more computational approach?

Yes. Over 300,000 of these systems have been identified, and they do such diverse things. As people have done in vitro biochemistry with these proteins, it's been found that their kinetic parameters differ by orders of magnitude. Some have a thousandfold more kinase or phosphatase activity than others. Similarly, their interactions can be orders of magnitude different in binding affinities.

There are also different ways that the components are configured. There are feedback loops in the transcription factors, where one of the operons that it regulates encodes itself. The question is, Why do you have autoregula-

While collaborating with Greg Petsko's lab, Ann Stock and colleagues determined the structure of the Salmonella chemotaxis protein CheY.



tion like this in some systems and not in others?

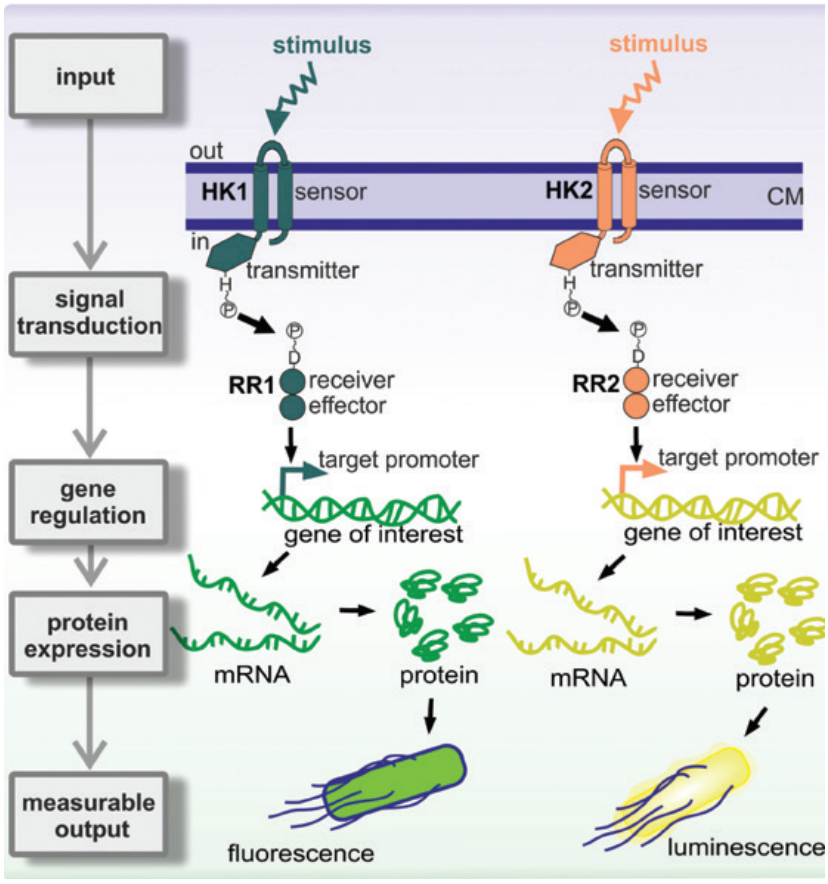
We're trying to understand some of the design principles of the systems. Why do different systems have different kinetic parameters, different binding constants and different pathway architectures? What does that achieve in terms of the output response?

We've found that protein concentrations are really key. This shouldn't surprise a biochemist. Autoregulation is designed to make just the right amount of protein at just the right time; if you start screwing around with that, the cells are not competitive. In studies of engineered strains with altered levels of proteins, within about 24 hours in chemostats, there's so much selective pressure that mutations arise that convert the level back to the wild-type level. That tells you how important this regulation is.

A lot of the behavior of the pathway comes from having the right setting of the kinetic parameters and binding constants relative to the protein concentrations. More recently, we started wondering, "Well, what sets the protein concentrations?" and began work with a model system looking at transcription factors.

We started to ask whether the level of a transcription factor is at capacity for the number of binding sites in the cell. I pictured a high concentration of transcription factor and not a lot of binding sites. But it turns out that the transcription factors really are not numerically in great excess. By putting in additional binding sites on plasmids, we found that by just doubling the number of binding sites, you really change the output of the system.

It's been very eye-opening. What we would consider minor perturbations in protein levels can have dramatic effects on the system. That should give us a little bit of caution in how we manipulate systems when we study them experimentally. For example, if a mutation affects the stability of the protein — and this happens frequently — our tendency is to attribute the alteration in system behavior to a functional consequence of the mutation that we've made rather than to throwing off the balance of protein concentrations.



ZHIYONG SUN, PHILIPP F. POPP, CHRISTOPH LOERER AND AINHOA REVILLA-GUARINOS/CREATIVE COMMONS

Two-component systems are named for their histidine kinase, or HK, and response regulator, or RR.

Q. Talk about your working relationship with research professor Rong Gao.

He's been a wonderful partner. Rong has a real love of mathematics and computation and has been the driving force to bring us into this systems biology approach to understanding pathways. It's a back-and-forth integration of mathematical modeling and experiments where the experimental data gives us enough

What we would consider minor perturbations in protein levels can have dramatic effects on the system. That should give us a little bit of caution in how we manipulate systems when we study them experimentally.

parameters to begin the modeling; as soon as we get the model developed, we can make predictions from it and then go back and test it in the experimental system.

It's really wonderful to have a senior person in the laboratory; first of all, to watch them develop, but also, as one progresses and becomes overburdened with many other activities, it can be incredibly useful to have someone who is still at the bench full time. I spent a big chunk of time in an administrative role. The founding director of our center passed away back in 2012. I took over as interim director, thinking that it would be a short-term thing, but ended up in this administrative position for almost eight years.

Q. What did you learn from that leadership role?

I've learned from administration that I don't want to do it. (Laughter.) I'm really enjoying being back in the lab.

Q. So what made you decide to serve as ASBMB president?

I've hit a stage in my career that I'd like to be giving back a little bit. The ASBMB has meant a lot to me; I believe very strongly in the need for a collective voice for our discipline. And my involvement with the ASBMB has made me want to do more. I've met amazing people, and I've learned so much from them, and it's given me a view of science from outside the narrow perspective of my own research.

Q. What do you hope to achieve as president?

My agenda is to increase the engagement of members with the society. We are doing so much, but even the most highly engaged members don't know all the things that the ASBMB is doing. So my goal is to do as much as I can to broaden participation in committees and in activities of the society and let members find the activities that they feel most passionate about and get involved.

Q. I understand that you have a twin sister who's also in science. What's that like?

It's been a really strange trajectory. Growing up as identical twins, we were always trying to distinguish ourselves from each other. If she had long hair, I had short hair. If her favorite color was green, mine was blue. Then we went to college and lived on opposite sides of a giant school and never saw each other, and we found out that we'd bought many of the same clothes and albums. It was just too funny.

Our career story is almost like that. We both went to UC Berkeley because we had limited resources and tuition was free. My sister got into the business school and went down a career path in business, and I went down a science path. After graduating, she worked for a couple of years at Shell Oil and then obtained an MBA from Harvard Business School. She was hired by a consulting company where her clothing allowance when she signed was greater than my annual stipend. We were opposites.

Then she consulted on the health care sector and started working with pharma. She went on to Genzyme and got more and more into science, eventually becoming president of Genzyme Molecular Oncology. (Author's note: Genzyme was a biotechnology company that merged with Sanofi in 2011.) Since then, she has headed BayBio and several biotech firms in the San Franciso Bay area. She's learned an enormous amount

of science along the way. I mean, despite no formal training, she knows more immunology than I do.

Q. Do you nerd out about molecules together?

Not so much. In our early years, we used to argue, because I had a passion for basic science and thought decisions being made from a commercial standpoint were too profit-oriented. I've had postdocs apply to my lab after they've had their projects canned in pharma because overnight the company was no longer interested in what they were working on.

But although my passion is still for basic research, I have come to appreciate other perspectives. During an interview at Merck, my interviewer explained that there's something really wonderful about knowing that what you do is going to impact people's lives directly. And the things that are most valuable, dollarwise, are often the things that impact the most people in the biggest way. From that perspective, it makes sense that pharma chases dollars.

Q. We're meeting on the last day of the final Experimental Biology conference. What do you hope to see at the ASBMB's independent meeting next year?

I am eagerly looking forward to Discover BMB, our first independent meeting in many years, which will be held in Seattle in March next year. I am hoping to see much more networking and interaction among our community.

With the small meeting format, we will have the ability to create a sense of community, including an emphasis on special interest groups. We'll be trying to create a hub in the exhibit hall to bring people together, to showcase society activities, and to promote socialization and networking at strategic times throughout the meeting. We have a very enthusiastic pair of program planning committee co-chairs, Karen Allen and Craig Cameron, as well as a task force that is working diligently to develop plans for a vibrant and enjoyable meeting experience next year in Seattle.

One of the most important aspects of scientific conferences is the opportunity for networking and socialization among participants. I often find that informal conversations rather than structured presentations are the most valuable in sparking new ideas. The annual meeting is a great venue for young scientists to network with leaders in the field as well as for established scientist to reconnect with distant colleagues. We'll be trying to promote such interactions in Seattle, and we're looking for opportunities to celebrate science outside the walls of the convention center.

ASBMB

Ann Stock, left, with Tracy Johnson, outgoing ASBMB President Toni Antalis and Sonia Flores, chair of the Maximizing Access Committee, at the 2022 ASBMB annual meeting, where Johnson received the society's Ruth Kirschstein Diversity in Science Award.

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Connect with colleagues at an ASBMB conference

The ASBMB organizes virtual and in-person events that cover scientific research, educational best practices, the funding environment and more.

Upcoming ASBMB conferences

The interplay between epigenetic regulation and genome stability
Sept. 28–Oct. 2, 2022 | Seattle, Wash.

Transcriptional regulation: Chromatin and RNA polymerase II
Sept. 29–Oct. 2, 2022 | Snowbird, Utah

Discover BMB
March 25–28, 2023 | Seattle

Explore all upcoming events at asbmb.org/meetings-events.

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THE CAREERS ISSUE

Turning points

Reflections on how mentors impact our lives

By Paul A. Craig

Recently I was talking with a colleague who mentioned how a single conversation with his mentor during his senior year of college completely redirected his life. I then shared a similar experience with him. I started thinking how much it would have meant to me as a 21-year-old senior to hear both of our stories.

I then began to wonder how many of my colleagues could share similar experiences, so I reached out to a few to ask how mentors influenced their experiences and decisions — specifically during their last two years of college.

As we transition out of COVID-19, life is very uncertain, and many of us are struggling with our mental health and with finding a sense of purpose or direction. The target audience for this article includes both students and mentors: to offer students hope and confidence to listen for encouragement, and to remind those in a position to mentor that our words can have great impact.

I have included my story and stories from seven colleagues from academia and industry. These stories all demonstrate how effective mentoring during college can shape future careers, but some include unexpected twists and turns.

The first five colleagues share how conversations and training in traditional lab and class settings were instrumental in their successful careers. The last two are from colleagues who also have remarkable careers but had very different mentoring experiences. I will let you enjoy their stories and then provide a few concluding thoughts.

Overcoming a bad experience

The summer before my senior year, I applied for a research position in a medical center to help me decide if I wanted to go to medical school or graduate school. I ended up having a negative experience in the research lab and was not even considering graduate school, instead focusing entirely on going to medical school.

Professor Dale Williams, my mentor at Oral Roberts University, approached me one day and simply said, "Paul, you should really consider applying to Ph.D. or M.D./Ph.D. programs. I think you would do well there."

I took his advice, applied to Ph.D. programs in biochemistry and have found this a wonderful path.

— Paul A. Craig
Rochester Institute of Technology

A confidence-building task

As an undergraduate working in the research labs of Professors Joe Sherma and Dave Husic at Lafayette College, I gradually had developed some confidence in my ability to perform experiments. But the ups and downs of research are challenging for an undergraduate to manage, as there is so much more failure than we are used to from doing labs in classes. I questioned whether I was doing a good job, because some experiments didn't work.

In the fall of my senior year, Professor Sherma, then the head of the chemistry department, purchased a new piece of equipment that was computer-controlled (a new thing at the time). He paid me a small stipend to read the manual, figure out how to use the instrument, and write an instruction manual for him and the other lab members to use.

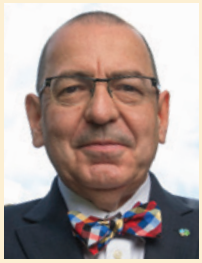
This gave me confidence that I had valuable skills that could be useful for other scientists as I headed off to graduate school the next year.

— Kristin Fox, Union College

Permission to change gears

As a summer undergraduate research intern between junior and senior year, I was asked by my nuclear physicist mentor to join an interdisciplinary collaborative team that brought plant scientists together with physicists. Our ob-

jective was to use image processing of electron micrographs to understand the molecular architecture of plant viruses from the potato X virus family.



By the end of the summer, I realized that my knowledge of physics, applied mathematics and Fortran programming (self-taught) had allowed me to make substantive contributions to the project. My plans for graduate school changed dramatically.

Instead of doctoral training in mathematical physics, I made the jump into physics applied to biology and pursued a doctorate in structural biology at the University of Oxford and never looked back.

I am now in the midst of a third career in data science/structural bioinformatics. Previously, I spent a dozen years as a structural biologist in academe, followed by a decade working as a drug hunter in the biopharmaceutical industry.

— Stephen K. Burley
RCSB Protein Data Bank

Learning to pay it forward

I went to Drexel University and majored in chemistry from 1990 to1995. Drexel always has had a very robust co-op student internship program, and, as a chemistry major, I was fortunate enough to do three internships with Steven A. Carr, who is currently the senior director of proteomics at the Broad Institute in Cambridge but then was a research investigator at GlaxoSmithKline (SmithKline Beecham at the time).

Steve is an expert in proteomics and protein-based mass spectrometry and welcomed me into his group when I was a 20-year-old college sophomore. He not only took the time to mentor me in this new field of protein mass spectrometry (my chemistry professors at Drexel at the time didn't, even though you could use mass spec to investigate proteins) but also showed me how biology and analytical chemistry could make significant impacts for patients in a professional drug-discovery environment.

Steve set a high bar for my performance, emphasizing attention to detail and scientific rigor but always encouraging me to challenge myself and think big.

This experience led me to change my major from chemistry to biochemistry and propelled me toward graduate school and my ultimate goal of working in the pharmaceutical industry, which I have been lucky to do at Novartis for the past 10 years.

I can say that Steve's mentorship and the other mentors from his group there changed the course of my life and helped propel me to the career I have today. I never have forgotten that generosity and his example as I strive to pay it forward, now that I am a leader, to help others just starting out.

— Scott Busby
Novartis Institute for BioMedical Research

'A taste of what life as a scientist might be like'

I would like to thank Alanna Schepartz for her mentorship during my days as an undergraduate at Yale. I first met Alanna when I enrolled in her seminar and companion lab course, Chemical Biology for Sophomores. For the first time, in this course I had a taste of what life as a scientist might be like: reading new literature and discussing it with colleagues, proposing new experiments and then very slowly trying to execute those experiments. This was a captivating experience, and I enthusiastically joined her lab as a research assistant.

While I sought out Alanna's advice at key junctures — when choosing a graduate program, a thesis adviser and a postdoc adviser — the most influential part of her mentorship was providing an early opportunity to experience life as a researcher in chemical biology.

— Lynn McGregor
Novartis Institute for BioMedical Research

'Faith in me before I had faith in myself'

I was sure that the Olive M. Lammert Prize was a mistake. This prize was for a chemistry major who was headed to graduate school, and my plan after graduation from Vassar College was to teach high school.

I tried to convince my professors that the Lammert prize should be given to someone else, but even the otherwise sensible Professor Miriam Rossi remained unconvinced. She told

me that I would find my way to graduate school, and of course she was right.

My professors had faith in me before I had faith in myself, and I carried that faith with me and relied on it during challenging times. Having someone believe in you is a powerful thing.

— **Cathy Drennan**
Howard Hughes Medical Institute and Massachusetts Institute of Technology

It only seemed like a loss at first

I've had many mentors in my life. Each one shared their expertise, insight and guidance in a kind and selfless way. Interestingly, perhaps my most critical mentoring moment occurred far from an academic setting.

During my undergraduate years, I worked for a large retail chain, and during the spring of my final semester, an assistant manager position opened up. I was the obvious choice, but my supervisor selected someone else. Frustrated and disappointed, I confronted him.

His answer was simple: "Twenty years ago, I earned my bachelor's and master's degree in social work while working here. Then they promoted me. It was easy to stay, and so I did. It was the right choice for them but a bad choice for me. Even though promoting you would have been best for me, I couldn't let you make the same mistake."

It was then that I realized that mentoring is about doing the right thing for the mentee and only the mentee.

— **Phillip Ortiz**
The State University of New York

Taking stock

When I was in college, I declared chemistry as a major late, and there were a number of very talented students in my class. Those students got most of our professors' attention, and I didn't have any mentors at that point in my career. What I did have was a great relationship with the manager of the chemistry stockroom, Ronald Smith.

Ron hired me when I was a sophomore, and I started out with rudimentary tasks. We did the setup and the preparation for all of the introductory lab courses at Bowling Green State University. When I was a senior, I had sufficient experience that Ron gave me a great deal of responsibility. He assigned me my own lab course, for which I was the sole person responsible for the prep. In addition, he recommended that I be hired as a teaching assistant for the nursing chemistry course (a position that usually was filled by a graduate student). Finally, he was able to persuade the department chair to allow him to work on switching over to a computerized inventory, because he informed the chair that I was capable of performing some of his duties while he worked on the project.

This was perhaps not the answer you were expecting. But Ron played a big part in my chemistry education and gave me confidence that I could perform laboratory work capably and that I could be a competent laboratory instructor.

— **Kathleen Cornely**
Providence College

Concluding thoughts

These are our stories about how mentors helped us along our paths. The stories don't include the many challenges we faced along the way (perhaps that should be another essay) — just the turning point and the present situation. In some cases, the stories have an "and they lived happily ever after" feeling, but others hint at the

struggles that happened then and continue on different levels.

These stories are from four women and four men, some from underrepresented groups, but as I read them, I realize that some stories are missing.

Have we overlooked introverted students or those who did not have a high GPA after one or two semesters as we looked for the rising stars? How many times have I made the following statement? "This student struggles in lecture but is really good in the lab." And then, in my mind, I consigned that student to a technician role or mindset without spending the time to really get to know them as my mentors took the time to know me.

I feel the need to include some action items to wrap things up.

For students seeking mentors:

- Seek to build relationships with your professors and supervisors at work.
- Join a research group and really get to know all the people.
- You may find mentors in surprising places. They may be faculty, staff or administrators from different departments — or even people from an off-campus job.

For mentors:

- Reflect on the people who helped you, and emulate their impact in your own mentoring.
- Build relationships with all kinds of students, not just the talented extroverts.
- Remember the impact of your words and your time on your students — you may never know when one of those students is at a critical turning point in their lives.

Paul A. Craig (paul.craig@rit.edu) is a professor at the Rochester Institute of Technology, where he teaches general chemistry and biochemistry, and he is PI of the Biochemistry Authentic Scientific Inquiry Lab, a team of faculty from more than 10 campuses. Follow him on Twitter: @PaulCraigRIT.

A science communicator explains it all

By Leia Dwyer

Diana Chien is senior program manager at the Massachusetts Institute of Technology School of Engineering Communication Lab. She talked to ASBMB Today about being a science communicator, her career path and the abstract pyramid. This interview has been edited.

Q: What is a science communicator?

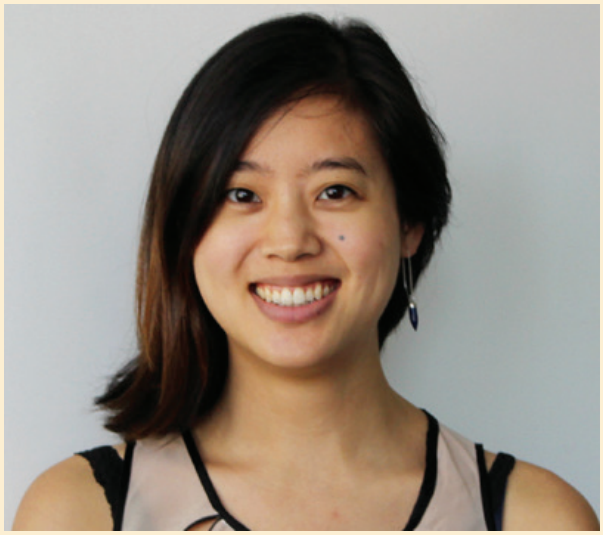
I like to default to the most expansive definition possible, which is someone who is trying to communicate their science clearly to an audience, but the range of science and the range of audiences is wide. It could be someone giving a presentation within their field, but it could also be a podcaster or a science journalist.

Self-identification as a science communicator is relatively new and goes along with the growing sense that scientists need to be engaged citizens and reach diverse audiences — not just people who speak the same technical language. They need to be able to go to Congress and advocate for causes that they care about.

There's a sense of empowerment, social engagement and civic responsibility — obviously not in all cases, but science communication is affiliated with that culture. It's a bit of a departure from the more traditional idea that science is a field in which very specialized forms of communication take place.

Q: What did your path to this career look like?

Really early on, I enjoyed reading and writing, and creative writing in particular. My mother was really supportive, and that provided me momentum to pursue that. In undergrad, I majored in ecology and evolutionary biology and minored in creative writing, specifically poetry. I had the usual existential undergrad crisis of "What do I want to do with my life?" I thought that going into industry might allow me the structure to retain the energy and initiative in my personal time to keep creative writing as my hobby or side gig.



I definitely got lucky in terms of timing. I became involved in the Communication Lab as a third-year grad student in microbiology at MIT, which is the time when you're starting to wonder what you'll do with your life after grad school. Comm Lab amplified my work as a grad student and helped me feel more confident and organized overall, and I learned many professional skills that were complementary to my Ph.D.

The Comm Lab founder, Jaime Goldstein, was very active as a mentor and gave me the opportunity to grow with the lab, which meant I had the chance to practice leadership and project management skills, develop my experience in pedagogical skills and grow my educational thinking. By my final year of grad school, I had accelerated the timeline of my thesis to take a position as Biological Engineering Communication Lab manager and instructor. Thankfully, my PI and lab mates were extremely supportive.

It was an intense transition in terms of the speed with which it had to happen; I didn't get to take a break between defending and starting the job. What made it emotionally feasible, and what had convinced me to take this career path in the first place, was the idea of taking your professional steps based on the people that you'll be working with. The intellectual and supportive community

of the Comm Lab felt like a good place to be.

At this point, I consider myself a science communication educator, because I'm not regularly writing press releases or doing interviews or actually talking about research; it's more facilitating other people talking about their research.

Q: Tell me about the communication lab model at MIT?

We have two models: an educational model and an operational or organizational model. The educational model is peer to peer, timely and discipline-specific. Under the umbrella of the School of Engineering Communication Lab, each department has its own communication lab with its own peer coaches (fellows) led by a departmental manager. Each team creates discipline-specific resources such as workshops about how to write proposals for graduate fellowships. However, the fellows of all the departments come together for training on communication tools and educational principles.

In the organizational model, teams of local experts respond to community needs, and we aggregate experiences and resources across those local teams. There's a strong sense that we should have these local incubators to identify unique community needs and apply just-in-time principles to respond to the departmental culture they are serving.

Q: Can you give a specific example of a communication tool?

In the first year of Comm Lab, we scheduled an all-day weekend retreat. It was very scrappy at the time; we had just one or two professors come in and talk about their views on best practices for communication. Jaime Goldstein, who founded the lab, divided us into pairs and asked each pair to create a teaching tool to support MIT biological engineering professor Eric Alm's breakdown of what he views as a good scientific abstract.

My team came up with some kind of waterfall metaphor, but the team that had Alm's grad student Scott Olesen in it came up with an hourglass visual and metaphor — the abstract starts broad, goes narrow and gets broad again.

We were not the first people to come up with this, but it ended up being one of those images or metaphors that is so sticky it feels like the most appropriate way to teach that content. It's one of the most fundamental tools we use to this day.

RESOURCES

NPR Scicommers, a community formed out of the "Joe's Big Idea" podcast hosted by National Public Radio science correspondent Joe Palca, links up STEM students and postdocs interested in science communication.

The **SciComm Trainers Network** is a growing professional network for people who work on the education side of things.

The MIT Communication Lab's **CommKits** for each department are available free to all online.

The American Society for Biochemistry and Molecular Biology offers **The Art of Science Communication**, an online course that focuses on how to present science to a nonexpert audience in a formal setting, such as a public lecture.

Q: What jobs are forms of science communication?

Science journalism is clearly a form of science communication that has been around longer than the term "science communication," but I think science journalism is a subset of science communication. Technical writers and medical writers are also science communicators, even though they had a professional identity before the term "science communicator" came into play.

People now work on advanced data visualization or other forms of branding for others doing technical work. Firms and consultancies work to help create visuals that tell the story scientists are trying to get across.

Increasingly, I see some unique roles within academia listed for very specific science communication needs; a bunch of academics identify a bottleneck in their workflow that boils down to something like templates for grant writing, and they hire a science communicator.

For the most part, our fellows don't see a dramatic pivot in the job they plan to take after their Ph.D. or postdoc, but they do see the possibility that communication can enrich the practice they already planned to go into, whether that's in academia or industry.

Leia Dwyer (leia.dwyer@gmail.com) is a Boston-area biotech and pharmaceutical industry professional.

A scientist on Capitol Hill

Anita Burgos shares what it's like to be a science policy adviser

By Elizabeth Stivison

One way to use science expertise outside of academia is by working in science policy. Your knowledge can be put to use helping the government design and implement policy about issues including health care, drugs, research and the environment. Scientific knowledge is useful for making good policy.

There are jobs in science policy at the state, national and even international level. On the national level, there are policy specialists in all three branches of government (executive, legislative and judicial) and in organizations outside of government, such as at think tanks.

To get an idea of what science policy work is like, I spoke with Anita Burgos about her job as a senior health policy adviser at the U.S. House of Representatives.

As a health policy adviser, Burgos gets to address issues that affect people every day. For example, one issue she and her team have been working hard at is improving maternal health. "For developed countries, we have the worst maternal health statistics. And if you're a Black mother, you are three to four times more likely to die" than a white mother, Burgos said.

The core of the job

Burgos broke down her job into three main parts: writing bills and drafting policy, staffing and informing the member of Congress for whom she works, and having meetings.

Drafting policy: Burgos works with attorneys and staffers on committees with health jurisdiction to write proposed legislation and advance it through the lawmaking process. For example, she might work on writing draft legislation relating to the diversity of participants in National Institutes of Health clinical trials.

Staffing and informing: Burgos is the expert on healthcare in her lawmaker's office. She researches issues and then provides the representative with background information and an informed recommendation in the form on a short summary, briefing or memo.

Taking (lots of) meetings: On any given day, Burgos might meet with constituents, patient advocacy groups, physicians groups, pharmaceutical companies, community groups or any number of others trying to get their points heard. It's part of understanding what people want and what issues need to be addressed. She might take a meeting alone or with the lawmaker, in which case her briefings beforehand are essential.

Skills from a Ph.D.

A Ph.D. is not necessary for policy work, but it is common, though still not universal, in science policy. Burgos said she sees ways her own neuroscience Ph.D. has helped her. "It shapes who you are and the way you think. It gives you a BS detector," Burgos said. Resilience — the ability not to get too emotionally derailed by setbacks with her projects — is another skill she learned in her Ph.D. that is useful in the political world.

Learning to write for different audiences is an additional skill she learned in grad school, though she did enter her Ph.D. program with an undergraduate minor in creative writing in hand. Spoken communication seems to be a skill Burgos has honed through her career; when I ask her questions, she replies in clear, fully formed paragraphs — a skill I imagine is a strength in her job.

In addition to the softer skills, her science knowledge itself is certainly useful. Lawmakers know things "a mile wide and an inch deep," Burgos said, so they don't necessarily have the detailed expertise required to understand the nuances of scientific questions. For example, recently there was a discussion about drugs that are structurally similar to fentanyl and how they should be classified by the U.S. Drug Enforcement Agency. Burgos was able to use her chemistry knowledge to inform the discussion about how some compounds look similar but don't necessarily function similarly, which might shape how they should be classified legally. Her Ph.D. training helps her when she does research like this, she said. "You can go in objectively and ask, 'What's going on here? What are the different explanations?'"

COURTESY OF ANITA BURGOS

Anita Burgos is a senior health policy adviser for U.S. Rep. Robin Kelly, D-Ill. Before that, she was a senior policy analyst for the Bipartisan Policy Center, and before that, she was an American Association for the Advancement of Science fellow in the office of then-U.S. Sen. Tina Smith, D-Minn.

Path to the job

In the fourth year of her Ph.D. at Columbia University, Burgos began to question the track she was on. "It's pretty commonly known that there is often some kind of crisis in the fourth year of your Ph.D.," Burgos said. "I just realized that I was not so sure that academia was the right fit for me."

She remained open-minded and curious about what else was out there. She attended an annual daylong informational event — "What can you be with a PhD" — that has sessions about all different kinds of jobs. That's where she learned about the American Association for the Advancement of Science's science policy fellowship. "I thought it was so cool. I didn't realize I could do that and really make an impact. Back to back, I went to the Society for Neuroscience conference, and the AAAS fellows had a booth at the conference too."

Seeing and talking to the fellows who were working in science policy in D.C. helped her realize that she, in a way, had been preparing for that career already. She'd already gone to Capitol Hill to advocate for science and loved the experience. She'd also founded a program while in grad school in which researchers give talks to the public about their science and lead lab tours. "The more I learned about the AAAS policy fellowship, the more I felt like they were describing me."

She ended up applying for and getting the fellowship and worked in the U.S. Senate for a year.

She found that she loved working in D.C. and in policy. So she stayed in D.C. and worked at the Bipartisan Policy Center, a think tank, for a year and a half. "People in Congress are busy all the time. They don't have time to just sit and think," Burgos said of the role think tanks fill in policy creation. At the Bipartisan Policy Center, she worked at the intersection of academics and policy to dig deep and come up with ideas for mental health policy that could be implemented by Congress.

Highs and lows

The best part of the job for Burgos is that she really is putting her knowledge to work and making a contribution to the country and world. The hardest part is how fast-paced and stressful it can be. "It can be hard to maintain work–life balance, and it can be draining, where even when you clock out your mind is still buzzing. It is all-consuming," she said.

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What goes into a tenure review letter

What tenure-track faculty and writers of tenure review letters need to know

By Bill Sullivan

The key milestone in an academic career is acquiring tenure. Tenure was created to foster academic freedom, protecting faculty who venture into controversial territory from being dismissed. As it stabilizes an academic's position, conferring tenure is a major commitment by the university that is not taken lightly. Those who evaluate faculty going up for tenure rely heavily upon reference letters from the candidate's colleagues.

When evaluating faculty members whose primary focus is research, universities typically solicit at least six external tenure review letters, usually from established members in the candidate's field of research. Despite the importance of these letters in the tenure process and their heavy influence on a colleague's future, little guidance is provided on what the reviewer should write. Faculty on the tenure track also should be aware of what goes into these letters for career development purposes.

Am I eligible to write the letter?

If you've been asked to write a tenure review letter, either the candidate suggested you or the departmental tenure review committee identified you as an investigator active in the candidate's field. If you feel that your area of expertise does not align with that of the candidate, you should consider declining the request.

Your assessment needs to be fair and impartial. You should decline the request if you have a relationship with the candidate that could be perceived as a conflict of interest. Relatives, close friends, significant others and former supervisors or mentors of the candidate should not be involved with the candidate's tenure evaluation.

Other conflicts of interest include previous or planned research collaborations, such as co-authored papers or grants. If you have a longstanding disagreement or personal beef with the candidate that may bias your review, you should consider declining.

Some universities are more flexible when it comes to the candidate's past collaborations. For example, a letter from someone who co-authored a paper more than five years ago may be acceptable. If you are uncertain whether your relationship or qualifications disbar you from writing the letter, it is prudent to explain the situation to the person who extended the request.

Finally, make sure you have sufficient time to complete the letter before the deadline. Depending on how well you know the candidate, it can take quite some time to review their CV, research papers and scholarly activity. Notify the committee if this will be a problem, because it could delay or jeopardize the review of the candidate's tenure application.

What should I include in the letter?

Along with the candidate's CV, the tenure committee chair likely will send some information about what should be included in your letter. (If not, feel free to ask.) If their requested items are not mentioned below, be sure to address them.

As a general rule, you do not want to burden the tenure committee with redundant or irrelevant information. Try to limit the letter to one or two pages and avoid summarizing the candidate's CV, as it will be included in the candidate's dossier.

Your letter should state explicitly whether you support the candidate for tenure and provide a concise rationale justifying that decision. As universities differ in their stringency for tenure, your recommendation should be based on the criteria used by the candidate's university.

To simplify the structure of the letter, divide it into three main blocks. Use the first block to introduce yourself briefly, emphasizing how you know the candidate and why you are qualified to assess their impact on the field.

The second block is an objective assessment of the candidate's contributions to the field. These can include

key publications, presentations or grant funding.

Avoid making a laundry list of achievements; instead, provide your expert opinion of the candidate's work. Is it of high quality? Is it pioneering or innovative? Has it changed paradigms? Did they develop a new technique or model system? Will their work have a sustained impact that moves the field forward? Is there something special that makes this candidate stand above their peers?

Be mindful that the various committees and stakeholders that review the candidate's dossier are not experts in the candidate's field, and some may not be scientists. A tenure letter is not the place to go into great technical detail regarding the applicant's research area. Additionally, reviewers may not be familiar with the significance of the work, the quality of the journals or the prestige of presenting at scientific conferences, so be sure to add context to their achievements.

Where appropriate, the second block is also a good place to mention the candidate's accomplishments in other areas relevant to academia, namely teaching and service. Letter writers might highlight signature contributions to teaching and mentorship. Particularly important areas of service to mention include editorial boards or grant review panels, as a strong reputation in the field is a prerequisite for these positions.

It also may be helpful to include modern metrics (alternative metrics or altmetrics) of the candidate's performance to emphasize their growing stature as an academic. Such altmetrics could include social media platforms, media appearances, Google Scholar citations, pageviews/downloads and number of articles written "beyond the journals" in publications like ASBMB Today.

The third block should discuss the candidate's future prospects. If you feel it necessary, begin this block with constructive feedback that mentions areas the candidate should focus on for improvement. Well-intentioned advice is not only helpful to the candidate's future endeavors but also underscores the authenticity of the positive remarks in your letter. End this block with your expert forecast of the candidate's ability for continued success and productivity.

Universities want to be assured that granting tenure is not going to foster complacency; they want to hear that the candidate has a genuine passion and lasting hunger to break new ground and become a world-renowned leader in their field.

Be sure to conclude your letter with a clear statement as to whether you support the candidate for tenure. If not, it would be helpful to provide an additional sentence that states what would change your mind.

Tenure review letters should remain confidential, but bear in mind that the candidate likely will be made aware of the contents of your letter either in redacted form or as part of a summary statement written by the tenure committee. It is advisable to maintain professionalism and avoid writing criticism that you would not feel comfortable telling the candidate in person.

Bill Sullivan (wjsulliv@iu.edu) is a professor at Indiana University School of Medicine and the author of several books. He is also a member of the ASBMB Today editorial advisory board. Follow him on Twitter: @wjsullivan.

How would Socrates teach science?

Adapting an ancient pedagogy to build deeper understanding and inclusive learning communities

By Ann Riedl & Mike Klymkowsky

The Socratic method is personal, typically involving conversation in a small group. Because it is interactive, it takes time: time spent listening to ideas and composing and posing questions that should lead students to reflect and reconsider their underlying assumptions, the relevance and implications of these ideas, and whether other ideas need to be considered. Responses to questions become the focus of new questions, a process that continues until the group reaches clarity and consensus. The process is not unlike the preparation, review, response and revision of a scientific manuscript.

> **As I was leaving the classroom recently, I overheard one of my students complaining that I always answer his questions with another question. "I hate that. I just want to know the answer." What I thought of as good teaching practice was annoying my student. The Socratic method dates back well over 2,000 years, but does it have a place in today's science classrooms?**
>
> **— Ann Riedl**

The goal of the Socratic method is to strip away illogical, inconsistent, irrelevant and unsupported claims and ideas, thereby revealing truth. People who hold illogical or empirically unsupported beliefs can find a Socratic discourse discomforting. Some view the Socratic approach as antagonistic and unwelcoming, particularly to students who are already uncomfortable within the academic community. When we asked students, "Why was Socrates annoying?" many said he was arrogant, certain that he knew the answers to the questions he asked and unwilling to accept alternatives. Some said Socratic questioning leads to competitive and potentially embarrassing situations — a form of jousting to establish who belongs in a class and who does not.

> **"The soul, since it is immortal and has been born many times, and has seen all things … has learned everything that is … so that when a man has recalled a single piece of knowledge — learned it, in ordinary language — there is no reason why he should not find out all the rest … for seeking and learning are in fact nothing but recollection."**
>
> — "Meno," The Collected Dialogues of Plato, Bollingen Series

Children start noticing, and caring about, their audience's response as early as age six, according to published research. Children may hesitate to ask questions because they fear being judged or appearing stupid. A Socratic approach can cause a student who already has concerns about their place in a class or a discipline to feel like an imposter, and such feelings are a primary reason why students leave science degree programs and careers.

Yet, in our experience, working scientists often float silly ideas and ask questions (occasionally over beer and popcorn) to clarify their understanding. They would rather resolve confusions from the start than build projects (or answer test questions) based on incorrect or irrelevant assumptions. Building the confidence to test ideas in public and to understand what determines whether they work is key to the scientific thought process.

Can the Socratic approach be applied in a way that minimizes its possible negative aspects, helps students arrive at mechanistic explanations and reflects how scientists actually talk to each other? Can it build up rather than erode students' confidence and help them to see themselves as part of the process that identifies relevant principles and resolves uncertainties? Can it be used to transform education into a creative and constructive process rather than a system that requires students to remember and regurgitate facts?

How does the Socratic method mirror the scientific process?

The sciences differ from philosophy and religion in a number of ways. Rather than Truth with a big T, the sciences aim to develop working and testable mechanistic models for natural phenomena. Robert T. Pennock, a philosopher and professor, wrote, "Science never guarantees absolute truth, but it aims to seek better ways to assess empirical claims and to attain higher degrees of certainty and trust in scientific conclusions."

Model building and testing is a creative and social process that involves playing with ideas, considering the evidence that supports the model and whether simpler or more accurate models are possible. These models presume an observer-independent physical world. They also provide science with a direction — over time, explanatory models get more accurate and explain more; the types of plausible models decrease as scientific understanding improves.

While wrong ideas do emerge, the scientific community rarely stays distracted for long by unsupported speculation or incorrect ideas.

The goal of a Socratic approach is to help students work productively with disciplinary ideas and their application, discarding those for which there is no or contradictory evidence. We believe that such an understanding is particularly useful in the biological sciences, where closely related organisms (such as mice, Neanderthals and modern humans) can display significant mechanistic differences as a result of their evolutionary histories. Without an understanding of basic principles, a student can only memorize the required answer.

How can we build an inclusive Socratic community in a science course?

Given the realities of many modern college classrooms (and Zoom sessions), generating a Socratic environment can be challenging, due in part to students' previous experiences with science education. In an age of Googling, memorization is much less important than making sense of and testing plausible models for various phenomena. To get Socratic, we have to reconsider the challenges we pose to students, the problems we ask them to solve, the phenomena we ask them to explain and the ideas we expect them to apply.

All too often, particularly in the biological sciences, students are faced with problems that can be solved only by memorizing the correct answer. Unlike physics and chemistry, the behavior of a biological system cannot, even in theory, be predicted from first principles (a point made explicitly by Ernst Mayr, who noted the role of historic, and often unknowable, stochastic and environmental events that influence evolutionary processes). At the same time, physics and chemistry constrain the underlying molecular and cellular processes. By focusing on these common processes, we can help students analyze novel situations and propose and critically consider plausible mechanisms that may produce them. We recognize and value the creative process that reflects what scientists do. We can focus on the importance of understanding the mechanisms of reaction coupling rather than memorizing the steps in the Krebs cycle.

> **It is all too common to find that even advanced students answer complex questions with a single word or phrase; it is almost as if they have never had to make an argument based on assumptions and mechanisms but have been trained to recognize the repeat stock phrases.**
>
> **— Mike Klymkowsky**

We must grapple with significant practical considerations. Socratic interactions traditionally involve small groups of people. How can we adapt them to an introductory science class, which is typically anything but intimate? Strategies exist that can be used in large classes and smaller recitationlike sections, provided instructors are trained in how to create scenarios that encourage student responses, and in how to respond in turn. This means avoiding the almost reflexive approach of correcting the student and providing the answer. We want to ask students to articulate their assumptions; these are skills that must be developed by both instructors and students. We need to emphasize that we do not expect a perfect response from students but rather a plausible one. This is no trivial challenge, particularly since it may mean students need to recall and return to ideas and ways of thinking that they were exposed to weeks or months earlier. Time for recursive reconsideration of underlying ideas must be built into course design.

This probably will lead to a decrease in content, so we need to consider carefully what we present and what we expect students to do with it. Are we asking for memorization or for the application of general principles and

discipline-specific concepts? Have we trained the students to build and evaluate models and explanations? Are we presenting them with tasks complex enough to allow for multiple solutions that can be the focus for Socratic feedback, leading students to reconsider and revise their responses? Do our questions require students, working alone or in a group, in class or asynchronously, to articulate their assumptions? In such a context, we can exploit asynchronous interactions mediated by software systems that allow for extended conversations within groups of students together with instructors' Socratic feedback.

> In a recent developmental biology class, I was struck by students' inability to consider how the anterior–posterior axis of a gastruloid could be revealed, even though Hox gene expression, a classic marker of this process, had been considered in depth earlier in the semester.
>
> — Mike Klymkowsky

Whether the group is large or small, a Socratic exchange requires that those running the conversation be trained in encouraging students to consider the implications of their assumptions and to reflect upon what they might be overlooking. Departments could hold short workshops and encourage classroom observations to teach instructors how to do this. The instructor's role is not to judge the correctness of the final response but to catalyze the discussion. In the best case, the instructor's role will be usurped by other students in the class.

The goal is to show that scientific progress does not depend on otherworldly geniuses but is the result of a social and collaborative process, a process in which all who are willing to engage can contribute.

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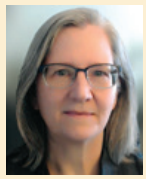

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Master's or Ph.D.? Which is right for me?

By Connor O'Hara

After earning an undergraduate degree or working for a few years in industry, many aspiring researchers consider graduate school. An advanced degree can lead to more rewarding career opportunities, provide specialized training or help determine a career direction (both in and outside of bench science).

I was at this crossroad in 2016. After a yearlong internship on the campus of Virginia Tech, I applied for both graduate school and an industry position elsewhere in Virginia. I was lucky enough to be offered both. I decided to defer graduate school for a year. Instead, I worked in the lab of a Food and Drug Administration contractor and earned a little bit of money to fund my graduate education.

Here are some of the factors that influenced my decisions.

Expense

When I started exploring options for graduate school, I fully intended to pursue a funded Ph.D. program in the field of drug discovery. However, mentors at Virginia Tech told me that it would be easier to get into a master's program and I'd have additional time to publish quality work before starting a Ph.D. I knew I'd have to pay for a master's, so I searched for ways to fund myself and ended up deferring my acceptance an entire year to work as a scientist; some good advice guided me to this decision, and as a result, I was a much more experienced grad student.

Many institutions across the country have funded doctoral programs in science, technology, engineering and mathematics fields; students receive a stipend from their university through federal funding dedicated to increasing the number of STEM graduates with a Ph.D.

It's often a different story for students pursuing an M.S. They must figure out how to pay for tuition, rent and other living expenses, which sometimes means taking out a substantial loan. However, at your target school, you should be able to find opportunities for scholarships and fellowships that provide financial relief. Generally, the university office of student financial services or a scholarship office can help you find potentially useful financial resources.

Experience

Some people pursue graduate science degrees after years of experience working in industry or perhaps as a research technician in academia. They've spent time honing their bench science skills as well as learning how to analyze data and follow standard operating procedures — all fundamental to successful and reproducible science. This experience may make the transition to a Ph.D. program easier. Principal investigators view these people as attractive applicants because they have a knowledge base that can shorten basic training and give them a head start in the lab.

Other people apply to a Ph.D. program while completing their bachelor's degree. They might have gained lab experience performing undergraduate research or during an internship. Or they might have had limited bench time. For me, what I learned during my postbaccalaureate internship sharpened my understanding of what I wanted to do with my scientific degrees.

An M.S. program might be a good choice for someone with limited lab experience. The time it takes to complete an M.S. defense provides a taste of bench research and more knowledge about the steps needed to move through a graduate program. Additionally, it's a good way for a student to learn about a PI and determine whether a particular lab and mentor are a good fit.

My master's program gave me an extra two years to perform research that would become a foundation for my Ph.D. dissertation work. This, much like my work experience, has both improved the quality of my work and increased my job opportunities after graduation. I am not alone in this strategy. Several other students in my department are progressing rapidly through their Ph.D. dissertation research because their master's thesis work

provided a strong foundation. Other students I know used their master's research time to learn what they did (or did not) like about working with their mentor and to take action (if needed) to join a lab they felt more comfortable in for their Ph.D. research.

Grades

As someone who spent most of my free time as an undergraduate skipping rocks across the New River, I'll be the first to tell you that acceptance into graduate programs can depend heavily on an applicant's undergraduate grades and scores on standardized examinations. I had to consider what doctorate programs would accept me despite my less-than-ideal grades.

I learned from personal experience that admissions faculty show greater leniency about undergraduate grades if you apply as an M.S. student. You can get in the door and prove your worth, and the department can evaluate your current knowledge before making a long-term Ph.D. investment.

By entering a master's program, several of my peers and I were able to fulfill all course requirements prior to our entry as Ph.D. students as well as present research publications, win department awards and even publish our work. This made us very competitive as applicants to Ph.D. programs whether we were retained in the same department or applied elsewhere.

Long-term goals

When I was deciding about graduate school, I had to consider my long-term goals in terms of personal and professional development. Where did I want to be in five years? 10 years? 20 years? It was challenging to plan that far ahead, but brainstorming was useful to direct my decision.

What do you like about what you've already done? Depending on what you want to do, a Ph.D. may not be necessary. Not sure where to begin? Take a trip to Indeed.com and browse interesting positions. What are their requirements for applicants?

I find that sites like Indeed and Glassdoor are excellent free tools for exploring requirements for interesting jobs as well as finding general information about working at a company in a specific role (including pay by title, interview questions and company receptiveness). In my final year of graduate school, I've been using these tools to prepare myself for life after graduation.

I know people who are managers at contract research organizations or work in research and development with just a bachelor's degree. They are successful and living comfortably. I have friends with doctorates who are doing the same.

The speed of your progression within a company and your initial starting point may depend heavily on your degree. An applicant with an M.S. and no experience outside an academic lab is likely to land a science position at least one promotion cycle down from the same applicant with a doctorate. It boils down to the amount of time you've spent in the lab.

Thinking more broadly, a Ph.D. is typically a four- to six-year journey that helps students become independent thinkers. The goal of candidacy and defense in the Ph.D. is to develop into a scientist with the knowledge and skills to conduct hypothesis-driven science and the ability to train and manage others to work as a team.

The expectations of an M.S. are adjusted for more foundational stages of independent research. The process often is completed in one to three years, and the student becomes competent at the method development, research, execution and analysis of data that leads to publication and supports future research efforts. I know many intelligent and capable researchers with M.S. degrees who lead teams at contract research organizations and major pharmaceutical companies.

At the end of the day, there's no right or wrong answer. Some paths have more stringent requirements, however — I know very few university professors who did not complete a Ph.D. followed by a postdoctoral fellowship. Yet major opportunities exist for employment in small biotechs or larger industry corporations as a research scientist with an M.S. alone.

The factors I've listed, coming out of my own experience, are just a few you need to consider in making this decision. If you're trying to decide what's best for you, ask around. Chances are you work with or know someone in your field who has one (or both) of these degrees. Ask for their opinions and advice and then apply what they've learned from their experiences to your own circumstances.

Earning a master's degree or doctorate — though not always necessary — can be an engaging and immersive experience that propels you forward.

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Nine tips for managing time in grad school

By Chloe Kirk

Graduate school, and academia to a larger extent, is perhaps one of the most unorganized jobs there is. I received no list of expectations, no rubric for what to get done each day or any real grading to gauge my progress. I knew I needed to, at some point, publish papers and defend my thesis.

Coming directly from my undergraduate life organized by classes, exams and regular assignments, I found this lack of organization to be both a blessing and a curse. The freedom was exhilarating; I was in charge of my day and of what I got to read and study. But with that freedom came incessant worrying that I was behind on everything, because there was always something else I could be doing.

Coming into grad school, I was overwhelmed by how much undirected time I had. Then I learned about time management, and the world started to make sense again. Here I share with you some of the most important skills for mastering time management in graduate school. I hope they help you as much as they have helped me.

1. Establish a schedule

Perhaps the best advice I received from an older graduate student in the lab is to work consistent eight-hour days as much as possible: 8 a.m.–4 p.m., 9 a.m.–5 p.m. And even more importantly, establish this schedule and boundaries with your lab and principal investigator.

This might seem like a tough one. Some days you might need to pull a 12-hour shift to get an experiment done. And sure, you can decide to come in at 9 a.m. one day and then start the next workday at 2 p.m. But in my experience, this left me feeling like I wasn't being productive enough or burned out from working long days. Setting a consistent eight-hour schedule keeps your body in a rhythm and lets you feel confident you've gotten work done.

2. Use a planner

Physically writing out what you need to get done for the day immediately puts you into a productive mindset. I'm also a big fan of using the free web browser and app ToDoist, which allows me to break down tasks by topic and schedule tasks for a later date. This way I can have multiple to-do lists (a work one and a home one) and move tasks to a later date if I have too much planned.

3. Break down bigger tasks

The biggest no-no of using a planner, however, is only writing down ginormous tasks such as "write my paper" or "literature search." These sorts of tasks will be so overwhelming to look at that you'll never want to even start them. Instead, I break them down into smaller, more reasonable tasks for each day. For example, instead of "write my paper," I'll put down "write my abstract" for one day and then "proofread abstract" for another day.

4. Set priorities

Don't tell yourself you have 20 top items you need to get done today. If you do, it's more likely than not you'll get none of them done. Have two or three big task items for the day and be OK with the fact that everything else on your list could be pushed. In my planner, there's a break on the paper between the top three tasks and everything else. Prioritizing just a few things, again, makes me feel less overwhelmed looking at that to-do list.

5. Time block your calendar

When I first started doing this, I felt silly having a huge chunk of time that just said "emails" or "staining cells." But blocking out time on my calendar for each task in the day further prioritizes what I need to get done and gives me the grace to push an overly ambitious task to the next day without letting it consume an entire day.

Seeing what time I have also stops me from planning too much.

6. Experiments take twice as long as you expect

I wish this were written at the start of every lab notebook. When I started grad school, I planned experiments so close together that there wasn't even a 30-minute overlap between imaging a first batch of cells to staining another batch. Be realistic with yourself. So many unforeseeable events arise during the day — mistakes in experiments or needing to make additional buffers — that I always estimate any experiment will take twice as long as I think it should on paper. And nine times out of 10, I end up taking almost that whole time.

7. Plan your week in advance

I dread Mondays as I come into the week with lots of experiments looming ahead. I like to prepare by planning out my week the Friday before so I can have everything set up and ready to get started on Monday.

8. Focus one day a week on desk work

This is one I'm still working on, but it makes a huge difference. It's so easy to do back-to-back experiments when I'm getting good data, but I also need to write up results, analyze data before I forget what I did and read to keep up with what's going on in my field. Try to plan one day of the week to focus just on desk work. Some labs even have a lab writing day once a week and book a conference room to focus on nonbench work.

9. Take breaks

Last but not least, I want to remind you to take breaks during your work and use your days off. Take holiday time. Take your weekends. Take that five-minute walk outside. All these other time management skills will get you nowhere if you're burned out.

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Raise your intangibles

By Eleftherios P. Diamandis

When Roger Federer and Rafael Nadal play in a Wimbledon final, the sportscasters try to guess who's going to win by comparing past achievements such as grand slams won, weeks ranked No. 1, Association of Tennis Professionals masters tournaments won, strength of forehand and backhand, etc. But they also invariably mention a crucial category they call "intangibles."

According to Wikipedia, intangibles are assets that lack physical substance, and they are very hard to evaluate; it's like saying people know you own something valuable even if they aren't sure what it's worth.

What do intangible assets have to do with careers in academia and elsewhere? Everything! Imagine you are one of 100 candidates competing for a faculty position. Of course, your publications in high-impact journals, your presentations at meetings and your grants will count a lot. But the majority of applicants, especially the top ones, likely will have similar assets. Here's where the intangible assets weigh in and break the tie.

How to build your intangible assets

In general, you want to separate yourself from the crowd. You want to be recognized among your peers as someone special or different. You need to develop a trademark that is recognizable, personalized and likable. Easier said than done. One way to develop your intangibles is by investing in your intrinsic talents and personality. Everybody is different. Just make sure that when you get a chance to talk, people turn their heads toward you and ask, "Who is this person, anyway?"

I use this trick routinely when I go to restaurants. When they ask for my name for a reservation, I say, "Elvis." For one, nobody has yet asked me how to spell "Elvis." And when my turn comes to get my table, and they announce my name, most of the other customers turn their heads to see who Elvis is. This will not get me a job at the restaurant, but it might get me a nice window table.

Any moment could be an opportunity for you to build your uniqueness, but you need to think twice, because hunting for attention may create both positive and negative effects. The general approach that works for me is to be unique and, if possible, memorable and, at times, discretely funny. Here's an example.

I'm in a board room with 10 people I don't know, and they all introduce themselves as Dr. So-and-so: name and title. When my turn comes, I can say something a bit more original, like "My name is Diamandis, Eleftherios Diamandis," which is reminiscent of "The name's Bond, James Bond." Those who get the joke will break a smile and may make a comment to me afterward. In 10 years, they won't remember what the meeting was about, but they might remember my introduction. If they have a job opening, they might give me priority for my intangible uniqueness.

Some successful jokes can go a long way. I still run into people who say they met me at this or that meeting 20 years ago; when I ask them if they remember what I lectured on, they say no, but they vividly remember my funny true story about the taxi driver, the watermelon juice and the risk for prostate cancer.

How to handle your employer

It's tough to make generalizations, because everybody is different, but in most cases, employers like cheerful and flamboyant employees. The reactions of your supervisor to your cheerful behavior will guide you as to where the red lines are. In general, supervisors will not hold a bad joke against you unless it's inappropriate or unprofessional. But if your jokes don't seem to work with a particular superior, you'd better retreat early.

Not every joke is bound to be successful. As my daughter frequently reminds me, "Dad, that was not funny." But a good, smart and tasteful joke can compensate for two or three bad ones.

Why would you joke with your supervisors? It's one of the best ways to get more access to them when it comes to business matters. When I make a joke in an email, my supervisors usually can't resist replying immediately with a counter-joke. The trick is to incorporate an element of surprise that is related to the business matter and almost forces a response.

Don't overdo it

The most frequent mistake with building intangible assets is going overboard. The asset then becomes a liability. Being funny too frequently can create the impression that you're not serious, and a slip of the tongue can offend somebody. Overdoing it also creates confusion as to when you are serious and when you are not. Mistakes of this sort could cost you a job, and you need to adjust your strategy according to circumstances.

Two pieces of advice are in order:

1. Avoid joking at job interviews unless you are super confident that the joke is tasteful and smart.
2. When dealing with people you don't know, be serious, at least at the beginning, and try to measure what they can and cannot take. Follow their leads.

At the end of the day, you can steal the show with your flamboyance, or you can mess up. If you have doubts, it may be best just to stick to your … tangibles.

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Balancing act: You're not alone on your tightrope

By Danielle Guarracino

As yet another late night ticked by, the clock showing 3 a.m. pass to 4 a.m., I found myself getting restless. I needed to grade more lab reports, review the next day's slides for my virtual biochemistry classroom and, maybe, put some of my toddler's toys away so we could walk in the house without damaging a foot.

Somewhere between tired and too wired for sleep, I found myself scrolling through Instagram for the tenth time that night. I don't remember exactly when in the endless pandemic nights I found them, but there they were, just when I needed them — groups of people who identify as mothers who also work in science. It was a community of people in situations like mine, and an array of other situations, with stories to tell and a virtual common ground. These informative, funny, strong people provided me inspiration when I least expected it. I want to tell you about them, but first let me tell you a little about myself.

I came to motherhood later than some; I gave birth to my daughter three days before I turned 39. I had passed through tenure and promotion to associate professor at the College of New Jersey, a primarily undergraduate institution, and felt comfortable in my almost nine-year career. I'd been career focused for much of my adult life; my husband and even my dog were used to seeing me give my largest efforts to my profession.

I wanted to be a parent, however, and while I'd often heard that there's no perfect time to have a baby, we planned as best we could when to start our family. I couldn't imagine the late nights of grad school, the arduous steps of my postdoctoral work and the effort to find a solid footing in my early academic career while also being a parent. I know others manage, and I am humbled by their stories. And when I didn't want to wait any longer to become a mother, I leapt in with both feet.

I did not expect the drastic paradigm shift in balancing work and life. I was set in my ways until my wonderful and awe-inspiring daughter rocked my world.

My first semester back after maternity leave, I was frequently in tears; I contemplated leaving my job. I was under enormous pressure to continue on my path, with added leadership roles, new teaching techniques and more research students to train along with my new responsibilities (and adventures) as a parent. I cared deeply about my work, but I cared even more for my child, and there is only so much time in a day.

COURTESY OF DANIELLE GUARRACINO

Danielle Guarracino, her 3-year-old daughter, Julia, and her 7-year-old beagle, Tobie, pose for a Mother's Day portrait.

The following semester, spring 2020, I made a plan for more balance and preparation. A month and a half in, the COVID-19 pandemic shut down the world. With a newly minted 1-year-old in tow, I had to redesign my entire professional life to fit our new virtual world.

This tale is not mine alone. Even before the pandemic, many parents with careers in science shared stories of

striving for work–life balance and a meaningful life that is bolstered, not thwarted, by a meaningful career. We are a community.

Since my late-night scrolling discovery, I have eagerly followed two groups on social media. Both are led by women who are mothers. They collect stories, data and information with similar goals: policy change to benefit families who work in science, and scientific literacy to help families make informed, science-backed decisions.

Mothers in Science

Mothers in Science is an international nonprofit that advocates for mothers working in science, technology, engineering, mathematics and medicine. It promotes workplace equity and inclusion for parents and caregivers and developing policies that can help retain women with children in STEMM fields. This involves identifying barriers preventing women with children from progressing in these careers.

CEO and co-founder Isabel Torres talked to me about the need to create a community. Many women feel isolated when they become parents, she said, and she felt a need to "connect the mothers." She also set out to research the barriers and myths surrounding women and their lack of representation in leadership positions in STEMM.

Mothers in Science conducted an international survey in partnership with the International Network of Women Engineers and Scientists, Parent in Science, Femmes & Sciences, 500 Women Scientists and Washington University in St. Louis. The results showed that structural and societal barriers, such as widespread maternity bias and discrimination, are completely normalized across many countries. The survey, "Impact of parenthood on career progression in STEMM," was issued between Sept. 15 and Dec. 31 and collected information about respondents' situation prior to the COVID-19 pandemic; it compiled responses from 8,930 mothers, fathers and nonparents across 128 countries.

Among the results: About 34% of the mothers surveyed left full-time STEMM employment after they had children. Among academics, the publication rate of women declined after they had children, and the publication gap between male and female parents persisted and increased over time. In terms of maternity bias and discrimination, 34% of mothers said their competence was questioned by their employers and/or colleagues after they had children, compared to 10% of fathers, and 38% of mothers said that they were offered fewer professional opportunities, compared to 13% of fathers. A whopping 61% of mothers said that parenthood negatively impacted their careers.

COURTESY OF ISABEL TORRES

Isabel Torres founded Mothers in Science because she wanted to connect women who feel isolated when they become parents and to raise awareness and research the barriers and myths surrounding women's lack of representation in leadership positions.

Much discrimination is so normalized that many women are not aware of it until many years later, Torres said. She noted that 28% of mothers chose to prolong maternity leave or to leave their full-time positions while breastfeeding, suggesting that breastfeeding stigma and lack of workplace support, such as inadequate lactation facilities, affects women's choices to return to work.

In general, taking parental leave still carries a stigma, especially in countries such as the U.S. where there is no common policy on leave, Torres said. The stigma also persists for fathers, because many workplaces offer little, if any, paternity leave, and many people have negative assumptions about fathers who partake.

By disseminating their survey data and working with statisticians, Torres and colleagues hope to start a conversation to raise awareness. With support from women in dozens of countries, they are promoting systemic change by proposing evidence-based ideas for new policies and contacting leaders in institutions, agencies and governments to implement those policies.

"The mother becoming the default parent is so normalized we don't see it," Torres said. "With three times more child care responsibilities and work, overtime, weekends … it adds up."

Mothers in Science and their collaborators are focused on changing certain policies; equal parental leave is a

top priority. Other proposals, such as policies to eliminate maternity bias, grant extensions for recipients who become parents during the grant period, or preventing after-hours meetings that could exclude parents, are more nuanced. A round-the-clock work culture is hard to change. The pandemic has shown that remote work is possible and workers can be productive within a self-created schedule. Increased flexibility could benefit all working parents, especially those in science whose work may not fit into prescribed times.

Torres paints a hopeful picture for a future that denormalizes obsolete traditional family roles and embraces a model where career and a family are not mutually exclusive. "We are all in the same boat," she said. "We all have a career and enjoy our kids, and the institutions have to adapt. It starts with the leaders, the heads of departments, to educate people and enforce the (anti-discrimination) laws that exist."

SciMoms

From the first moments I held my daughter, I knew I needed to make informed decisions to help her thrive — beginning with how to feed her. Both she and I struggled with breastfeeding, and I switched to formula feeding when it became too difficult. I felt like a failure; everything I read on the internet made me question and fret over my decision.

Then I found SciMoms, an educational nonprofit founded by mothers who work in science that promotes evidence-based parenting and policy. I read their article "Is breastfeeding really best and is formula harmful?" and found relevant and useful references, with the science boiled down in a way I could understand easily. Quoting the American Academy of Pediatrics, the writers assured me that "both approaches (to feeding your baby) are safe and healthy."

The SciMoms use comics, songs, infographics, blog posts and social media to bring scientific literacy to the masses, especially parents. I find solace in science, but scientists are not the only ones who can use scientific tools to make decisions. Everyone can benefit from having evidence-based, factual information, especially when making parenting decisions.

Alison Bernstein, an assistant professor of translational neuroscience at Michigan State University and a founding member of SciMoms, walked me through their origin story: Five scientists and science journalists penned an open letter in response to celebrity campaigns against genetically modified organisms. With the hashtag Moms4GMOs, they started a petition requesting that advocacy, especially by celebrities or other high-profile influencers, be based on facts, not fear. This petition gained the interest of filmmakers who produced the documentary "Science Moms." And from this, SciMoms was formed.

The group's goal is to make "reliable resources easy to find," Bernstein said. Information exists on the science of everything from nutrition and vaccination to the safety of activities such as skateboarding, trampolines and contact sports. Using their scientific and journalistic training, she said, the SciMoms "sift through massive amounts of information quickly, see what is valid from experts in the field and what can be thrown away, and distill it down for people."

They also link to experts, functioning as science-to-layperson translators. "Not everyone has the same education," Bernstein said, or the time to research "every last detail," but parents have very real questions and they want facts. This need became more urgent with the COVID-19 pandemic as seemingly conflicting information, often based on scant research, single studies, and political agendas, flooded the media, offering little authoritative guidance for navigating a mutating virus.

The SciMoms target audience, Bernstein said, is "the mom you meet at the playground who maybe has not had science since high school or does not care for the details of evidence-based science you would not need to know

COURTESY OF ALISON BERNSTEIN

Alison Bernstein, an assistant professor of translational neuroscience at Michigan State University, is a founding member of SciMoms.

(in everyday life)."

This parent has questions and wants to know what experts say but also wants simple answers and resources. These can be as straightforward as the safety of the vaccine schedule for young children or as nuanced as nutrition concerns: organic, GMOs, pesticides? SciMoms will provide information and, at times, a personal story or thoughts, but they will not endorse or recommend one point of view. They are a volunteer organization with no underlying agenda, sponsorship or monetary gain, Bernstein said. Their common goal is scientific literacy, and they persist because parents seek information and may not have the time or resources to make sense of it on their own.

"The goal of our science communication is to translate the science," Bernstein said, so people can "make science-based decisions for health and wellness."

The March 2021 issue of Time magazine featured profiles of "Moms on a Mission," including SciMoms. A few months later, COVID-19 vaccines were approved for ages 12 to 15 but not for younger children. In families with mixed vaccine status, and parents were unsure what activities and environments were safe. Bernstein and other science communicators developed an infographic that ranked low-, medium- and high-risk activities.

When groups like SciMoms collaborate with other science literacy–based organizations, they often are accused of preaching to the choir, Bernstein said. But collaboration among evidence-based parenting groups reaches a wider network through the domino effect of conversations and increases the spread of information to parents who don't work in science. While much of their evidence is anecdotal, from messages she and other SciMoms have received, an increase in sign-ups for their blog and newsletter demonstrates a growing influence.

"It's about finding like-minded people who are using the same types of scientific tools to make decisions," she said, and then building trust among a larger community.

Since the height of the pandemic, I've been referencing the articles and links culled by SciMoms, trusting their sources on mask policies, Centers for Disease Control and Prevention guidelines, vaccine information and more. In parallel, I often scroll through Mothers in Science for stories of parents who have surmounted great challenges and who work for policy changes. These two sides of the same coin provide me, a mother and scientist who is looking to parent effectively and balance my professional and personal life, with an online community that helps, nurtures, supports and adds confidence to my decision-making.

So while I may be finishing the last words of this essay at 2:24 a.m. as I put off my daughter's lunch prep for tomorrow and consider plotting data I obtained in the lab today, it brings me joy to know that this may reach a few more scientific parents trying to walk their own tightrope between work, family, decisions and policies. Thank you for being a part of my community and for advocating for parents in science.

Bringing science into our children's lives through our careers, our choices and our networks will influence a new generation to stand up for facts and to consider evidence when achieving their own balance.

Danielle Guarracino (guarracd@tcnj.edu) is a professor of chemistry at the College of New Jersey and a member of the ASBMB Today editorial advisory board.

All alone in a crowd

By Lea Vacca Michel

I thought I had anticipated everything. I'd booked a beautiful Airbnb within walking distance of the conference center. I had a list of phone numbers and flight info for all my students. I'd spent hours helping my students prepare their research posters. I'd gone through the presentation list and created a schedule of interesting talks for my students to choose from. And thanks to a collaborative effort with the conference staff, the sign language interpreters were confirmed for all those sessions. We were ready.

When traveling to national meetings with my students, I typically allow one afternoon of free time so they can explore the area, take in a museum or visit whatever local venue they fancy. This time, we were going to Orlando, so the choices were endless (and expensive). But I was determined to make one thing happen — we were going to a theme park.

It would be all or nothing — we all went or none of us went. I created a poll so my students could vote on which park they'd most like to attend. The results were unanimous: Universal Studios. I worked with a friend and travel agent to book the tickets so we could get a group rate. I prepaid for the tickets and told each student I would supplement their payment so they could all afford it: "Whatever you can pay, just let me know."

Despite a few snafus, we made it to Universal around 2:30 p.m., and we were determined to stay until the park closed. It was really hot, quite a change from the 30-degree weather we had just left in upstate New York. There were eight of us, so sometimes it was a challenge to keep track of everyone, but for the most part, we stuck together. We went on rides, took in shows, ate junk food and explored the magical Harry Potter Village. By the end of the night, my feet and my brain were equally exhausted.

COURTESY OF LEA VACCA MICHEL

The Michel research group from the Rochester Institute of Techology takes a break from the 2019 ASBMB annual meeting in Orlando, Florida, to visit Universal Studios. Pictured, left to right, are Sean Lewis, Xinbei Liu, Lea Michel, Leslie Gallardo, Zack Ward, Julia Faraone and Morgan Bauer.

All in all, the trip to the park seemed like a smashing success. But it really wasn't, and here's why.

Before most of the rides, two of my students had to remove their cochlear implants. The movement, the water, the chaos — for all these reasons, they didn't want to risk damaging their $35,000 implants. I'm sure I would have made the same wise decision. However, when those students removed their implants, they were tossed into a world of silence — isolated from the group and all alone in the crowded park.

It wasn't until the next day that one of those students bravely explained what happened. How a seemingly joyous adventure turned into a scary ordeal. Even a trip to the bathroom, separated from the rest of the group, was traumatic. I was heartbroken. How could I let this happen? What should I have done differently?

The truth is I could not have predicted this. I do not live in a world that is not made for me, so I assume everything will be fine. And it was for most of us but not those two students. I realized that I was asking the wrong question. Instead, I needed to ask, "What can I do to make sure this doesn't happen again?"

I met with some colleagues and with one of the students, and we brainstormed ways to ensure this ordeal wouldn't be repeated. But the task was daunting. There were so many scenarios, so many things that could go wrong. The best I could do was to sit and think — going over what happened again and again.

As I thought, I realized this situation was not unique to my two deaf/hard-of-hearing students. Social activities meant to promote feelings of inclusion, to improve group dynamics, and to build a sense of camaraderie and belonging are often well intentioned but sometimes misguided. I'd been organizing social gatherings with my research group since I started at the Rochester Institute of Technology in 2009. Most were well attended and a lot of fun, but there was a pattern I hadn't wanted to acknowledge until now — most of the time, the students who missed those events were people from nontraditional backgrounds and/or underrepresented groups.

I tried to put myself in their shoes. All were different, but they had one common thread — they were not part of the majority. Would they have fun? Would they be able to communicate with the other students? Would they understand what was going on? Would they feel out of place? Would they understand the inside jokes and the pop culture references? Would there be anyone they could relate to at the event? If any of the answers were no, I could see why those students would be hesitant to join in. So while I was thinking, "Wow, I'm hosting a fun afternoon of games and free food," they were thinking, "I don't feel like I belong, and this is probably going to make it worse."

Don't get me wrong. I don't think we should cancel all group social events. I think they have a lot of merit. They can help with team building, with strengthening relationships and with enhancing a student's sense of belonging. But because they also can do the opposite, it's important to think really hard about our events and ask ourselves some questions before we plan them:

- How can we make the event more inclusive?
- If there's a physical activity of some sort, does the activity disadvantage anyone in the group? If so, how can we alter the activity to ensure everyone is able to participate on an equal footing?
- Does the activity cost anything? If so, how can we lower the cost or make it free without putting students on the spot or making them feel bad about not being able to afford it?
- If the event is off campus, can everyone get there and back home easily?
- If the event is just a potluck meal, how can we encourage conversation among the group without leaving anyone out? If someone is the only member of an underrepresented group, perhaps they can bring a friend to help them feel more comfortable.

Do we have a lot we have to consider? Yes — especially for large groups, like my research group of about 20 students. Are we going to be able to accommodate every single student all the time? Maybe not, but isn't it worth it to try? Isn't it good to push students out of their comfort zone? Sure, but there's a difference between outside a comfort zone and into an impossible zone. Don't force students to do things that make them feel physically or emotionally very uncomfortable.

So what did I learn from all this? I learned that even though I consider myself an inclusive person, I still have a lot to learn. I learned that good intentions don't make up for bad planning. And I learned that in certain situations, people can feel very alone, even in a crowd of friendly faces.

Lea Vacca Michel (lvmsch@rit.edu) is an associate professor at the Rochester Institute of Technology and a member of the ASBMB Minority Affairs Committee.

The life of an international postdoc

By Himanshi Bhatia

Arriving in St. Louis, Missouri, from India in 2018, I faced multiple challenges. From acclimating to a new culture to understanding a unique accent and learning Fahrenheit-to-Celsius conversion, daily life included a steep learning curve. The most challenging aspect, however, has been the incessant immigration rules and regulations.

Visa woes

My university, like many research institutions in the United States, hires international postdocs, or IPs, on the infamous J-1 exchange visitor visa, which is administered by U.S. Citizenship and Immigration Services. The J-1 requires home-country residency, and waiving this requirement can take years and tons of paperwork. To obtain this waiver, the candidate needs no-objection certificates from their home country, their family and the U.S. Department of State. Given the present pandemic conditions, the entire process can take two to three years, if not more. A candidate who fails to obtain this waiver within five years of their arrival must leave the U.S. immediately.

My waiver has been stuck with the State Department for several months; I've received no updates even though I paid $120 to have my application processed. This is stressful but unsurprising. For senior Indian postdocs in the U.S., such delays and wait times have become the norm, so much so that no one bats an eyelid anymore.

J-1 scholars can work only at not-for-profit institutes and universities. When I was stuck in a toxic lab environment in the early days of the pandemic, the only options available to me were jobs in other research labs. However, the pandemic had revealed the ugly side of academia; I've found that supportive principal investigators are the exception and not the norm.

I took a chance and applied to the few labs looking to hire a postdoc in the midst of furloughs and hiring freezes. Fortunately, I ended up in a lab that does awesome science and has an understanding work culture. Many of my former coworkers were not as fortunate and ended up moving from one toxic lab to another.

One good thing about a J-1 is that dependents of the visa holder can apply for a work permit in the U.S. While the work permit application fee is quite steep ($400), having a job and an identity in the U.S. independent of their spouse can be liberating for a dependent both emotionally and financially. No other academic visa category (H-1 or O-1) acknowledges dependents.

Navigating unexpected obstacles

J-1 regulations can be scary and restrictive, but like most academic immigrants, I was prepared for such bureaucratic hurdles. However, I was not prepared for the limits my noncitizen status placed on career-enhancing opportunities, namely the lack of available career development awards. Most funding opportunities for early-stage researchers require applicants to have U.S. citizenship or permanent residency. The only National Institutes of Health career development grant I am eligible for is the K99/R00 Pathway to Independence Award, one of the most competitive for early-career researchers.

K99/R00 applicants must have less than four years' postdoctoral experience at the time of application, which presents a challenge. Most international academics move to the U.S. to enhance their CVs and scientific skill sets, and most are behind their American counterparts in their publication profiles, ability to work with cutting-edge technology and network of collaborators. It is extremely rare for an IP to have an academic profile comparable to an American postdoc in the early stages of their post-Ph.D. career. In my four years in the U.S., I personally have known of only one IP who bagged the K99/R00 award.

To gain parity with those who have Ph.D.s from institutions in the U.S., many IPs need a lot more than the five years allotted by the NIH as early-career trainees. This includes both time spent working in the lab and time spent working around the above-mentioned

visa obstacles. By the time an IP has surmounted all the technicalities and difficulties, they have been a postdoc too long to apply for the K99/R00.

Almost all IPs are stressed out by their uncertain future. With visa problems and the lack of good funding opportunities, most have to accept staff scientist positions. Their workload stays the same as when they were postdocs, and their salary may or may not increase; however, with this job title, they cannot apply for early-career awards. A few lucky IPs get promoted to pre-faculty instructor positions.

Survival strategies

A scientist is nothing if not a troubleshooter. To stay (and flourish) in academia with limited external support, many IPs take the extended lab stay in their stride and work toward enhancing their academic achievements and skill sets.

One perk of working in a U.S. university is the chance to hone soft skills that can make an IP more employable. I participated in trainee-run activities and groups on campus. I wrote a blog on science policy for ProSPER, edited scientific manuscripts for InPrint and even applied to the on-campus biotech consultancy BALSA. These opportunities improved my overall postdoctoral experience at Washington University in St. Louis and made me think about nonacademic career choices.

My employer, WashU, promotes exceptional postdocs to faculty-level instructor positions. Such a promotion gives an IP experience in the managerial aspects of academic research and allows them time to apply for citizenship. These appointments usually end with the IP landing a full-time assistant professor role.

So what defines success?

For some, academic success might be a high-impact publication; for others, it can be landing a tenure-track position. For IPs, the definition of success is more complicated. Success for me would be finishing a fruitful postdoc before I move on to a position in science communication. Many IPs consider getting their green card a mark of success; they no longer need to hold a work visa or worry about relying on the whims of their employer. As for me, it will be a while before I can reap the benefits of permanent residency in this country.

I believe the U.S. research community needs to include IPs in discussions of any future policy changes. International academics are law-abiding taxpayers who make up a large part of the workforce at U.S. universities. In the absence of efforts to improve their experiences, U.S. research will lose extraordinary scientists to other developed nations.

Himanshi Bhatia (himanshi.b@gmail.com) is a postdoctoral research associate at the Washington University in St. Louis and is passionate about science communication. Follow her on Twitter: @Himanshi16b

Underpaid: Women scientists in the academy

The salary gender gap is not as great for those in industry, researchers find. We should consider the implications for the future of academic science.

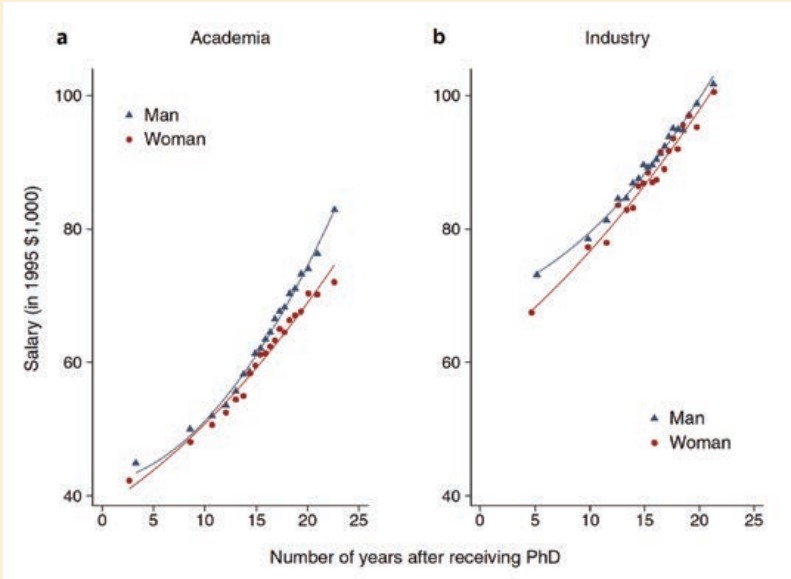
By Susan J. Baserga

It may not be surprising to many of us women scientists who work at universities and colleges that we are underpaid compared with our colleagues who are men. Yet an analysis in the journal Nature Biotechnology in fall 2021 revealed that the gender pay gap is smaller for women who work in biotechnology and pharma.

This remarkable finding has negative implications for retaining the next generation of women in academic science — and for reaching diversity, equity and inclusion goals at our universities and colleges.

Using National Science Foundation data from 1995 to 2017, Waverly W. Ding, Atsushi Ohyama and Rajshree Agarwal examined the salaries of 34,421 full-time scientists employed in either academia or industry (for-profit firms). They compared inflation-adjusted salaries in both sectors, controlling for a number of variables. Thirty percent of the scientists were women.

Their major finding was that the gender pay gap is 1.5 times wider in academia than in industry, with women in academia earning 5.3% less than the men (see graph). Also notable is the clear difference in the overall salary range in academia versus industry for both men and women, with industry having significantly higher salaries than academia.



Waverly Ding and colleagues show a larger gender wage gap between men and women in academia (a) compared to that in industry (b) across the career lifecycle.

How did this come to be?

For starters, women are more likely than men to be employed in non–tenure track positions. The authors found that the gender wage gap occurs only in the non–tenure track positions.

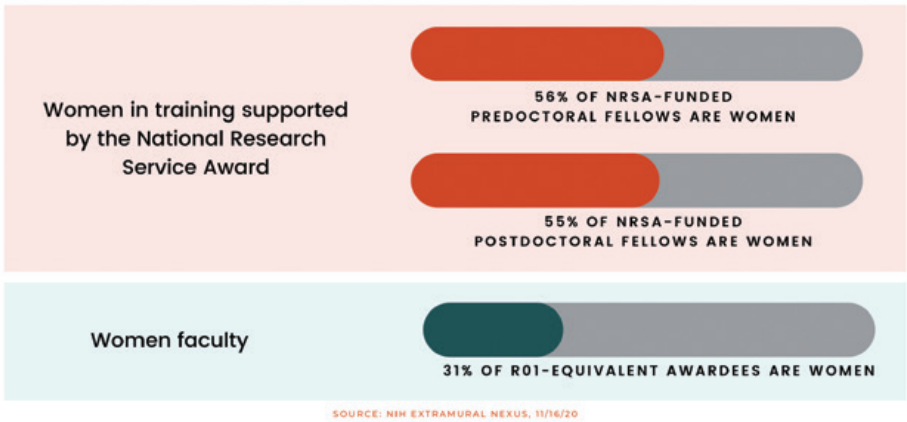
In contrast, in industry, although women scientists are underrepresented in leadership positions, the authors detected no gender wage gap in nonleadership positions.

They conclude that because women sort themselves into non–tenure track positions in academia, they experience salary inequity throughout their careers. In the long term, the non–tenure track also largely denies women leadership roles in policy setting at the university and college level.

A known issue

In 2020, the National Institutes of Health Office of Extramural Research examined gender disparities among NIH-supported scientists at various career stages.

In a blog post, OER Deputy Director Mike Lauer pointed out that women leak out of the pipeline specifically at the juncture between postdoctoral fellowship and research-focused faculty position. Although women receive 56% and 55% of pre- and postdoctoral National



Research Service Award fellowship grants respectively, only 31% of the R01-equivalent grants go to women (see infographic).

A reasonable assumption would be that most R01 grants are garnered by women who hold tenure track faculty positions. The NIH data are thus consistent with those of Ding et al. in that they demonstrate that women leave the tenure track in academia at a higher rate than men. At the same time, the NIH finds that the sorting of women into non–tenure track positions occurs before they would have garnered an independent faculty position.

Critical questions at the root of the gender wage gap in academia, then, are: Why do women with Ph.D.s in the biological sciences sort themselves into the non–tenure track at a higher rate than men? And why do they then earn less there? Undoubtedly the answers will turn out to be complex.

Negotiating as a woman

One contributing factor to the gender wage gap is likely the problem of negotiating — either because women are socialized not to want to seem pushy or because we fear the backlash if we do negotiate assertively.

Recent work published in the Journal of Applied Psychology and highlighted in Forbes argues that women negotiate better when they have an alternate choice. If a woman is the trailing partner in a dual-career couple academic hire, she is less likely to have that choice. I should know: As an assistant professor, I was the lowest paid person at my rank for some years.

Tools for negotiating effectively as women are found in the work of Linda C. Babcock of Carnegie Mellon University's Heinz College and colleagues, highlighted in Iris Bohnet's book "What Works: Gender Equality by Design." They argue that women are more effective at negotiating their salaries when they know what to ask for. Salary transparency is key here — information that is hard to come by at private universities and colleges.

Another tactic is to invoke a silent partner in salary negotiations. For example, instead of asking for more compensation on behalf of myself, I would say that my mentor, adviser or coach insisted that I ask for a higher salary or for more equitable laboratory resources. Studies have shown that this feint helps women avoid backlash.

Taking the long view, to preserve the nation's investment in women with Ph.D.s in the biological sciences, universities and colleges must do better at recruiting and retaining women in academic tenure track faculty positions. This is also critical to preserve access to a diverse group of mentors and role models for future generations of scientists.

We must get to the bottom of the leaky pipeline for women scientists in academia and finally fix it.

Susan J. Baserga is a professor at Yale University and the Yale School of Medicine. She chairs the ASBMB's Women in Biochemistry and Molecular Biology Committee and is a member of the Public Affairs Advisory Committee. She received the society's William C. Rose Award in 2016.

ASBMB

The interplay between epigenetic regulation and genome stability

Sept. 28–Oct. 2 | Seattle

Most meetings on epigenetics and chromatin focus on transcription, while most meetings on genome integrity include little attention to epigenetics and chromatin. This conference will bridge this gap to link researchers who are interested in epigenetic regulations and chromatin with those who are interested in genome integrity.

In addition to the scientific focus, we will promote interactions between two societies. The ASBMB and the Biophysical Society of China will hold this conference together. The first joint conference of the two societies was held in China in 2019.

Aug. 29: Regular registration deadline

asbmb.org/meetings-events/epigenetic-regulation-and-genome-stability

ASBMB commits to diversity, equity, accessibility and inclusion

By Ciearra Smith

The American Society for Biochemistry and Molecular Biology is committed to enhancing diversity, equity, accessibility and inclusion, or DEAI, throughout the society, and I am pleased to share its DEAI commitment statement.

It's never too late to stand up for what's right, especially when we are still seeing people killed due to racism. The ASBMB needs a DEAI commitment statement to show that it is serious about enhancing its DEAI efforts and establishing a culture that is diverse, equitable, accessible and inclusive.

The statement builds upon the good examples of other societies' DEAI commitment statements, and some overlap exists, such as the understanding that diversity fosters innovation. However, the ASBMB's statement stands out because it highlights the society's commitment to each aspect of DEAI — all are equally important.

I hope our members know that the ASBMB is dedicated to DEAI. This statement will help the ASBMB community hold itself accountable. This firm and specific commitment to DEAI is the first step in a continuous journey of learning, understanding and integrating DEAI throughout the ASBMB and its membership.

Ciearra Smith (csmith@asbmb.org) is manager of diversity, equity and inclusion programs at the ASBMB. Follow her on Twitter: @CB_witha_PhD.

Diversity, equity, accessibility and inclusion commitment statement

The American Society for Biochemistry and Molecular Biology recognizes that diversity, equity, accessibility and inclusion are vital to the success of the scientific enterprise and therefore must be integrated throughout the organization, the fields of study it represents and the broader STEM community. The ASBMB is committed to promoting a culture that values DEAI.

Diversity fosters excellence and innovation

Scientists who have varied life experiences provide different insights when faced with complex scientific questions. The ASBMB advocates for equity, accessibility and inclusion of historically excluded groups within BMB and strongly believes people from these groups are critical to advancing science. The society actively strives for both its membership and leadership to reflect the diversity of the global population. The ASBMB is committed to increasing the number of historically excluded scientists in the BMB fields and supporting them as they navigate their education and career.

Equity requires data collection, assessment, transparency and accountability

Opaqueness perpetuates inequity. The ASBMB is committed to evaluating its programs, policies and practices, making the results known to its members and the public, and maintaining a culture of accountability.

Access to opportunities requires stakeholder input, planning and investment

The ASBMB is committed to creating accessible programming and facilitating participation by people regardless of race, ethnicity, national origin, sex assigned at birth, gender identity, sexual orientation, disability, economic status, age or religion. The society seeks to identify and invest in solutions to eliminate barriers to access for all educational, professional, volunteer and leadership opportunities that it offers.

Inclusion is about understanding and respect

The ASBMB strives to make all its members feel understood, valued and accepted. The society seeks to establish and sustain a sense of belonging by soliciting input and feedback and using it to inform decision making.

The society will uphold these core values of DEAI across all departments and committees — and support its members in their DEAI efforts at their respective institutions and out in the world. The organization will speak out and stand up against racism, discrimination, exclusion, prejudice, ableism and sexual harassment. The ASBMB is committed to being an agent of change.

Free biochemistry textbook now available online

By Henry Jakubowski & Patricia Flatt

The new online textbook "Fundamentals of Biochemistry" is part of the LibreText initiative to provide free online texts for all chemistry courses in the undergraduate curriculum and can be found at bio.libretexts.org. The book has been written for a two-semester course with a chapter organization consistent with most biochemistry textbooks. The book can be customized by the instructor for a specific use, including a one-semester course. We wrote the book to be rigorous from both chemical and biological perspectives, stress structure–function relationships, and not focus too much on human biochemistry. We also have included significant mathematical analyses, which reflect the increased use of modeling in describing protein and cellular functions. It is a comprehensive classical text and not written from a problem-based or guided inquired approach, but it could be used for courses taught with those approaches when combined with in-class active learning.

We have made extensive use of figures and texts that are available through Creative Commons licenses. We would not have been able to write this one-year biochemistry text without using such materials, as we did not have a publishing company supporting our work. We view ourselves both as authors (of original materials) and as compilers (of materials licensed through Creative Commons).

Here are some novel features in the book:

Interactive 2D mathematical graphs: Biochemistry educators know that students struggle to interpret graphs. With our interactive graphs, users can change constants with immediate updates of the graphed functions.

Interactive molecular models: We will have over 400 interactive iCn3D models that allow students to view and interact with rendered structures. They also can export individualized renderings using a simple URL.

Imbedded Virtual Cell, or VCell, models: With these, students can display time course graphs for simple noncatalyzed reactions, such as the reversible chemical conversion of reactant A to product P, A ↔ P, as well as complex reactions, such as the mitogen-activated protein kinase cascade and the entirety of yeast glycolysis. We strongly believe that time course graphs will help students better understand the differences between enzyme catalysis in test tubes vs. the cell and the differences between equilibrium and the steady state. We also have expanded coverage of metabolic control analyses.

Animations to accompany the VCell models and some metabolic pathways: Animations offer another way for students to understand mathematical equations and graphs, and they support those who may be predominantly visual learners.

Recent research results: We routinely update the book to describe new findings. Three examples are RNA-glycans, structures of the Janus kinase cytokine receptor complex, and the decameric seipin complex that catalyzes lipid droplet formation.

Special topics chapters: We have a chapter on abiotic origins of life and will add one on quantum biochemistry and, more importantly, one on biochemistry and climate change.

The book will be complete by September but is useable now. It needs end-of-chapter problems based on the research literature and chapter-imbedded problems. We also will write learning objectives for each chapter section, tied to those developed by the American Society for Biochemistry and Molecular Biology. As the book is open access, we invite you to contribute in any way you can (problems, editing, inclusion of new materials, etc.). Send an email to hjakubowski@csbsju.edu if you are interested.

Henry Jakubowski (hjakubowski@csbsju.edu) is an emeritus professor of chemistry at the College of St. Benedict and St. John's University.

Patricia Flatt (flattp@wou.edu) is a professor of chemistry at Western Oregon University.

'Anywhere you go, be ready to review your work'

By Martina G. Efeyini

Maria Grandoni talked to ASBMB Today about working as a scientist in manufacturing at MilliporeSigma and in quality control at PPD.

1 How did you get started in industry?

In college, I was a biochemistry major. One of the technologies being used for biochemistry was high-performance liquid chromatography — something I have always been interested in.

I worked in chemical manufacturing with MilliporeSigma for a couple of years. After a time, I realized it wasn't something I genuinely liked. I started looking again. PPD was describing their testing methods, and HPLC and Western blots came up. Both seemed like good options.

2 What did you do at MilliporeSigma?

My group was making large amounts of potent material. It was drug manufacturing. I like to say, "In large amounts they cause cancer, and in small amounts they cure cancer." That's where I was using the methods.

3 PPD is a contract research organization. What do you do there?

I'm in quality control. I'm on the stability team for a client. They're making sure that these compounds at certain time points are still meeting their specification criteria.

Maria Grandoni

CURRENT POSITION
Scientist at PPD

EDUCATION
Bachelor's degree in biochemistry, Worcester Polytechnic Institute

FIRST JOB OUTSIDE OF ACADEMIA
Associate production scientist at MilliporeSigma

FAVORITE MOLECULE OR PROTEIN
Prions. "I don't know if that counts. Out here in Wisconsin, we have an issue. We've always had issues with wasting disease with deer. It's really sad. I remember in high school when that was first brought to our attention and everyone was asking questions: What do we know about it? How can we stop it?"

I'm specifically with the high-performance liquid chromatography group. I do analyses to determine if these compounds are still usable.

4 What does a typical day look like?

Because HPLC requires mobile phases, it's a lot of communication not only with my supervisor but with other people that I'm working with.

I try to always have my testing planned at least a week in advance. And if I have a free day, when I'm not doing testing or making solutions, I'm usually figuring out future testing and making sure I have everything I need.

5 What advice would you give to someone who is interested in a similar career path?

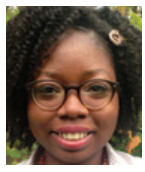
Learn about good manufacturing practice. It definitely looks better to those considering hiring you that you have an understanding of what it is. It's everywhere, especially in commercial use.

In manufacturing, you read the step, you do the step. That's all you have to do. You have to be incredibly focused on detail because, if you miss anything, that could cause the whole process to come to a halt. There could be an impact to the chemical reaction. Be ready to review your work.

In quality control, where the data is going to a drug potentially used for people, there's a lot of pressure. If you feel overwhelmed, don't think you're not capable. You just need to understand that it takes time and you'll get it.

(This interview has been condensed and edited. To read a longer version, go to asbmb.org/asbmbtoday.)

Martina G. Efeyini (mefeyini@gmail.com) is a science communicator and STEM education advocate, and a career columnist for ASBMB Today. Follow her on Twitter: @mefeyini.



CLASSIFIEDS

Postdoctoral Researcher
University of Pittsburgh School of Medicine

The Chu Laboratory is seeking creative, collaborative and independently motivated post-doctoral researchers to study the role of secretory/degradative pathways and synaptic pathobiology in primary neuron, mouse and/or iPSC models of familial dementias. Join an active team of researchers working on FTLD-tau, valosin-containing protein and PINK1, with opportunities to study Golgi/retromer & lysosomal biology or mitochondria.

https://careers.asbmb.org/job/post-doctoral-position-to-study-organelle-homeostasis-and-synaptic-biology-in-familial-neurodegeneration/63787800/

Postdoctoral Position
University of California, Davis

The Department of Molecular Physiology and Biological Physics at the University of Virginia invites applications for two tenured/tenure-track faculty positions in molecular and cellular physiology and chemical biology. The Department seeks to expand its strengths in cardiovascular, cancer, and other disease related biology with new faculty hires in molecular and cellular physiology of the cardiovascular system and diagnostic or therapeutic chemical biology.

https://careers.asbmb.org/jobs/view/postdoctoral-position/63752089/

Principal Investigators in Cellular, Systems and Developmental Biology
Lunenfeld-Tanenbaum Research Institute

The Lunenfeld-Tanenbaum Research Institute of Sinai Health, a University of Toronto affiliated biomedical research center, is recruiting emerging leaders in the area of Cellular, Systems and Developmental Biology. They are seeking applicants who will develop innovative, outstanding and independent programs in Cellular, Systems and Developmental Biology. Research approaches include, but are not limited to, the application of functional genomics, proteomics, metabolomics, epigenomics, single-cell analytics, and tissue engineering to investigate complex systems from the molecular to organism level including humans and/or model animal systems. Topic areas encompass reproductive, developmental, and regenerative biology, cellular physiology, and network and systems biology.

https://careers.asbmb.org/job/principal-investigators-in-cellular-systems-and-developmental-biology/63290054/

Scientist Educator-Assistant, Associate, or Professor of Medical Education-Biochemistry
Belmont University

The Thomas F. Frist, Jr. College of Medicine at Belmont University is seeking a biochemist to be a core faculty member as a Scientist Educator in the Department of Medical Education. This is a full-time faculty position at the rank of assistant, associate, or professor.

https://careers.asbmb.org/job/scientist-educator-assistant-associate-or-professor-of-medical-education-biochemistry/62263363/

To see a full list of jobs, please visit careers.asbmb.org

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