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# ASBMB TODAY

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



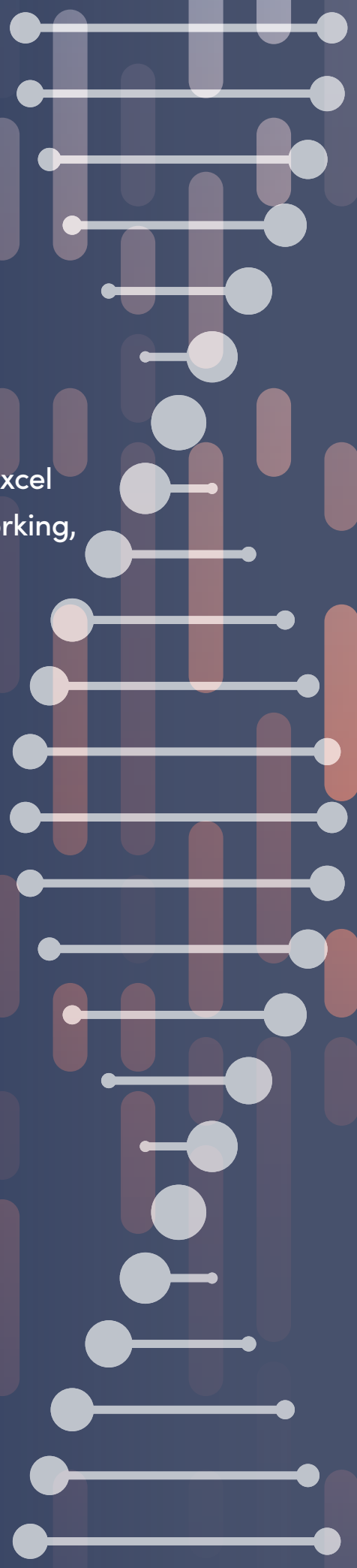
**Sequencing the angelfish genome**  
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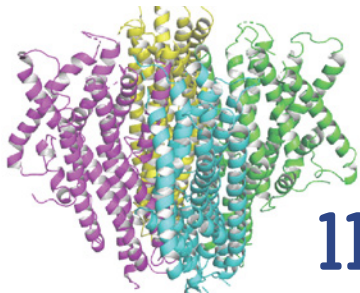
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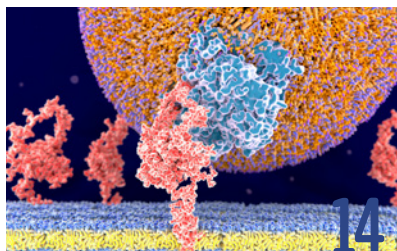
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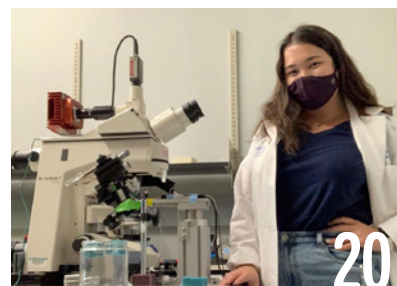


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# A hub for career exploration

*By Ann Stock*

We all know it's important to prepare students and postdocs for a broad range of scientific careers. Yet when I was writing a renewal application for a T32-funded biotechnology training program, I struggled to identify evidence-based strategies and assessments for my university's career exploration and professional development activities.

I recently served on a study section that reviews similar training grants, so I know this challenge is not unique.

Bioscientists have many career options, but the faculty members who train them often have little experience outside academia. We can easily envision activities that expose trainees to a variety of careers, or workshops and courses that build both translational and technical skills. It's harder to address trainees' social and psychological needs as they navigate the often stressful process of deciding what career path matches their aspirations. How do we know if the programs we design and deliver will succeed in preparing students and postdocs for fulfilling careers?

I am happy to tell you that help has arrived! The Professional Development Hub, known as pd|hub, recently launched its inaugural collection of educational models to support career exploration. The goal is to curate evidence-based practices in Ph.D. professional development and then make them

available to the people who need them. And our society helped make it happen.

Now a national center, pd|hub was conceived during the American Society for Biochemistry and Molecular Biology's 2016 sustainability summit, an initiative of the society's Public Affairs Advisory Committee, or PAAC, under the leadership of Wes Sundquist.

Progress toward the hub and the pd|hub Collections repository continued through a number of working groups, including members of the PAAC and the Education and Professional Development Committee, and funding from the Burroughs Wellcome Fund, the National Science Foundation and the National Institutes of Health.

The ASBMB is a member of the pd|hub Scientific Societies Group, which partners with pd|hub to share ideas and resources and collaborate on cross-disciplinary projects such as a recent webinar series.

pd|hub brings together stakeholders to advance evidence-based, inclusive professional development practices. The pd|hub Collections compile educational models from across the country. In addition to reading about the models on the website, institutions can become implementation sites, gaining access to detailed lesson materials, training for trainers, support for implementation and centralized evaluation.

I recently spoke with Cynthia Fuhrmann, principal investigator of



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pd|hub and an associate professor at the University of Massachusetts Chan Medical School, about the inaugural pd|hub Collection, “Foundations of Career Exploration for Ph.D. Scientists.” Our conversation has been edited.

**AS What’s unique about the pd|hub Collections?**

**CF** As you’ve experienced, it’s difficult to find effective models for Ph.D. professional development — most are not published, and the few that are may be spread across various science or education journals. At pd|hub, institutions can find a curated set of diverse, effective models and can also access resources and support for adapting, implementing and evaluating them.

**AS Tell me about this first collection.**

**CF** It focuses on the fundamentals of career exploration. This process involves not only assessing different career paths but also considering one’s own strengths, interests, values and needs while navigating an identity shift. Lack of support through this process can impact mental health and well-being of early-career scientists, and even their sense of belonging in science. We’ve curated three courses and two single-workshop models that are ready for universities to adapt for their own trainees. The first cohort of implementation sites is underway now, and applications for the next cohort will open this spring.

**AS How were the models selected?**

**CF** We didn’t want this collection to be limited to models already well known, so we put out an open call to attract submissions that apply a wide variety of approaches. Models were curated carefully using peer review to assess effectiveness. We looked



**Cynthia Fuhrmann is the principal investigator of pd|hub, which recently produced its first collection of Ph.D. professional-development resources.**

for alignment with what experts in vocational psychology and related fields know about career exploration. We also sought inclusive teaching approaches and adaptability. The people who submitted the models now play an integral role in the train-the-trainer workshops and communities of practice as fellows of this pd|hub Collection.

**AS In the next round of applications for implementation sites, what types of institutions or programs are you looking for?**

**CF** Our pd|hub team and fellows will work closely for a year with the sites. With this investment in mind, we seek applicants who are ready to adapt and implement a model this year. These include institutions in early stages of developing their Ph.D. career development offerings or those seeking to fill gaps in their existing program. We particularly encourage applications from minority-serving institutions or faculty who work closely with students or postdocs from groups historically marginalized in science.

**AS What commitment does an institution make to become an implementation site?**

**CF** With support from the NIH, the sites get trainings, consultations and evaluation at no cost. However, they commit to implementing the model at least once at their institution and participating in activities such as train-the-trainer workshops and community-of-practice meetings.

**AS What does the future hold?**

**CF** pd|hub Collections are designed to keep practices evolving. As we collect data across the sites, we’ll learn about how the approaches work in different settings or adaptations. These lessons will be shared through the community. We’ll introduce future collections focused on other professional development competencies. Over time, the collections will form a rich resource database and connect communities to drive innovation.

*Learn more at [pdhub.org](http://pdhub.org).*

**Ann Stock** ([stock@cabm.rutgers.edu](mailto: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 is the ASBMB’s president.



## Quinlan receives teaching award

Margot Quinlan, a biochemistry professor at UCLA, recently was named a recipient of the university's 2022 Chemistry and Biochemistry Hanson–Dow Faculty Award for Excellence in Teaching.

Quinlan, who joined the UCLA faculty in 2008, teaches biochemistry to undergraduate and grad students. She is a co-principal investigator of the UCLA Maximizing Student Diversity Program, which



QUINLAN

is supported by the National Institutes of Health, and she serves as faculty director of the Biomedical Sciences Enrichment Program, an intensive six-week summer program for historically marginalized and underrepresented first-year science students. In 2018, she was named a faculty fellow in the UCLA Center for Diverse Leadership in Science.

The Quinlan lab uses a combination of advanced biochemistry, microscopy and genetic approaches to study dynamics of the actin cytoskeleton with a goal of understanding the role of the cytoskeleton in cell polarity and a focus on early development. Her lab now is focusing on Spire and Cappuccino, two proteins that collaborate to build an actin network essential for early body axis development in *Drosophila*.

Hung Pham, an assistant adjunct professor in chemistry, also received the Hanson–Dow Award, which was established in 1986 to recognize outstanding faculty members in the UCLA chemistry and biochemistry department.

## Aggie women honor Shippen

The Texas A&M University Aggie Women Network has named Dorothy Shippen, a university distinguished professor and regents fellow of biochemistry and biophysics in the College of Agriculture and Life Sciences, as its 2022 Eminent Scholar. This honor is given to one faculty member each year by the network, an alumni group that is part of A&M's Association of Former Students.

Shippen's early contributions to telomere biology include discovery of a *Euplotes crassus* telomerase RNA template and determination of the mechanism and regulation of *E. crassus* de novo telomere formation. Most importantly, she established *Arabidopsis thaliana* as a model system for the study of telomere function. This work paved the way for significant findings, including identification of *A. thaliana* CST complex homologues and, in collaboration with Carolyn Price, identification of human CTC1, which has been linked to devastating stem cell disorders. More recent work focuses on the impact of environmental stress on plant telomeres.



SHIPPEN

In 2019, Shippen received the American Society for Biochemistry and Molecular Biology's 2019 William C. Rose Award for her contributions to both molecular biology and the training of younger scientists. She also has been honored with the Texas A&M Association of Former Students' Distinguished Achievement Award for Graduate Mentoring. Among other projects, she currently is working to maximize student diversity in biomedical sciences.

Shippen earned her Ph.D. in biol-

ogy at the University of Alabama at Birmingham and completed postdoctoral fellowships at the University of California, Berkeley, and the University of California, San Francisco.

## Del Mármol receives regional award

As she was ending her postdoctoral fellowship at the Rockefeller University, Josefina del Mármol was named winner in the life sciences category of the 2022 Blavatnik Regional Award, an honor for postdoctoral scientists at academic research institutions in New York, New Jersey and Connecticut.

Del Mármol, now an assistant professor of biological chemistry and



DEL MÁRMOL

molecular pharmacology at Harvard University, is a member of the American Society for Biochemistry and Molecular Biology's inaugural cohort of the Max-

imizing Opportunities for Scientific and Academic Independent Careers, or MOSAIC, scholar program.

Researchers in del Mármol's lab seek to understand the link between olfactory structure/function and animal behavior, and their studies demonstrate how olfaction differs from other senses at the molecular level. Instead of pairing with only a few select molecules in a lock-and-key fashion, most olfactory receptors bind to many different molecules. This promiscuity in pairing with a variety of odors allows each receptor to respond to many chemical components. The brain deciphers the odor by considering the activation pattern of combinations of receptors.

Del Mármol earned an undergraduate degree in biology from the



University of Buenos Aires and a Ph.D. in molecular neurobiology and biophysics at Rockefeller, during which time she was one of the Howard Hughes Medical Institute's inaugural international student research fellows.

The 2022 Blavatnik Regional Award winners and finalists were honored at the New York Academy of Sciences annual gala in November.

## Silva, Damo win diversity leadership awards

American Society for Biochemistry and Molecular Biology members Steven Damo and Gustavo Silva are among the 25 researchers selected to receive the first Science Diversity Leadership Awards, a new funding opportunity launched by the Chan Zuckerberg Initiative and the National Academies of Sciences, Engineering and Medicine.

Damo is the chair and an assistant professor of life and physical sciences at Fisk University. He is



DAMO

being recognized for his project titled "Structure-Function Studies of Metal Efflux in Group B Strep," which will elucidate the biochemical properties of

a bacterial zinc efflux protein with a prominent role in adverse pregnancy outcomes. The Damo lab studies how metals modulate protein functions. Damo helps write and grade the ASBMB accreditation exam, and Fisk was the first historically Black institution to earn ASBMB accreditation.

Silva is an assistant professor of biology at Duke University. He is being honored for his project titled "Deciphering the Functional Ubiquitinome in Health and Disease," which

will study how ubiquitin signals determine neuronal physiology and proteostasis. The Silva lab is interested in how cells respond to stressors that are common in inflammation and diseases. Silva is also a member of the ASBMB Maxi-



SILVA

mizing Access Committee.

Both investigators prioritize diversity, equity and inclusion as well as training the next generation of scientists at their institutions. They have an outstanding track record of research, mentoring, teaching and outreach.

The Chan Zuckerberg Initiative and the NASEM are recognizing the Science Diversity Leadership Award recipients for their scientific and mentoring achievements. Each award winner will receive \$1.15 million over five years to support their research programs and outreach, mentoring and teaching activities.

## Sonenberg named to hall of fame

Nahum Sonenberg has been inducted into the Canadian Medical Hall of Fame for his discovery of the eIF4E protein and his work to establish the field of translational control in medicine.

Sonenberg is a professor of biochemistry at McGill University. The Sonenberg lab studies the molecular basis of protein synthesis control and its importance in disease. In a recent discovery, the lab showed that inhibiting eIF4E phosphorylation reduces tumor growth and metastasis. Sonenberg is collaborating with the pharmaceutical industry to translate this discovery for use in treating patients. In addition, the lab examines mechanisms of neuronal translational

control in learning and memory and in neurodevelopmental and neurodegenerative disorders.

Sonenberg earned his Ph.D. in biochemistry from the Weizmann Institute of Science in 1976 and then completed postdoctoral training at the Roche Institute of Molecular Biology in Nutley, New Jersey. He has received the Robert L. Noble Prize of the National Cancer Institute of Canada, the Killam Prize for Health Sciences, the Gairdner Foundation International Award, the Rosenstiel Award and



SONENBERG

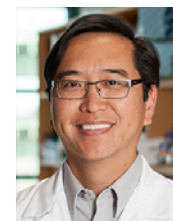
the Wolf Prize in medicine. In 2006, he was elected a fellow of the Royal Society, and he was given the title of officer of the Order of Canada in 2010. He is an

international member of both the National Academy of Medicine and the National Academy of Sciences, a fellow of the American Association for the Advancement of Science and a member of the American Academy of Arts and Sciences. He has mentored more than 160 graduate students and postdoctoral researchers.

The six 2023 Canadian Medical Hall of Fame inductees will be honored in June during a ceremony at Dalhousie University in Nova Scotia.

## Zou named chair at Duke

Lee Zou has been selected to serve as chair of the department of pharmacology and cancer biology at Duke



ZOU

University effective March 1. Prior to this appointment, he operated a research lab at Harvard University and was a professor of pathology

# MEMBER UPDATE

at Harvard Medical School and the scientific co-director of the Massachusetts General Hospital Cancer Center.

The Zou lab studies the detection of and cellular response to DNA damage. Zou's work has important implications in oncogenesis, cancer development and cancer therapy. The lab recently published a research article on molecules that promote the lengthening of telomeres in cells.

Zou earned his Ph.D. from Stony Brook University and the Cold Spring Harbor Laboratory in 1999 and then completed his postdoctoral training at Baylor College of Medicine and Harvard Medical School. He has received numerous awards including the National Cancer Institute's Outstanding Investigator Award, the Kraft Prize for Translational Research and a Breakthrough Award from the Department of Defense.

Zou also serves on the editorial board of the *Journal of Biological Chemistry*.

## Dean tapped to helm UGA's Griffin campus

The University of Georgia has named Jeffrey Dean assistant provost and director of its Griffin campus effective Jan. 1. In this new role, he oversees all research, extension and academic programs at UGA Griffin.



DEAN

Before this appointment, Dean was a professor and head of the department of biochemistry, molecular biology, entomology and plant pathology at Mississippi State University in the College of Agriculture and Life Sciences. Under his leadership, this department doubled enrollment for its bachelor's

degree program in biochemistry, launched an accelerated five-year master's degree program for top students and renovated its buildings. Earlier in his career, Dean held teaching, research and leadership roles at UGA.

Dean's research spans the fields of forestry, plant biology and biochemistry. In recent years, he has studied how wood forms and biodegrades, how to boost growth and efficient use of biomass. While at UGA, he also explored how environmental stresses shape the way conifers grow and develop. His lab has won more than \$4 million in funding from federal agencies ranging from the U.S. Department of Agriculture to the Environmental Protection Agency.

Dean received bachelor's degrees in chemistry and biology from Stanford University and earned his doctorate in biochemistry from Purdue University. He is the author or co-author of more than 90 peer-reviewed journal articles and other publications.

## Munson named to health equity post

Mary Munson has been named assistant vice provost of health equity at the University of Massachusetts Chan Medical School. She will support the office of health equity and diversity by helping to recruit and foster a diverse pool of tenure-track faculty members and serving as a co-leader of the Investigator Career Advancement program.

Munson is a professor and vice chair for diversity in the biochemistry and molecular biology department at UMass Chan. The Munson lab studies the spatial and temporal mechanisms

of membrane trafficking using biochemical, structural and biophysical techniques with yeast and mammalian genetics. Two of their projects focus on exocytosis and severe congenital neutropenia associated with defects in endocytosis.

In 1989, Munson received her



MUNSON

B.S. in chemistry and biology at Washington University in St. Louis. She went on to earn her Ph.D. in molecular biophysics and biochemistry from

Yale University and completed her postdoctoral training at Princeton University.

In addition to her passion for research, Munson is devoted to promoting diversity, equity and inclusion in academia as well as training the next generation of scientists. In 2022, she received the Chancellor's Award for Advancing Institutional Excellence in Diversity and Inclusion.

Munson is also the faculty advisor for the UMass Chan student chapter of the Society for Advancement of Chicanos/Hispanics and Native Americans in Science, or SACNAS; a leader of her department's Diversity Action Committee; and a trained facilitator for the Entering Mentoring and Restorative Justice programs.

Munson served on the *Journal of Biological Chemistry* editorial board from 2017 to 2022. She is co-chair of the American Society for Cell Biology's Women in Cell Biology committee and a co-investigator of the ASCB's MOSAIC program for select K99/R00 scholars. She was elected in 2022 as a fellow of the ASCB.



## Maria C. Linder

Maria C. Linder, a dedicated scientist and mentor at California State University, Fullerton, died Sept. 25, 2022, at age 83 after a stroke. She had been a member of the American Society for Biochemistry and Molecular Biology since 1984.



Linder was born Sept. 26, 1938, and raised in New York City. She earned a bachelor's degree from Vassar College and a Ph.D. in biochemistry from Harvard University and then completed her postdoctoral training at Harvard and the Massachusetts Institute of Technology. In 1977, she joined the faculty at California State University, Fullerton, in the field of nutritional biochemistry.

During her research career, Linder published more than 125 articles and two books. She made major contributions to the field of copper and iron metabolism, transport and storage during homeostasis and disease.

Linder won more than \$12 million in competitive grants over the years and received numerous accolades. In 2007, she received the California State University system's Wang Family Excellence Award. She was also awarded the 1993 American Chemical Society Award for Research at an Undergraduate Institution and was recognized as a fellow of the American Association for the Advancement of Science.

In addition to her research career, Linder prioritized teaching, mentoring and outreach.

"I'm proud of my own research accomplishments, as well as the work of my students," Linder said in 2017 when she was recognized for 40 years of service to the university. "It's been rewarding to be a mentor and interact with the wonderful young people entering the sciences — and to help them achieve their goals."

Linder is survived by her husband Gordon, stepson Eric, sister Renate, niece Amanda and four grandchildren.

## Guy Allen Thompson

Guy Allen Thompson, a biochemist who worked with plants and a member of the American Society for Biochemistry and Molecular Biology since 1970, died Feb. 23, 2022. He was 90.



Thompson was born May 31, 1931, in a small Mississippi Delta farming town, where he developed a love of nature and an interest in local birds. After graduating as valedictorian of his small consolidated school, he attended Mississippi State College. He worked summers building roads and monitoring cotton cultivation before graduating with a degree in chemistry. Thompson served in the Air Force before earning a Ph.D. in biochemistry from the California Institute of Technology and then did postdoctoral work at the University of Manchester in the U.K. In 1960, he met and married Eileen Wood.

After six years on the faculty at the University of Washington, Thompson took a position in the botany department at the University of Texas, where he taught for 53 years until his retirement. He published more than 150 scientific papers and book chapters as well as two technical books. Thompson advanced to full professor in 1974 and served as botany department chair from 1996 to 2000. He was elected a fellow of the American Association for the Advancement of Science in 1989.

"Guy's biochemical work was generally done in his laboratories, but he always envied his more botanical colleagues who spent time outdoors on field trips or other research activities," a family obituary stated.

After becoming professor emeritus at the age of 70, Thompson volunteered for activities such as gardening at the Lady Bird Johnson Wildflower Center, making trails at a nature conservancy preserve and monitoring wildfire danger for the city of Austin. He enjoyed doing outdoor chores at home and worked for 12 years as a landscaper at the local library.

Guy and Eileen Thompson also traveled extensively after his retirement, and he renewed his childhood interest in birdwatching.

Thompson is survived by his wife; his three children, Sally Macklin, Gillian Verga and Jeremy Thompson and their spouses; and five grandchildren.

## Mary Ann Williams



Mary Ann Williams, a nutritionist who taught at the University of California, Berkeley, and a member of the American Society for Biochemistry and Molecular Biology for more than 30 years, died Sept. 20, 2022, at the Knolls of Oxford in Oxford, Ohio. She was 97.

Williams was born May 18, 1925, in Albany, New York, to Boyd and Anna (nee Wolfe) Williams. She received a bachelor's degree in nutrition from Iowa State University and then went on to pursue advanced degrees in an era when few women enrolled in postgraduate programs, earning a master's in biochemistry from Cornell University and a Ph.D. in nutrition from the University of California, Berkeley.

Williams served on the faculty at the University of California, Berkeley, for 36 years, starting in 1955. The John Simon Guggenheim Memorial Foundation awarded her a fellowship in 1963. She officially retired in 1991 but continued to teach part time into the late 1990s.

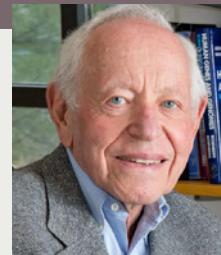
In a 1996 interview with *California Agriculture*, a newsletter, Williams reflected on the early days at her university's College of Agriculture, of which she was a part. The poultry department was paying her graduate stipend, so she had to learn some "practical poultrying," she said.

Later, she was close to early nutrient research made possible by radioisotopes and other postwar advances. "The major emphases were human protein and mineral requirements, especially zinc, iron and calcium," Williams told the newsletter. "The results of these studies provided information that has been basic to establishing the currently used recommended daily allowances made by the Food and Nutrition Board of the National Research Council."

Williams also voiced concerns about water and land management in her adopted state of California in the interview. "I visit Germany frequently so I know that Germany has the size of California and twice the population," she said. "Central Europe has been crowded for a long time, so they know how to keep cities more livable and people-friendly, policies that reduce the need to sprawl into farmland or other open land."

Williams, who had no known survivors, spent her last 22 years in Oxford, Ohio. Outside her academic interests, she was a fan of opera, other classical music and tennis.

## Leon E. Rosenberg



Leon Emanuel Rosenberg, a pioneering physician–scientist and vocal advocate for underrepresented groups, died July 22, 2022, at age 89. He was a member of the American Society for Biochemistry and Molecular Biology for more than 50 years.

Rosenberg was born March 3, 1933, in Madison, Wisconsin. His parents, Abraham and Celia Rosenberg, had fled persecution in present-day Belarus. He was inspired to go into medicine after his mother suffered an accident and severe injury to her hand, according to his memoir, "Genes, Medicines, Moods: A Memoir of Success and Struggle"; he was about 5 years old at the time.

Rosenberg earned his B.A. and M.D. at the University of Wisconsin and then interned at New York–Presbyterian Hospital. As a research fellow at the National Institutes of Health, he became fascinated with genetics and metabolic diseases.

A trailblazer in both basic and translational research as well as a catalyst for the field of personalized medicine, Rosenberg found the biochemical and genetic basis of several severe metabolic disorders that cause diseases such as ketoacidosis. He developed lifesaving therapeutic treatments by modifying these patients' diets or supplementing enzymatic deficiencies. His work also contributed to early prenatal diagnosis of genetic defects via biochemical analysis of metabolites in amniotic fluid.

At Yale University, Rosenberg founded the first department of human genetics in the United States as well as the clinical genetics division. As the Yale School of Medicine's dean, he launched a magnetic resonance center and an office of minority affairs.

He was named the chief science officer at Bristol Myers Squibb in 1991 and then moved to Princeton University in 1998. After 16 years at Princeton, he taught at the Princeton Day School until he retired in 2018.

Rosenberg was elected to the American Academy of Arts and Sciences, the National Academy of Medicine and the National Academy of Sciences, and he received the Kober Medal from the Association of American Physicians and the McKusick Award from the American Society of Human Genetics.

In 1981, Rosenberg testified before a U.S. Senate subcommittee, passionately opposing a bill aimed at overturning the *Roe v. Wade* Supreme Court decision of 1973.

He spoke out — and charged his peers to speak — about mental health and psychiatric illness. In an essay titled "Brainsick" in the magazine *Cerebrum*, he wrote, "It makes no sense to allow stigma, whose underlying premise is that people with mental illness are weak, to cow affected people into being unwilling to be diagnosed. It is time that I and other physicians say so."



# How the ASBMB opened doors

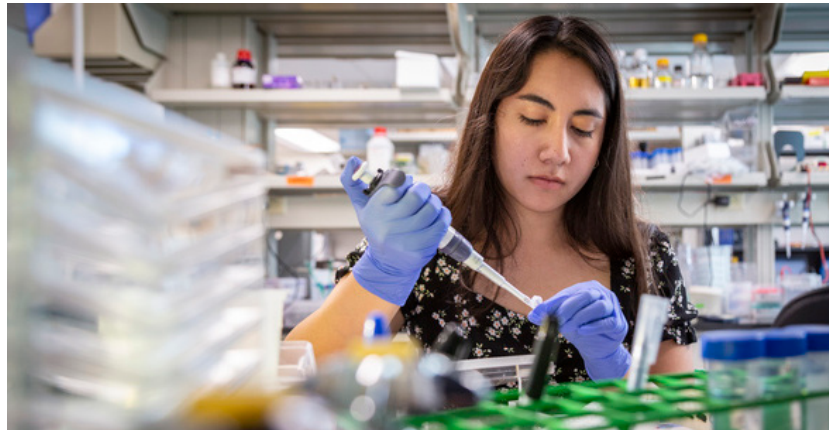
By Anna Hu

A fellow student first drew Clarissa Nuñez to the American Society for Biochemistry and Molecular Biology Student Chapter at New Mexico State University. After hearing a classmate promote the ASBMB, Nuñez started showing up to meetings and never looked back. Before her graduation last year, she served as a secretary, president and vice president of the chapter.

Coming to college from her hometown of Las Cruces, New Mexico, Nuñez knew she enjoyed science and was excited to learn about how life works at the molecular level. She went through a process of elimination to find her major, ultimately deciding on biochemistry with a minor in molecular biology.

Science didn't seem like a potential career until she joined the ASBMB Student Chapter, Nuñez said. It was there that she heard from other students working in research labs, helped host events such as career development talks and scientist panels, and found out about the National Institutes of Health Maximizing Access to Research Careers, or MARC, fellowship, which helps fund undergraduate degrees while encouraging hands-on research experience. She successfully applied to the MARC program, and it became another cornerstone of her college experience.

Through both the ASBMB chapter and MARC, Nuñez found a community of like-minded peers and new ways to explore science. Classmates became friends with whom she could study, talk about and do research, and eventually go through the graduate



ROBERT HOOD, FRED HUTCHINSON CANCER RESEARCH CENTER

Clarissa Nuñez joined the ASBMB Student Chapter in her first year at New Mexico State University.

school application process.

MARC also gave her great female and Hispanic mentors, including the two scientists who led the program.

"It unlocked a whole new layer of the university, the science community on campus that I would not have been exposed to if I didn't attend the meetings," she said of the chapter.

As part of the MARC fellowship, Nuñez worked on an independent project in Brad Shuster's lab for her last two undergrad years. Her work focused on the protein PRC1 and its role in cell division, and she said this experience taught her fundamental lab skills in addition to being, in her words, a really fun project.

Another formative research opportunity was an internship at the Fred Hutchinson Cancer Research Center, where she got to work in the lab full time. With all this training under her belt, Nuñez realized she had a passion for research.

"As I had these experiences, and as they wrapped up, I think I just realized the thing I wanted to do most was work in a research lab forever," she said, adding that she asked herself, "What's one way I can be challenged

to improve those skills and really become a rigorous scientist?"

For her, the answer was graduate school, and Nuñez now is at the University of Texas Southwestern pursuing a Ph.D. in cell and molecular biology. Looking back on her academic journey, she said her commitment to the ASBMB chapter was key. From the challenges of being president to the joys of scientific outreach, from her initial uncertainty about a graduate degree to taking that leap of faith, the community she found in the ASBMB was a guiding force.

"I think just having that experience in undergrad really opened so many doors for me," she said, "and honestly, I don't think I'd be where I'm at if I had not been a member, as cheesy as that sounds. It really did open a lot of connections, and mentorship, and different things that paved the way to where I am now."

Anna Hu (ahu4@wellesley.edu) earned her bachelor's degree in biochemistry from Wellesley College and is now a research assistant at the Harvard School of Public Health. She is a volunteer writer for ASBMB Today.



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VIRTUAL ISSUE

## Recent advances in biochemistry and molecular biology



This small collection showcases some of the exciting work published in 2022 that represents recent advances in biochemistry and molecular biology, such as cryo-EM in structural biology, cell biology and molecular biophysics.

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# A sweet tale of silkworm taste

By Aswathy N. Rai

**T**aste has evolved as the predominant driver of insect feeding behavior. Taste-sensing mechanisms not only help insects distinguish between food and toxins but also play a role in courtship, mating and egg laying.

Scientists have identified taste receptors in insects, called gustatory receptors, as proteins having seven transmembrane domains, like G-protein coupled receptor, or GPCR. These receptors recognize and bind many molecules, from sugars to bitter substances.

Kazushige Touhara and his team at the University of Tokyo have been studying the mechanisms by which insects sense taste and smell.

In their recent study published in the **Journal of Biological Chemistry**, research assistant Satoshi Morinaga and colleagues built upon the lab's past research and proposed a model for recognizing the fruit sugar D-fructose by the BmGr9 taste receptor.

Endopterygotes, insects such as moths and butterflies, develop wings inside their bodies and undergo metamorphosis through egg, larval, pupal and adult stages. The Touhara lab previously found that the silkworm's BmGr9 taste receptor is a D-fructose-gated ion channel receptor not categorized as a GPCR but conserved within endopterygotes as a distinct family of receptors.

"We reported that an insect gustatory receptor looks like a ligand-gated channel distinct from a mammalian GPCR, which makes us very interested in this receptor fam-

ily," Morinaga said. "The gustatory receptor appears to be a ligand-gated ion channel with the seven transmembrane topology that is reversed from that of a GPCR."

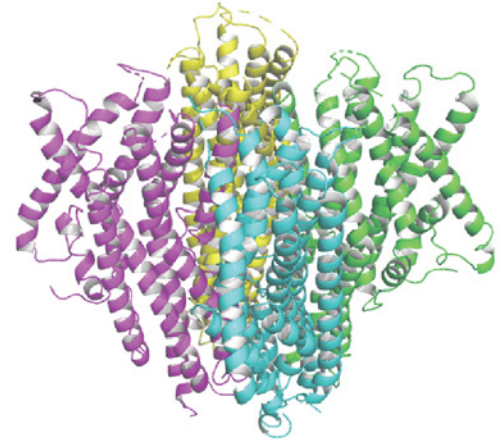
Using total internal reflection fluorescence microscopy, the authors observed that BmGr9 exists in cells as a group of four, or a homotetramer, similar to that of an insect odorant receptor coreceptor called Orco. The orientation of Orco and BmGr9's protein ends had similarities relative to the inner or outer sides of the cell membrane.

Based on these similarities, the team used a previously solved cryo-EM structure of Orco from *Apocrypta bakeri*, a species of fig wasps, to predict the structure of BmGr9 using homology modeling.

"We constructed a structural model for a gustatory receptor based on the structure of a known olfactory receptor," Morinaga said. "Along with biochemical and site-directed mutagenesis studies, we provide for the first time a structural model for an insect gustatory receptor and a mode for sugar binding."

Like BmGr9 and Orco, the olfactory receptor OR5 in an ancient insect, the jumping bristletail, or *Machilis hrabei*, also exists as a homotetramer and is an odorant-gated ion channel. The OR5 receptor binds the odorant eugenol.

To compare their ligand-binding modes, the BmGr9 and OR5 structures were superimposed. The study reports that the amino acid residues essential for D-fructose responses in BmGr9 correlate with the position



COURTESY OF TOUHARA ET AL.

The BmGr9 receptor exists as a group of four subunits, each represented by a different color.

of amino acids in the OR5 receptor that senses eugenol.

"We also provide insight into a conformational change that leads to a channel opening after sugar binding to the receptor," Morinaga said. "This receptor is activated by D-fructose very selectively, and the next step is determining how the high selectivity is established."

The proposed mechanism of D-fructose recognition and binding by BmGr9 will help the researchers determine the 3D structure of BmGr9, which will validate this study further.

"The knowledge of an insect gustatory sensing system will be useful to develop compounds that have an aversive effect on insects that eat and damage our farm crops," Morinaga said.

DOI: 10.1016/j.jbc.2022.102573

## Aswathy N. Rai

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# How mucus keeps us healthy

By *Leia Dwyer*

**W**e tend to associate mucus with colds and flu, but its role in the body is complex and varied. This colloidal network of salts, enzymes, antibodies, glycans and glycoproteins is found in the nose, mouth, lungs, stomach, intestines and reproductive tract. The slimy mucus layer of the stomach includes bottle brush-shaped glycoproteins called mucins that contain carbohydrate chains called glycans that help build a selective, viscous barrier between epithelial cells and the external environment.

Sara Lindén at the University of Gothenburg in Sweden studies interactions between microbes and mucosal surfaces in the stomach, intestine and airways. “Until relatively recently many researchers thought the role of the glycans on the mucins was merely to hold water and thereby create a lubricating barrier on our mucosal surfaces,” Lindén said. “Recently, a number of studies have shown that the mucin glycans have roles in binding to and governing interactions with microbes, including both the natural commensal microflora and disease-causing microbes.”

*Helicobacter pylori* is a common bacteria that can cause harmful infection. Spread through contaminated drinking water, poor sanitation and saliva sharing, it might be present in as much as 50% of the world’s population. Most people are unaffected, but some experience stomach pain and develop ulcers. Chronic infection can lead to certain stomach cancers, and many strains of *H. pylori* are now antibiotic resistant.

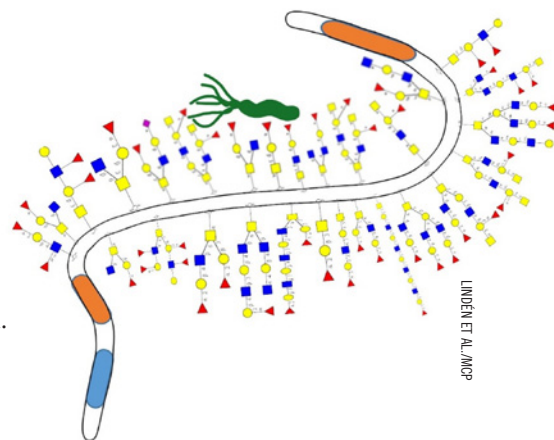
Lindén’s doctoral studies involved *H. pylori* interactions in the human stomach, and she has continued this line of research. A recent article in the journal **Molecular & Cellular Proteomics** reports on novel glycan structures her team found in mucin from stomach samples of individuals with and without *H. pylori* infection.

The lab’s previous studies showed people benefit from mucins that bind efficiently to *Helicobacter*, as this limits the bacteria that come into contact with human cells and cause disease. Proteins on the *H. pylori* surface called adhesins bind to surface structures on the cell, Lindén explained. “Mucins can also bind to these adhesins and act as releasable decoys that *Helicobacter* can bind to instead of the human cell.”

Lindén and her team were surprised at the diversity they found in over 600 carbohydrate structures identified from just 28 patient samples. Patients infected with *H. pylori* showed larger interpatient variability in this diversity than noninfected patients. In this context, Lindén said, “The high diversity of glycans suggests that interactions with microbes in the stomach can vary enormously between different individuals.”

Previous experiments in animals have shown that *H. pylori* infection and mucin production are cyclically related: Infection leads to decreased mucin production as well as changes in the mucin glycosylation, allowing more *H. pylori* to bind cells and infect. In this study, Lindén’s team found specific structures that correlated particularly well to *H. pylori* binding.

All this could inform the design of



This cartoon shows green *Helicobacter pylori* associating with diverse glycans (red, yellow and blue) in mucus of the stomach.

glycan-based therapeutics as an alternative to the standard use of multiple antibiotics. Gurdeep Chahal, lead author of this article, imagines that “targeting the *H. pylori* adhesins with the analogues of these glycans could reduce the bacterial colonization in the stomach while simultaneously treating chronic gastritis.”

Lindén sees the results going further: “The work presented here shows how structures in the human body differ between individuals and how this affects interactions with a pathogen ... part of a larger concept of understanding how our body surfaces defend themselves against disease causing microorganisms and how we can enhance these defense systems to treat and prevent infections without antibiotics.”

DOI: 10.1016/j.mcpro.2022.100421

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



# Can microbes prevent postsurgical gallstones?

By Brianna Alexander

**A**nearly 70-year-old procedure, bariatric surgery, or BS, continues to gain momentum as a popular approach to combat morbid obesity. The procedure results in dramatic weight loss over a short period of time. However, studies have reported that about 40% of BS patients develop gallstones after surgery, and these rocklike deposits of bile fluid can cause severe pain when they block a bile duct.

So why do some patients develop gallstones, while others do not?

Maimoena S.S. Guman, a researcher at Amsterdam University Medical Centers who already had found that gallstones form differently in BS patients than in the general population, reported recently in the **Journal of Lipid Research** on efforts to answer this question.

“The unique part of this research is that this is the first attempt to investigate protective mechanisms instead of causality for gallstone development,” Guman stated in an email.

To identify baseline differences between BS patients who did and did not develop gallstones, Guman’s team studied 88 patients, analyzing three metrics prior to surgery: the fasting metabolome, the liver and adipose transcriptome, and the gut microbiome. They monitored gallstone development after surgery and analyzed differences in each population for possible protecting factors. In line with previous reports, they



JENNIFER OOSTHUIZEN/CENTERS FOR DISEASE CONTROL AND PREVENTION

**Researchers found that Enterobacteriaceae, such as the one shown here, and Lactobacillaceae were abundant in bariatric surgery patients who did not develop gallstones.**

found that 32 of the 88 patients, or 36.4%, developed gallstones or sludge (which precedes gallstones) or reported gallstone symptoms within two years of the procedure.

The metabolic analysis showed higher concentrations of plasma metabolites, including a number of conjugated bile acids, in the patients with gallstones. In the same patient group, transcriptomic analysis showed the upregulated expression of 15 genes related to processes including cell division, cholesterol/fatty acid metabolism and tissue inflammation.

In analyzing the gut microbiome, Guman’s team found differentially expressed strains between the patient groups. Four of these strains were enriched in patients with gallstones, including *Ruminococcus gnavus*, a biomarker for gallstones. Patients

who did not develop gallstones, however, had an enrichment in 37 different strains of bacteria, 7 belonging to the Enterobacteriaceae family and 12 to the Lactobacillus family, including a strain used in the making of yogurt: *Lactobacillus casei*.

When asked if a simple probiotic source, like yogurt, could help protect against gallstone development, Guman wrote, “Based on our results it would be too early to conclude that a simple intervention as having yoghurt enriched with lactobacillaceae would help, although this finding has been described previously. An intervention study with one group having lactobacillaceae, either in yoghurt or maybe as supplement pills, would be needed to prove this relationship.”

This study was driven by the desire to gain knowledge that could help protect BS patients from gallstone development. Guman’s team has identified factors that may lead to that goal while opening doors for new avenues of research.

“Prevention is better than cure,” Guman wrote, “but first, we need more research, and I hope this work has inspired others to keep digging further.”

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## From the journals

By Ken Farabaugh, Connor O'Hara & Andrea S. Pereyra

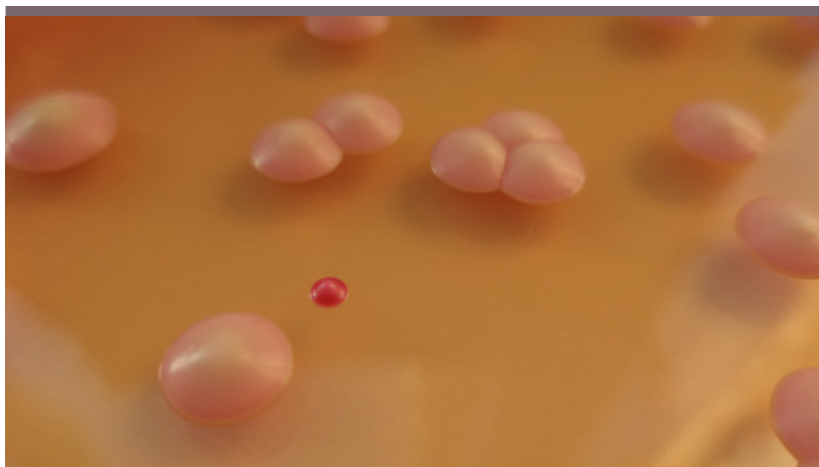
We offer summaries of papers recently published in the **Journal of Biological Chemistry**, **Journal of Lipid Research** and **Molecular & Cellular Proteomics**.

### Seeing beyond the semen to its proteome

Across the plant and animal kingdoms, fertilization is an essential aspect of life that is heavily conserved. Researchers know a lot about this process across species, but they still have much to learn about the content and function of the proteins involved.

Martin Garlovsky from the University of Dresden and colleagues from Arizona State University analyzed the sperm proteome of the common fruit fly and identified more than 3,000 proteins using a label-free method of quantitation. With updated technology and bioinformatics, they added greater value to existing data. Using advances in liquid chromatographic systems and data acquisition times, they advanced from simple characterization of the sperm proteome to quantitation, shedding further light on protein function. They described this work in a recent article in the journal **Molecular & Cellular Proteomics**.

While these proteins largely constituted structural elements such as alpha- and beta-tubulins, the researchers also found seminal fluid proteins and those involved in neuronal function. This could lead to comparison of similarities of the brain and testis, including the shared functional designs of sperm and neurons as high-transmitting



BOJAN ZIVAN/WIKIMEDIA COMMONS

Yeast petit mutant is compared with wild-type colonies on an agar plate infused with phloxine B.

### Life finds a way

Sulfur is one of the essential elements required for life. Plants and microbes often take up sulfur from inorganic sulfates in the environment using the sulfate assimilation pathway, or SAP, which reduces sulfates into sulfides and then synthesizes organosulfurs. In yeast, the SAP culminates in Met15-catalyzed biosynthesis of the amino acid homocysteine. Since its discovery, researchers have considered the gene encoding Met15 to be an essential marker for yeast growth in media lacking organosulfurs, and strains lacking Met15 have been used as the cornerstone of many genetic and genomic studies.

In their recent publication in the **Journal of Biological Chemistry**, S. Branden Van Oss, Saurin Bipin Parikh, Nelson Castillo Coehlo and colleagues at the University of Pittsburgh School of Medicine used structural and evolutionary modeling and genetic complementation experiments to show that the previously uncharacterized gene YLL058W encodes an alternative homocysteine synthase. They found that cells lacking Met15 still can assimilate inorganic sulfur and grow as long as excess sulfides are eliminated from the environment, indicating that Met15 is not essential for sulfur assimilation. In addition, the authors posit that the location of YLL058W near the unstable telomere region of the chromosome in all species that contain a homolog could indicate strong positive selective forces.

These results have implications for research on microbial and eukaryotic sulfur metabolism, including such aspects as the nutrient starvation stress response. This discovery also highlights how unknown variables can confound long-held assumptions.

DOI: [10.1016/j.jbc.2022.102697](https://doi.org/10.1016/j.jbc.2022.102697)

— Ken Farabaugh



## A promising oral compound to treat high cholesterol

Balance of plasma cholesterol levels is achieved by the liver, the main site of production and recycling, working with peripheral tissues, the main sites of uptake for utilization. Cholesterol flux is mediated by low-density lipoprotein, or LDL, and high-density lipoprotein, or HDL, and by their respective surface receptors.

Disturbances in plasma lipid homeostasis, such as elevation in LDL cholesterol, are linked to a higher risk of cardiovascular disease.

Alexandra K. Suchowerska of Nyrada Inc. in Australia and a group of international collaborators studied the effects of NYX-PCSK9i, a small-molecule inhibitor of the enzyme PCSK9, on plasma cholesterol levels. In the liver, PCSK9 binds to the LDL receptor in the surface of the hepatocyte, stimulating its internalization and degradation, thus impeding LDL cholesterol clearance and favoring accumulation in plasma. Their findings recently were published in the **Journal of Lipid Research**.

The researchers showed that NYX-PCSK9i disrupts PCSK9–LDLR interaction, thus preventing LDL receptor degradation and maintaining LDL cholesterol uptake. Compound NYX-PCSK9i reduced plasma total cholesterol up to 57% and increased fecal cholesterol excretion when fed to mice that were altered genetically to have elevated choles-

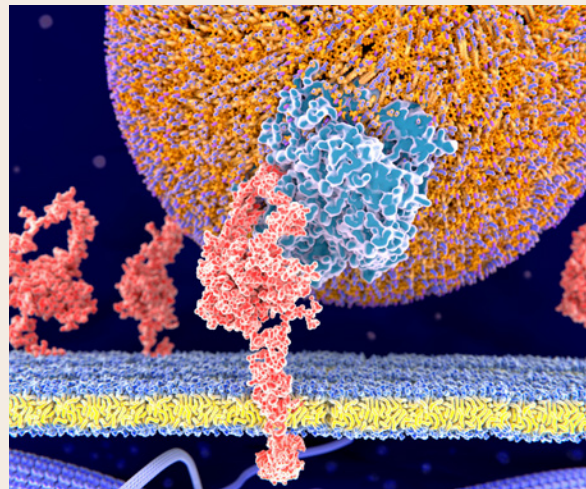
terol. Levels of HDL cholesterol were not changed.

Established cholesterol drugs such as statins often increase PCSK9 serum levels in humans. The study found that NYX-PCSK9i enhanced the effect of the anti-cholesterol drug atorvastatin, further reducing cholesterol up to a total of 65% and setting a precedent for future clinical trials.

More research is needed to confirm the mechanism by which NYX-PCSK9i inhibits the PCSK9 enzyme and preserves LDL cholesterol clearance by the liver.

DOI: 10.1016/j.jlr.2022.100293

—Andrea S. Pereyra



information carriers. Also, the prevalence of ribosomal proteins show that sperm may not be as transcriptionally silent as previously thought.

Overall, this research extends knowledge of sperm and seminal fluid protein biology and provides further evidence of the complexity of a seemingly simple system.

DOI:10.1016/j.mcpro.2022.100281

## Synchronizing liver metabolism with lactation

After a person gives birth to a baby, their brain communicates with the metabolic organs by means

of prolactin to ensure nutrients get to the mammary gland for milk production. The baby's suckling creates a positive feedback mechanism that keeps prolactin levels high and influences parental metabolism to support milk production.

In human milk, lipids contribute up to 50% of the energy content, in part via triacylglycerols synthesized in the liver. However, researchers do not yet fully understand the mechanism that protects a lactating person from excessive liver fat accumulation, known as hepatic steatosis.

In a recent article in the **Journal of Lipid Research**, Maria A. Ramos–Román and colleagues from the

University of Texas Southwestern Medical Center and other institutions across the U.S. studied the relationship between liver metabolism and lactation six weeks after birth.

Compared with formula-feeding parents, they found that lactating parents had lower fasting plasma insulin with greater adipose tissue insulin sensitivity, higher endogenous glucose production and higher high-density lipoprotein cholesterol.

Parents with elevated prolactin during lactation had lower intrahepatic triacylglycerol levels, and fatty acids were readily shuffled from the liver into the circulation as very low density lipoprotein triglyceride

## A new biomarker for Type 1 diabetes?

Our immune systems play a fascinating and important role in keeping us safe from pathogens that otherwise would wreak havoc on our bodies. For people who have an autoimmune condition such as Type 1 diabetes mellitus, or T1D, a few trigger-happy killer T cells will confuse an otherwise well-running immune system. Since over 60,000 young people develop T1D each year in the U.S. alone, researchers want to better understand the disease's pathogenesis and find useful clinical biomarkers for its onset.

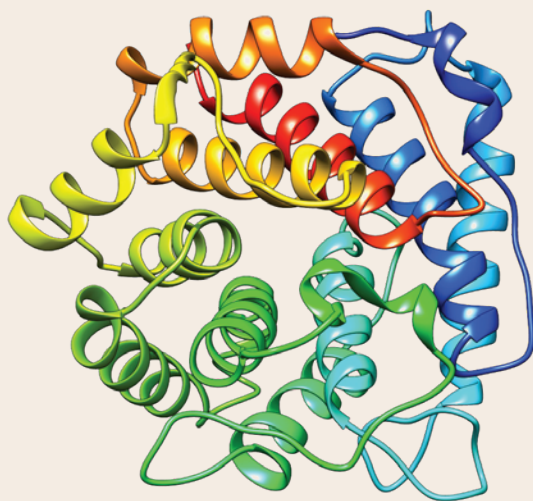
In a study published in the journal **Molecular & Cellular Proteomics**, Dinko Šoić from the University of Zagreb, Croatia, and an international team of researchers recently identified a unique sugar biomarker and found that its expression is elevated in children newly diagnosed with T1D compared to their unaffected siblings. The researchers learned that oligomannose glycans elevated in early-onset T1D might be coming from glycoprotein C3, a coordinator of downstream immune response.

The team analyzed plasma C3 levels from 61 newly diagnosed children and 84 of their unaffected siblings using liquid chromatography–mass spectrometry in a cost-effective and high-throughput approach. With a mere 10 microliter sample from each child, the researchers used an affinity capture technique to enrich C3 levels for lysis into a peptide and glycoprotein mixture. After enriching and purifying the glycopeptides, they used the highly sensitive analysis for site-specific profiling of C3 N-glycans.

The researchers reported that these observed changes to the glycosylation profile of plasma may be associated with the onset of T1D and that C3 glycopeptide levels potentially could be used to assess T1D risk. The team has not yet determined whether the changes they observed to N-glycosylation are causing the onset of T1D or are secondary to the pathology; however, C3 N-glycosylation shows promise as a biomarker to help clinicians diagnose and even prevent T1D.

DOI:10.1016/j.mcpro.2022.100407

— Connor O'Hara



PROTEIN DATA BANK/CCSB

This is the X-ray crystal structure of C3D, a C3 fragment and ligand for complement receptor 2. Researchers recently found that C3 is elevated in early-onset Type 1 diabetes.

particles, thus preventing accumulation, the researchers found. Furthermore, lactating parents had increased uptake of these particles by peripheral tissues, resulting in beneficially lower plasma levels.

DOI: 10.1016/j.jlr.2022.100288

## Specific anti-cancer antibodies

The binding of programmed death-ligand 1, or PD-L1, to its receptor, programmed cell death protein 1, or PD-1, suppresses T cells and the immune system. Cancer cells frequently exploit this activity by overexpressing PD-L1 to evade immune activation; however, neutralizing monoclonal antibody therapy that targets PD-L1 has been effective in treating these cancers. Researchers recently have found that single-domain antibodies, such as nanobodies derived from camelids, may offer additional specificity and treatment options.

In a recent study in the **Journal of Biological Chemistry**, Tara Kang–Pettinger and colleagues at the University of Leicester used X-ray diffraction, NMR, AlphaFold and biolayer interferometry to solve a number of crystal structures of PD-L1 bound to nanobodies and characterize their binding interface. They found that the PD-1 binding surface on PD-L1 overlapped with another binding surface that recognizes CD80, a second receptor expressed on antigen-presenting cells that promotes a T cell anti-tumor response.

By comparing the binding sites of PD-1 and CD80, these researchers identified a binding

region on PD-L1 specific for PD-1 and not for CD80 that could be bound by nanobodies. This binding permitted multiple simultaneous avenues to counteract PD-L1 overexpression and represents a step forward in the fight against cancer.  
*DOI: 10.1016/j.jbc.2022.102769*

## A map of mouse proteins

Biomedical researchers frequently use mice in their work because mice have many anatomical, physiological and genetic similarities to humans. Because they are such a valuable model organism, researchers want to find methods to screen and better understand the mouse proteome.

Tian Lu from Fudan University in Shanghai and a team at Westlake University in Hangzhou attempted to provide a more comprehensive map of protein data across different mouse tissues to help researchers better understand protein expression and function in mice. In their recently published paper in the journal **Molecular & Cellular Proteomics**, they report a comprehensive spectral library of more than 12,000 mouse proteins and a detailed proteomic analysis of 41 mouse tissues.

This analysis better characterizes some rarely studied tissues, including those of the cornea and

retina. The team found distinct protein expression in the nervous and immune systems that may lead to greater understanding of transplant rejection in immunocompromised patients in the clinic. They also found greater expression of antioxidant enzymes on the left side of nine paired organs, including the kidneys, testes and adrenal glands. This unprecedented exploration of the mouse proteome may enhance our understanding not only of mice as model organisms but of human disease as well.

*DOI: 10.1016/j.mcpro.2022.100408*

## Exercise-induced signaling crosstalk

Physical inactivity and sedentary lifestyle are leading risk factors for obesity, Type 2 diabetes and heart diseases. Scientists know that the cytokine oncostatin M, or OSM, alleviates insulin resistance in obesity through the phenotypic change of pro-inflammatory to anti-inflammatory macrophages when OSM is produced by adipocytes; however, researchers do not yet fully know what role OSM production plays in skeletal muscle after aerobic exercise.

Tadasuke Komori and

colleagues at Wakayama Medical University in Japan reported in a recent article in the **Journal of Biological Chemistry** that OSM produced in the skeletal muscle after a single bout of aerobic exercise played a significant role in crosstalk between muscle and immune cells. Using OSM-deficient mice and direct intramuscular injection of OSM, they showed that OSM in the skeletal muscle was linked to the recruiting and accumulation of macrophages and neutrophils after exercise. Furthermore, they found that OSM induced the expression of a number of anti-inflammatory cytokines and markers.

These findings indicate that OSM is a novel myokine produced in muscle fibers and plays an important role in biological events such as the phenotypic determination of macrophages after aerobic exercise. This work could inform strategies for improving insulin sensitivity in muscle tissue.

*DOI: 10.1016/j.jbc.2022.102686*

## A new way to collect intestinal lymph

Intestinal trafficking of nutrients, drugs and cells follows one of two routes depending on the physicochemical characteristics of



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the cargo in question. Once inside an absorbent cell in the colon, cargo can reach the general circulation directly via the portal vein or indirectly via mesenteric lymphatic vessels. The latter route is important for the absorption of dietary lipids, in particular long-chain free fatty acids and triacylglycerols, packed into lipoproteins such as chylomicrons.

In a recent article in the **Journal of Lipid Research**, Nikolaos Dedousis and colleagues at the University of Pittsburgh describe a new technique to collect mesenteric lymph from mice and to isolate intestinal chylomicrons and immune cells.

The authors modified an existing

two-day technique to a single-day surgery with higher survival and greater lymph retrieval in mice. A cannula was placed in the duodenum to infuse lipids, and another cannula was placed in the mesenteric lymph duct to collect lymph every hour for six hours after feeding.

The team analyzed the mesenteric lymph isolated by this technique and found that secretion of triacylglycerols peaked three hours after the lipid infusion and that levels were three times higher than the two-day technique. They also found immune cells positive for CD45 and CD4 markers and regulatory T cells in the retrieved mesenteric lymph.

DOI: 10.1016/j.jlr.2022.100284

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## Upcoming ASBMB events and deadlines

### APRIL

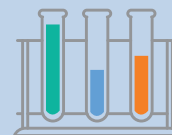
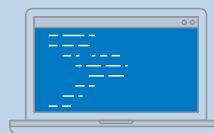
- 15 IMAGE workshop application deadline
- 21 Advocacy Training Program application deadline

### MAY

- 10 Motifs, modules, networks conference early registration deadline
- 10 Motifs, modules, networks conference abstract submission deadline
- 31 Annual award nominations deadline

### JUNE

- 1 Marion B. Sewer Scholarship deadline
- 12 Motifs, modules, networks conference regular registration deadline
- 20 CoA and CoA-derivatives conference early registration deadline
- 20 CoA and CoA-derivatives conference abstract submission deadline





## Apply for the Marion B. Sewer Distinguished Scholarship for Undergraduates

Marion Sewer, an accomplished pharmacology professor, was deeply committed to service within the scientific community.

The Marion B. Sewer Distinguished Scholarship for Undergraduates offers financial support to students who demonstrate an interest in the fields of biochemistry and molecular biology and enhance the diversity of science. Students whose social, educational or economic background adds to the diversity of the biomedical workforce or who show commitment to enhancing academic success of underrepresented students are eligible.

**Scholarship amount: \$2,000 toward tuition for one academic year.**

### Requirements

To be considered for a scholarship, you must:

- Be a U.S. citizen, U.S. national or permanent resident at the time of application. Students with DACA status also are eligible. Foreign nationals who are in the U.S. on visas are not eligible.
- Be enrolled or accepted for enrollment as a full-time student at an accredited two- or four-year institution located in the U.S. or U.S. territories.
- Be an ASBMB member at the time of application. Undergraduates can join the ASBMB either directly or by joining an ASBMB Student Chapter at a participating institution.

**Application deadline:** June 1

Learn more and apply at [asbmb.org/undergraduate-scholarship](https://asbmb.org/undergraduate-scholarship)



# Taking a first bite of biochemistry

The SMART Team program can propel teens toward science careers

*By Paula Amann*

Kimy Hernandez, 17, a senior at Longmont High School in Colorado and member of the SMART Team program, shows off a 3D model of p53, a mammalian protein that suppresses tumors.



KELLY TORIKENWA

Amid the thousands of grad students, postdocs, early-career investigators and tenured professors streaming into the Seattle Convention Center for Discover BMB last month was 17-year-old Kimy Hernandez, a high school student.

Hernandez is a senior at Longmont High School in Colorado and — like most of the more than 100 teenagers who attended the American Society for Biochemistry and Molecular Biology 2023 meeting — a member of a Students Modeling a Research Topic, aka SMART, Team. Their mission: to present group research projects developed with their high school sci-

ence teachers and, in many cases, with working scientists.

Inspired by SMART Team’s meld of 3D modeling, analysis and research, Hernandez, who uses the pronoun they, is poised to become a first-generation college student. They plan to study molecular biology; their parents, both Mexican immigrants, were unable to study beyond high school.

“SMART Team really served as a catalyst for my love of science and for pursuing it as a career,” Hernandez said.

This year’s SMART participants hail from 21 schools in nine U.S.



states and one Canadian province. As recently as 2019, before the COVID-19 pandemic, SMART Team and a sister program, Modeling a Protein Story, known as MAPS, sponsored 63 teams across the continent.

“The only regret I have about SMART Team is not starting earlier,” Hernandez said. “SMART really provides you with a diverse group of people who teach you a lot about yourself.”

## Witnessing the world of science

Veteran attendees might experience ASBMB conferences as a collegial yearly break from their professional routine, but for high schoolers, the camaraderie can come as a revelation.

Tim Herman started the SMART Team program in 2001 and began bringing participants to the conference in 2004. “The most powerful

thing that happens is in the opening session,” he said of the annual meeting. “There will be SMART Teams in the audience, and they see people greeting each other. High school students can imagine themselves as future members of this community of science.”

When they make their SMART Team presentations, students experience the realities of research life, said Luke De, a long-time teacher with SMART Teams at private schools in New Jersey and California. This includes giving talks about their studies and fielding sharp questions.

“Kids have to get in front of M.D.s and Ph.D.s,” De said. “We harp on the idea that science is a conversation, but rarely do kids get to experience that conversation.”

At the ASBMB meeting, that passionate exchange comes alive.

“We’ve always been focused on introducing students to the real

“ Kids have to get in front of M.D.s and Ph.D.s. We harp on the idea that science is a conversation, but rarely do kids get to experience that conversation.”

LUKE DE

SMART Team program founder Tim Herman, second from right, talks protein molecules with students from Governor's Academy of Byfield, Massachusetts in April 2016.



COURTESY OF TIM HERMAN

## FEATURES

**“A strength of any profession lies in its ability to recruit the next generation of practitioners.”**

**TIM HERMAN**

world of science, including publishing and presentation,” Herman said of SMART Teams, adding that the conference “gives these high school students the chance to stand alongside undergraduates and present their work.”

A strength of any profession lies in its ability to recruit the next generation of practitioners, Herman pointed out. “We have former SMART Team students who are now running research labs and interested in working with local SMART Teams,” he said.

At Longmont High, Chris Chou, co-coordinator of the school’s Medical and BioScience Academy, has been offering the SMART Team program for 11 years. She tells a story that illustrates the conference’s impact.

During a SMART Team visit to the University of Colorado Boulder about six years ago, high schooler Maya Lippard Blau became smitten with X-ray crystallography for the study of proteins, Chou said. At the 2017 ASBMB annual meeting, Blau met Stephen White, a scientist doing this work at St. Jude Children’s Research Hospital in Memphis, Tennessee. The

two swapped contact information, and the teenager went on to a 2018 summer research internship with her new mentor.

“Instead of just reading about x-ray crystallography, she was doing it,” Chou said, “and that launched her interest in science.”

Blau followed her passion through college and into an M.D./Ph.D. program in infectious diseases at the Medical College of Wisconsin. “Because I was close to both the medical and the research side, I realized I couldn’t picture my future career without both,” she said.

### Building student skills in biochemistry

In the short term, SMART Team means “students having the opportunity to dive deeper into topics only touched on in courses,” Chou said. “They get to interact with professors, visit research laboratories.”

Longmont students have taken a field trip to a Pfizer laboratory in Boulder, Colorado, to witness cancer drug research and visited the Biomolecular X-ray Crystallography Facility at the University of Colorado Boulder.

Kelly Lubkeman, co-coordinator with Chou of the academy at Longmont, echoes her colleague’s enthusiasm. Her students normally would “get the skills and basics in their classes, but don’t get the exposure to what a research scientist really does on a daily basis,” she said. SMART Team helps fill that gap.

Longmont students in the program now are studying and modeling the tumor suppressor protein p53. Mutations at several points in this macromolecule have been linked to human cancers — and at least one is a potential drug target.

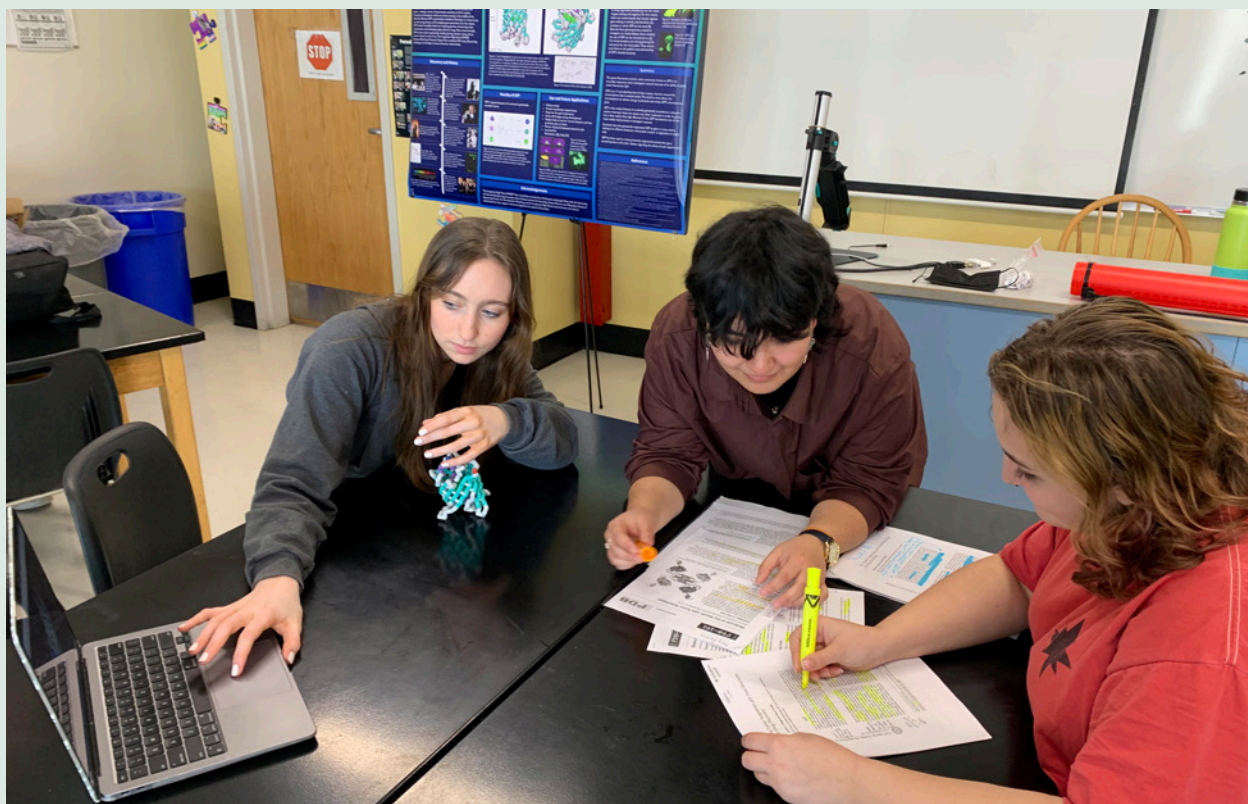
“They call it the holy grail,” Lubke-

**Mark Arnholt, a high school teacher turned SMART Team coordinator, center, looks on as students at Cedarburg High School use 3D Molecular Design’s Flow of Genetic Information Kit.**



SEAN RYAN





man said. “If we could successfully target a drug for that mutation ... it will open the door for a lot of other cancer drug treatments.”

Across the country at Mahtomedi High School in Minnesota, biology teacher Jim Lane has witnessed social and cognitive growth in his SMART Team students.

“I see kids coming out of their shell, but also developing discourse skills and collaboration,” Lane said, adding that his students begin to forge the intellectual skills needed for research. “They are constantly rethinking, iterating and reflecting on their learning. The collaborative atmosphere is what really pulls the team together.”

SMART Team veteran Luke De believes the program can lead students to the heart of science as they gain confidence in their own curiosity.

“Kids think the crazy ideas they have are frivolous,” De said, “but

what they learn is that those crazy ideas are the things that make scientific research.”

## Expanding the research rainbow

Abi Ferguson, 17, another Longmont senior, has been exploring the fine points of beta adrenergic receptors, which affect the function of smooth muscle and digestion. She has noticed the many medications, such as beta blockers, that interact with the protein she is studying.

While exploring her macromolecules, Ferguson got hooked on biology. She learned to find and decode crucial insights in research studies, gleaning more details about her proteins.

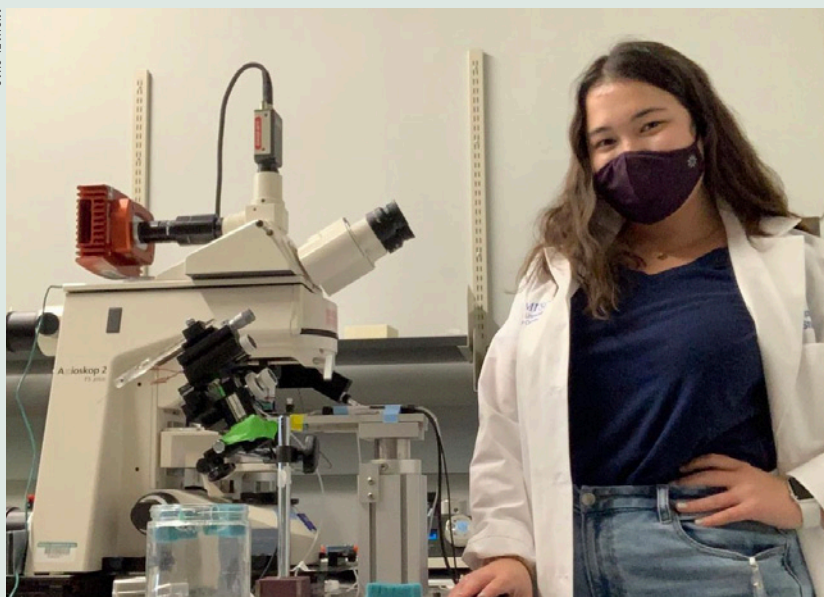
“SMART Teams really pivoted me to science,” Ferguson said. “This is what I want to do.”

Greta Wedel, also 17 and a senior at Longmont, said she’s learned to

**From left, Greta Wedel, Kimy Hernandez and Abi Ferguson, seniors at Longmont High School in Colorado, discuss their SMART Team project in late January, as they gear up to present at Discover BMB in Seattle.**



MICHAEL OKAS



**Abbey Kastner, a doctoral student in neuroscience at the Medical University of South Carolina, credits the SMART Team program with getting her started on her journey toward a biological research career.**

**SMART Teams are largely female, including young women of color — a striking contrast to the historic underrepresentation of women and marginalized groups in the biological sciences.**

read scientific journal articles and help her teammates write research abstracts. With these science-based skills, Wedel envisions a different career path but one that also demands high-level analysis and writing: the law.

“No matter who you are, how you learn or what you’re interested in, there’s something valuable to find in SMART Teams for everyone,” Wedel said.

Hernandez has found it challenging to forge constructive relationships among SMART Team members. Yet, in their classmates’ differences, they have learned, lie the group’s collective strength, as members take on specific tasks — from model making to reading peer-reviewed research studies.

“There’s a lot of people with lots of learning styles,” Hernandez said. “Everyone’s able to specialize.”

SMART Teams are largely female, including young women of color — a striking contrast to the historic underrepresentation of women and marginalized groups in the biological sciences.

“What we’re doing ... is exposing more students to science research, because science is stereotypically done

by white males,” Chou said. “We’re trying to recruit a more diverse group of students who are traditionally underrepresented in science to pursue future careers in science.”

The team aspect of the program plays to adolescent strengths and interests, as peer relationships gain importance in their social and academic development, noted SMART Team coordinator Mark Arnholt. “You end up with students from very different social backgrounds working together and creating long-lasting friendships,” he said.

## Tracing the program’s ripples

Blau looks back on SMART Team as a foundation for the science she studies now. “I ended up learning to read scientific papers,” she said. “It felt like I had a huge advantage in college and beyond.”

For Abbey Kastner, 25, a doctoral student in neuroscience at the Medical University of South Carolina, the path to a science career started with SMART Team. She traces her first steps on that path to a talk on the program during freshman orientation at Hartford Union High School in her Wisconsin hometown. That introduction, Kastner said, “made me realize there’s jobs out there that involve research, and I can do them.”

With the guidance of Arnholt, then a teacher at Hartford Union, Kastner’s SMART Team built a model of CYP17A1, a gene on chromosome 10 involved in drug metabolism and lipid synthesis.

“We worked with researchers at Marquette University,” Kastner said, “which is something most high schoolers don’t have the option to do.”

In 2016, Kastner’s senior year, her team project won a first-place award in a statewide spring competition at

the Milwaukee School of Engineering. But the crucial takeaway from SMART Team was bigger than one prize.

“The first thing was confidence,” Kastner said.

Her burgeoning ambitions led to a summer internship at the Medical College of Wisconsin.

Kastner went on to study biochemistry and neuroscience at the University of Wisconsin–Eau Claire. There she spent four years as a student researcher and two years as a lab manager.

“I’m grateful for all the mentorship I’ve had because that is not extended to all students and certainly not to all female scientists,” Kastner said.

Looking back, she said her first exposure to SMART Team was a catalyst for her science career: “It’s crazy that one conversation can change everything.”

Blau and Kastner are case studies in the way SMART Team can help steer young people toward a research career.

“SMART Teams, by offering high school students the chance to engage with basic scientific research, is inspiring the next generation of scientists,” said Blau.

In addition to becoming a scientist, Kastner wants a role in the public conversation about scientific research. “I feel like there is a gap between what the public knows and what scientists do in the lab,” Kastner said. “I want to be part of communicating between these audiences.”

**Paula Amann** (pamann@asbmb.org) is the ASBMB’s science writer.



## SMART Team program brings research to life

When 3D printing was a new invention, Tim Herman saw its potential as a tool for modeling macromolecules with crucial roles in living things — and for strengthening secondary science education.

“I envisioned this 3D printing technology as the key to introducing high school students to the invisible molecular world,” Herman said. “Models give meaning to words.”

Multiple research studies support the idea that 3D physical models help engage students and that students prefer them to other forms of learning.

While on the faculty of the Medical College of Wisconsin, Herman learned that the Milwaukee School of Engineering had a rapid prototyping center. He founded the Center for BioMolecular Modeling, or CBM, at the engineering school in 1998 and went on to launch 3D Molecular Designs, a family-owned company, the following year.

In the early 2000s at CBM, Herman led teachers in a new course, “Genes, Schemes and Molecular Machines.” They 3D-printed a ribosome, the cell structure that synthesizes polypeptides. The ribosome recently had been described for the first time by Thomas Steitz, a Yale University professor who would go on to win the 2009 Nobel Prize in chemistry with two colleagues.

“The teachers were the ones who told us they wanted their students to have the same experience,” Herman said.

And so Students Modeling a Research Topic, or SMART, Team was born in 2001 at the Milwaukee School of Engineering. In December 2021, the program moved as CBM merged into 3D Molecular Designs.

SMART Team garnered long-term support through the Science Education Partnership Award from the National Center for Research Resources at the National Institutes of Health. It also has received grants from the Howard Hughes Medical Institute. Each high school pays an annual \$250 participation fee that helps fund technical support in the form of an experienced science educator and 3D model printing.

For high school students, the program begins with a training phase that’s followed by a research phase. At the heart of the experience is the macromolecular model.

Mark Arnholt is a veteran science teacher and now coordinator for SMART Team. “The second they’re holding that physical model ... is one of those ‘aha’ moments,” Arnholt said. “They can finally understand why this protein is interacting the way it does.”

Students start with the known story of a protein, model making, drafting an abstract and reading both primary and secondary sources. Then they have the chance to devise their own research project.

“Science is all about asking questions, and once you’ve identified those questions, you can start to chase them down,” Arnholt said. “A lot of the questions don’t have answers, and those are the ones you want to pursue.”

Luke De was a director of independent research projects at the Pingry School in Basking Ridge, New Jersey, in the early years of the program. “SMART Teams did something genius: It paired kids with a researcher and forced them to tell a story,” De said. “All the stories were tangible; you were literally building a model.”

And, in addition to being a learning tool, protein modeling helps high schoolers shine a light on the roots of human illnesses, Arnholt said. “Slowly and steadily, students realize that every disease can be traced back to a protein that is misbehaving.”



# 'A challenge to learn'

High schooler is first to sequence the angelfish genome

*By Elizabeth Stivison*





**T**he first full sequence of the angelfish genome recently was published, and there are a few unusual things about this paper.

First, it has a single author. That's not unheard of in science, but it's not common.

Second, the author has two unusual affiliations: BioCurious and BASIS. Neither is obviously a university or company. It turns out that BioCurious is a community lab space in Santa Clara, California. And BASIS, short for BASIS Independent Silicon Valley, is a private middle and high school in San Jose.

So was this sequencing done independently by a high school student?

It was. Indeever Madireddy, a 17-year-old high school senior, is the paper's author.

Indeever's interest in biology began when he was in middle school. He credits his science- and tech-focused school with giving him early exposure to biology, chemistry and physics. By 10th grade, he knew he wanted to try bench research. "I'm really lucky to be in the Bay Area with a lot of opportunities," he said.

## The lab

One of those opportunities was BioCurious, a nearby community lab. "BioCurious is for DIY biologists or entrepreneurs," Indeever said. "If you want to start a company or just do independent experiments, you can pay a monthly fee and use the lab."

BioCurious is run 100% by volunteers, and its equipment is hand-me-downs donated by industry. Lab users must take a safety course and only are allowed to do BSL-1 research, the lowest biological safety risk level. Because Indeever is under 18, his parents — who are not scientists but are responsible adults — had to be with him. Other than that, the people in the lab all work independently.

"It's up to you to do research you want to do,"

Indeever said.

Johan Sosa is an information technology expert by day who also does research at BioCurious. He said he noticed several things about Indeever: He was full of ideas, not afraid to fail, willing to put the work in and had a scientific way of planning.

"Indeever wanted to do (his experiments) in such a way that if certain assumptions didn't work out he'd still have something workable," Sosa said. "There's also this thing from the startup culture that he has: 'fail fast!' And when he fails, he has the perseverance to learn from the failure, figure out why the experiment didn't work, figure out if there's something fundamentally wrong or if he can find a way around it."

Sosa saw Indeever work on several projects in the lab over the last few years while many other hobby scientists and students came and went.

"One difference that I see with Indeever is that he sticks around," he said.

"A lot of things in bio don't work usually, a protocol you find in a paper doesn't

**Johan Sosa said he noticed several things about Indeever: He was full of ideas, not afraid to fail, willing to put the work in and had a scientific way of planning.**



COURTESY OF INDEEVER MADIREDDY

**While still in high school, Indeever Madireddy got his first bench experience at BioCurious, a community lab run by volunteers.**

DAVIDSON INSTITUTE



**Indeever Madireddy keeps and cares for more than 100 fish in indoor and outdoor tanks at his home in California.**

actually work, it gets frustrating. I noticed he was persistent; he was not afraid to ask anyone around to find out what could have gone wrong.”

Indeever was “willing to reach out to get resources to help,” Sosa said. “Just super passionate about it.”

## The fish

Indeever isn’t just in the lab thinking of experiments all day. He also keeps fish. He has more than a hundred fish at home, fresh and saltwater, in indoor and outdoor tanks, and cares for them all. In fact, the angelfish that ended up donating its DNA for sequencing was one he raised by hand.

About two years ago, Indeever had a pair of freshwater angelfish, or *Pterophyllum scalare*, that laid eggs regularly, but as often happens in fish tanks (and in the wild), other fish ate the eggs. Indeever wanted to save a batch of eggs and hatch them, so he used a pipette to rescue them and move them to a predator-free tank. When the eggs hatched, he raised the fish himself, feeding them brine shrimp by hand until they were big enough to eat regular fish food.

While Indeever was working on another of his many projects, he noticed that other people in the BioCurious lab were doing sequencing projects. He was intrigued and looked into what genomic sequences were publicly available. “Literally by chance, I realized the angelfish genome wasn’t available,” he said. “And then coincidentally, one of my pet angelfish passed away about two weeks later.”

Since he now had a source of angelfish DNA, there seemed to be only one thing to do: Indeever set about figuring out how to sequence a genome.

“I really had no idea how to do any of this,” he said. “I’d never done genomics or DNA sequencing myself. It was a challenge to learn.”

## The genome

He started reading papers, watching YouTube videos and talking to the people in the lab who were doing sequencing. They pointed him in the right direction. “I found a paper from someone who sequenced an ant genome with nanopore technology for under \$1,000,” he said.

Sosa was again impressed by Indeever’s perseverance through difficulties.

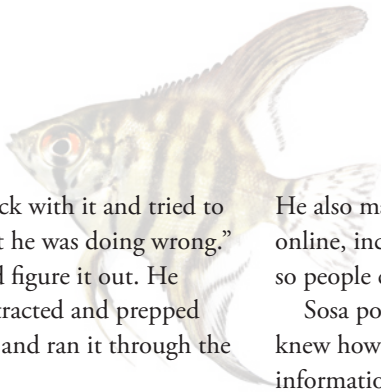
“At first when he did the DNA extraction it wasn’t really working,” Sosa said. “But he knew it was possible to

**Indeever Madireddy used this device to sequence the angelfish DNA. Inside is a flow cell that contains the nanopores through which the DNA passes to be sequenced. It’s connected by USB to a computer that reads out the data in real time.**



COURTESY OF INDEEVER MADIREDDY





do it, so he stuck with it and tried to figure out what he was doing wrong.”

Indeever did figure it out. He successfully extracted and prepped his fish’s DNA and ran it through the sequencer.

In nanopore sequencing, DNA strands are passed one base at a time through pores in a membrane through which an electrical current is flowing. A quantifiable change in voltage occurs as each base passes through the pore, and this change is recorded and read out as that particular base. Since the sequencing relies only on the DNA being passed through the pore, it can continue longer than other types of sequencing where the genome must be fragmented first. In theory, nanopore sequencing can read megabases at a time. This makes it a great technique for sequencing a total genome.

After getting all the data, next Indeever had to figure out how to analyze it and turn it into a usable sequence. “I initially wanted to do the bioinformatics part myself, but my computer didn’t have enough memory,” he said.

He ended up using the Galaxy platform’s Flye de novo assembler for single-molecule sequencing reads, which uses a publicly available server and an established pipeline.

With this first attempt, Indeever assembled 65% of the genome. But he thought he could do better with a second sequencing run, so he set up a crowdfunding page, raised more than \$1,000 to buy the necessary reagents and another flow cell for the nanopore, and continued his work. With the second run, he assembled 86.5% of the angelfish genome.

## The paper

Indeever wrote up his article and submitted it to peer review at micro-Publication, an open access journal.

He also made all his data accessible online, including any failures he had, so people can learn from his mistakes.

Sosa pointed out that Indeever knew how frustrating it is to look for information behind paywalls and was passionate about making sure that when he published, it was in an open access journal.

Richard Gibbs, director of Baylor College of Medicine’s Human Genome Sequencing Center, read the published article and appreciated the work. “It is very heartening to see this young investigator use these methods for this project,” he said. “This is useful data, and the demonstration that the project can be carried out by an individual working essentially on their own is impressive.”

Gibbs noted that it might be a good idea to check the quality of the sequencing reads, including the coverage (how many times any particular area of the genome was sequenced) and the error rate of the device. But he added that, regardless of those details, “This is impressive.”

Indeever said he’s grateful for the opportunities he’s had so far: having parents who are supportive of his pursuits, going to a school that exposed him to interesting concepts early and living in an area with resources like a community lab.

In addition to sequencing the angelfish genome, his projects include a patent-pending method of creating paper shopping bags out of kelp, a more sustainable resource than trees.

His advice to other aspiring scientists is simple: “Just go do it.”



DAVIDSON INSTITUTE

**Indeever Madireddy, a high school senior from San Jose, California, published the first full sequence of the angelfish genome by using DNA from his own pet fish.**

**Elizabeth Stivison** (elizabeth.stivison@gmail.com) is a postdoctoral researcher at Vanderbilt University studying inositol signaling and a careers columnist for ASBMB Today. Follow her on Twitter: @e\_stivison.





# Lighting the way to undergraduate research

A team of Albion College students presented their research on light-activated pharmaceuticals at the ASBMB annual meeting

By *Laura McCormick*

**“If a student asks to join the lab, I talk with them less about the particulars of the research and more about what it means to be part of a research group. They’re not ‘doing research’ so much as they are ‘joining a research group.’”**

**CRAIG STREU**

The thrill of discovery is a big draw to working in a research lab — the opportunity to uncover something new in the world around us. For undergraduates, stepping into the lab for the first time can also be a little intimidating. Craig Streu’s lab at Albion College is a great place for these young scientists to start.

“If a student asks to join the lab, I talk with them less about the particulars of the research and more about what it means to be part of a research group,” Streu wrote in an email. “They’re not ‘doing research’ so much as they are ‘joining a research group.’ If the culture is good, then recruiting, motivation for results, safety, teamwork all follow.”

Albion is a small liberal arts college in southern Michigan. The campus prides itself on being a close-knit community, and the Streu lab in the chemistry and biochemistry department is no exception. The college has only undergraduate students, providing a unique training atmosphere in the lab. Student researchers train one another on new equipment and help each other troubleshoot problems.

Diane Kernan, a junior biochemistry major, believes addressing problems is a big part of learning how to work in research.

“It’s a natural part of being in the lab and learning,” she said. “A lot

of people are so used to just doing one thing and getting it right ... but you know, failure is more likely to happen than success. And when you have those little successes, you celebrate them so much more because you realize how much work you put into this.”

There is a strong sense of synergy in the Streu lab, and the students’ enthusiasm for their science is clear.

“We’re like one family or team. ... I can ask people for help or they can ask me for help,” said Paul Volenksy, a junior biochemistry major. “We use each other to become better in the lab.”

Much of the research in the lab focuses on improving cancer therapeutics. Many chemotherapies on the market work by inhibiting essential cellular processes. While these drugs halt the growth of cancer cells, they also can cause severe side effects in patients due to the damage to healthy cells.

The researchers in Streu’s lab are working to circumvent this problem by adding specificity to cancer drugs. They use azo groups to modify these chemicals. An azo group — two nitrogen atoms connected with a double bond — appears simple, but certain wavelengths of light can induce a conformational change in the nitrogen bond. As a result, it is possible to trigger the activation of a drug at a certain time and place —



such as the site of a tumor.

Although the lab is centered on creating azologue compounds, students work on unique projects and focus on modifying a variety of drugs. For example, several researchers are working to incorporate azo groups into mitotic checkpoint inhibitors, while others are focused on modifying tyrosine kinase inhibitors.

Junior biochemistry major Madeline Budd appreciates the independence Streu encourages. “Something that surprises me is how much freedom we have in the lab — the choice to choose my own synthetic route, a choice to choose a different procedure, use different chemicals,” she said. “It’s up to me and I really like that.”

In all, nine students in the Streu lab were scheduled to present six posters on azologues at Discover BMB, the American Society for Biochemistry and Molecular Biology annual meeting held last month in Seattle.

Typically, students start in the lab by refining their organic chemistry skills, working to add the azo group to their drug of interest. As they progress in the lab, they start expanding their experimental

toolbox — for example, learning new biochemical assays to test the activity of the molecules they have synthesized.

Critical to this progress is Streu’s balanced mentorship. Although he supports his students, he still allows them to maintain autonomy in the lab.

“I encourage them to take ownership of the lab, so I try not to hover, but I’m never far,” Streu wrote. “As students become ready for more responsibility, it happens organically.”

Many students initially were drawn to the lab because they wanted to study medicine. They say working with Streu has shaped their view of science.

Mariah Brenz is a junior majoring in biochemistry and biology. “I never really knew what research entailed at all, but having all that hands-on experience has really influenced me,” she said. “It’s opened a lot of doors for me.”

Samantha Dye, a senior biochemistry major, shared similar sentiments. “Working in this lab made me realize how interested I am in drug design and discovery,” she said.

Dye now plans to earn her Ph.D. in chemistry and work in industry.

**All the researchers in Craig Streu’s lab at Albion College are undergraduates. Front row: Kaitlyn Piontkowsky, Fadwa Kamari, Samantha Dye, Diana Kernan, Paul Volesky and Noelle Robert; center: Jade Patel and Lexi Moss; back row: Craig Streu, Chris Rohlman, Ryan Beyers, Theodore Hirschfield, Mariah Brenz. Noah Rollison, Madeline Budd and Peter Filbrandt.**

As the students prepared to attend their first ASBMB conference, their excitement was building. For some, this was a brand-new opportunity to present their work off Albion’s campus and meet other researchers. Others had attended an American Chemical Society meeting in the past but never a molecular biology-focused conference.

Theodore Hirschfield, a junior majoring in biochemistry, hoped to gain some useful knowledge. “I’m excited to see what other people are doing,” he said. “Our group has run into a couple of roadblocks along the way. ... Maybe we can apply something that we learn to our own group.”

**Laura McCormick** (lemccorm@email.unc.edu) is a graduate student in cell biology and physiology at the University of North Carolina at Chapel Hill. Follow her on Twitter: @le\_mccorm.



# The researcher and the roaches

By *Renaë Crossing*

“Cockroaches are more advantageous than you would think.”

So said Jingwei Li, an undergraduate student at Case Western Reserve University, who has been studying cockroaches to learn about Parkinson’s disease.

“So many of my friends were in labs that use mice,” he said. After plenty of pipetting in his past lab rotations, a hands-on project with the American cockroach, or *Periplaneta americana*, sounded appealing. “Sure, I’ll try,” he said.

Roaches have a few genes in the brain that are similar to humans’, including genes for Parkin and D2-like dopamine receptors. And because they have a longer lifespan than fruit flies

**Case Western Reserve University undergraduate researcher Jingwei Li was scheduled to present his research on Parkinsonism in cockroaches at Discover BMB in March in Seattle.**

— staples of scientific study — scientists can study longitudinal changes more easily.

With fruit flies, you only have 40 days. With cockroaches, you can have a year or two.

## Model student, model organism

Ryan Arvidson, Li’s supervisor and an assistant professor of biochemistry at Case Western, said Li began with only “some pilot data and a few replicates,” and yet, “he seemed to succeed almost immediately.” (That never happens.)

“He wasn’t there to check a box,” Arvidson said of his student.

Li was tenacious, documenting the molecular shopping list of a huge bunch of nerves called the cephalic ganglia. This shopping list is called a transcriptome, and it will give insight into a roach’s brain on Parkinson’s.

Li’s research also involved measuring how cockroaches with genetically induced Parkinson’s disease walked. “Cockroach locomotion,” it’s called.

The cockroaches with Parkinson’s moved spontaneously: Instead of making laps around a container’s perimeter, their movement was jerky and unpredictable — think Michael Jackson’s “Thriller.” They also had less grip strength. To determine this, Li tied one end of a string around a cockroach’s thorax. He lifted the cockroach slowly and noted how high the tension gauge reading got before the cockroach let go.

And the cockroaches’ movements became smaller and fewer over time. “Hypokinesia,” it’s called, and it’s

from diminished dopamine, not diminished muscle. The body begins to move with less oomph.

## From pest to Parkinson’s

Cockroaches have played a role in scientific research for over a century, including for what robotics researchers describe as the “elegant” transition they can make from horizontal walking to vertical climbing, but neuroscience tools rarely have been applied to them until now.

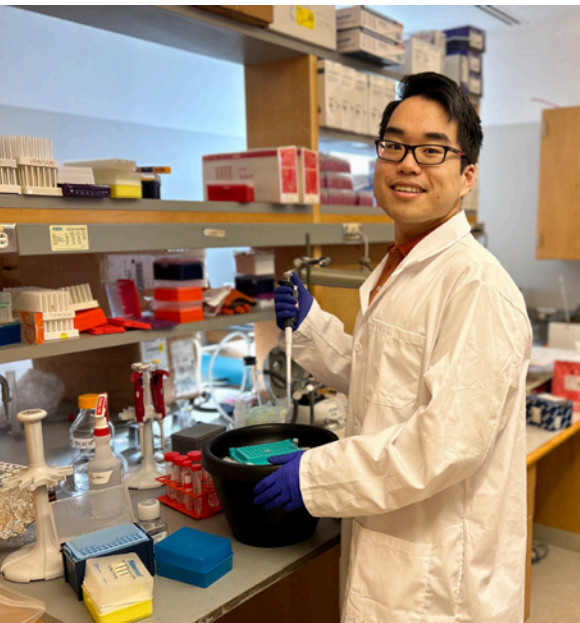
One day, scientists hope to use the lifespan of cockroaches, and new genetic tools, to test FDA-approved drugs and the impact of diet on Parkinson’s symptoms.

After a long day of studying cockroach locomotion, Li likes to impair his own with the environmental stimuli of a good gym session. “To destroy my muscles,” he said.

In Arvidson’s lab, Li said, “I felt like a bigger part of the picture. I wasn’t just there to grow some cells and that was it.”

Li will graduate this semester and, heading for medical school, hopes to keep returning to research.

And the cockroaches? The cockroaches were lifted from their status as pests. Li said they became a lot more like pets.



COURTESY OF JINGWEI LI

### Renaë Crossing

(renaecrossing@gmail.com) is a writer and former teacher. She holds a first-class master’s degree in life science from the Hong Kong University of Science and Technology and a first-class master’s in teaching from the University of Melbourne. Follow her on Twitter: @renaecrossing.





# Exploring marine science at the cellular level

By Dami Oke

**H**ow do you end up studying how stingray venom affects cancer cells?

For Karlie Tischendorf, it all began when a high school English teacher assigned each student to learn about and present on any topic of their choice. Tischendorf saw this as a blank check to satisfy her curiosity about coral bleaching. After a deep dive into this process, she knew she had to get involved in marine biology.

Now a senior at Purdue University, Tischendorf started her undergraduate career as an aquatic science major, but after a few classes, she was unsatisfied — she wanted to understand marine life on the microscopic level. She shared her discontent with her mentor, and after reviewing the possible options and receiving additional guidance from her adviser, Tischendorf changed her major to biochemistry with a minor in aquatic science. She also has a second minor in Spanish.

In 2022, Tischendorf spent 10 weeks as an intern at the Mote Marine Laboratory and Aquarium in Sarasota, Florida. Designed in partnership with the National Science Foundation, the Research Experiences for Undergraduates program gives undergraduates a concise and hands-on experience in real-world marine research. She worked with longtime Mote Labs researchers Cathy Walsh and Carl

Luer on extracting venom from stingrays. It's a challenging process; in other organisms, venom is stored in a gland, but stingray venom is stored in tissue cells in the spine.

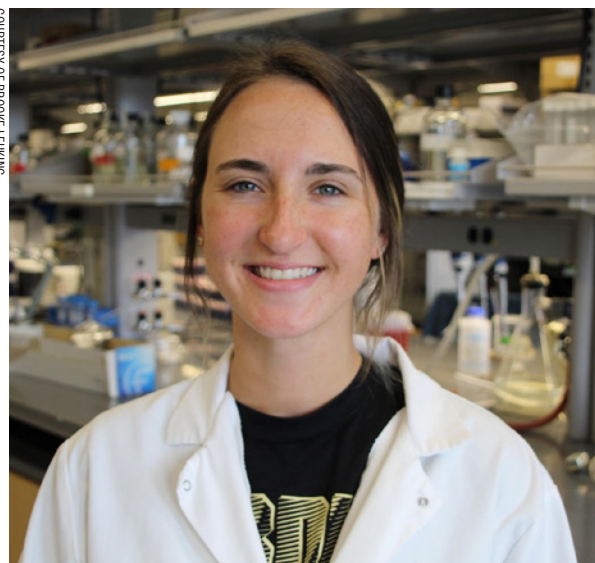
To learn about the therapeutic potential of compounds in the venom, Tischendorf used a variety of assays to determine how it would affect cells isolated from a mouse with fibrosarcoma, a malignant cancer. While this project still has a ways to go, Walsh said, “The initial results are exciting and gave us the interest to want to continue going further.”

This is one of five research projects Tischendorf has worked on as an undergraduate. Her advice to students interested in science is to find habits that work for them individually, be patient with themselves and beware of making unhealthy comparisons. She also advises, “Say yes to opportunities as they come up because you really don't know where it's going to lead you.”

When her adviser encouraged Tischendorf to apply to be outreach co-chair in the biochemistry club — even though she'd never attended a meeting — she followed her own advice. As a result, she met more peers and built meaningful relationships. To this day, she says it was “one of the best things that could have ever happened.”

Similarly, she said changing her major to biochemistry was “a shot in the dark.” But that shot led her

COURTESY OF BROOKE LEWING



**Karlie Tischendorf, a senior at Purdue University, was scheduled to present on her project to determine the therapeutic potential of compounds in stingray venom at Discover BMB.**

to a plethora of experiences, each preparing her for her next opportunity. After her graduation in May, Tischendorf said she'll take a gap year before applying to Ph.D. programs that allow her to delve deeper into marine ecotoxicology. She's also been working toward her scuba certification so she can spend time diving around St. Kitts and Nevis as well as Turks and Caicos.

**Oluwadamilola “Dami” Oke** (okeo@gwu.edu) is a Ph.D. candidate of biomedical engineering at George Washington University and recently became a contributing writer to ASBMB Today.



# Offensive strategies in the lab

Love of football inspires undergrad's food preservation research

By *Jaclyn Brennan—McLean*

**B**raden Lewis has been an Iowa State University football fan as far back as he can remember. Both his parents graduated from ISU, so Lewis developed an early love for Cyclone football games. He's also a lifelong lover of science, eager to play with microscopes ever since first grade. Those combined interests led him to pursue a science degree at ISU, where he's now a junior in the biochemistry department and an undergraduate researcher in a food microbiology laboratory.

What does that have to do with football? Lewis' knowledge of the game inspired his research, and he has developed an innovative biochemistry

**In developing his research project, Braden Lewis decided on a combination strategy to improve food preservation: high-voltage atmospheric cold plasma, or HVACP, and cinnamaldehyde.**

technique based on offensive grid-iron strategies.

Lewis was introduced to food microbiology when he joined Aubrey Mendonça's lab as a freshman honors student. He began by supporting the work of graduate students, and within a year he was hired as an undergraduate researcher. Since then, he's been running his own studies to improve pathogen reduction methods for the food industry.

Typically, food is preserved and pathogens reduced via pasteurization, canning and the use of antimicrobial compounds. Yet these established techniques sometimes can impact the flavor profile or nutritional value of food. Chemical preservatives also can scare consumers away. To make food preservation safer, more natural and more consumer friendly, the Mendonça lab

is exploring the use of nonthermal technologies and natural antimicrobials and preservatives.

In developing his own research project, Lewis decided on a combination strategy to improve food preservation: high-voltage atmospheric cold plasma, or HVACP, and cinnamaldehyde.

HVACP is a processing technique that can wash food without raising its temperature or destroying essential nutrients. This simple technology works by applying an electric field to atmospheric air to create reactive oxygen and nitrogen species that kill bacteria. Cinnamaldehyde, the natural chemical compound that gives cinnamon its flavor and odor, is known to have antimicrobial properties.

"I'm kind of a huge sports guy, so I've always thought of this project



COURTESY OF BRADEN LEWIS

like offensive strategy in a football game,” Lewis said. “There are two ways to move the ball. You can run the ball or you can pass it. ... But it's really that combination of running and passing that is much more effective than either one alone.”

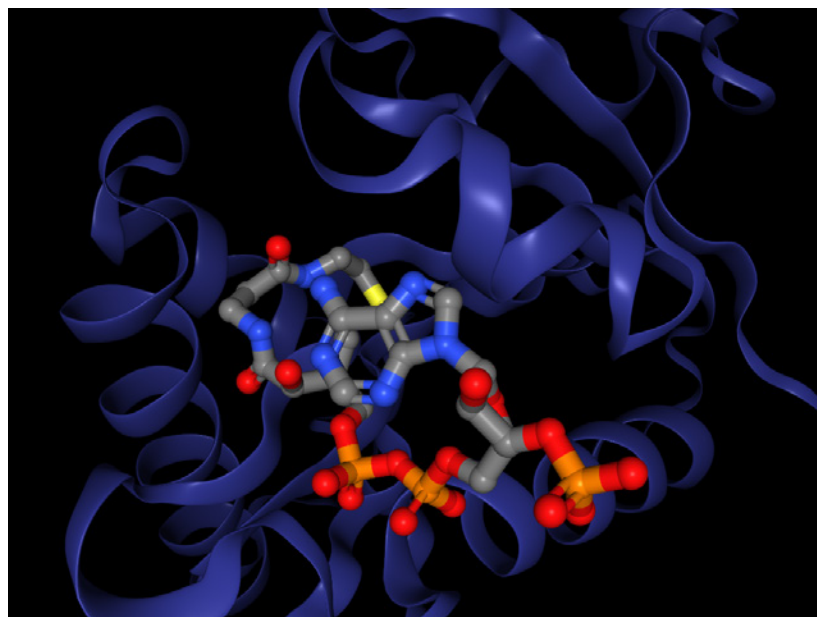
He was right. The combination of HVACP and cinnamaldehyde had a synergistic effect and reduced bacterial content from “millions to 10 or less in just a few minutes,” he said.

Lewis was killing bacteria, preserving the food (in this case, pineapple juice) and retaining nutrients without heat or harsh chemical interventions.

Lewis was excited to share his technique with others at the Discover BMB conference in Seattle. He plans to pursue a Ph.D. after graduation, with the goal of becoming a professor. Now a teaching assistant for a biochemistry course and a peer mentor, he offers this advice to other undergrads: “Be willing to try anything. The worst case scenario is that you might learn that you don't really like a particular topic, and that's okay. Sometimes that's just as important.”

Mendonça has similar words of advice for students: “In many instances ... good professors can demystify these things for you and make (learning) a pleasurable experience. Braden is actually a biochemist and never believed he would have loved microbiology. Now he wants to do a minor in microbiology.”

**Jaclyn Brennan-McLean**  
(jacbrennan12@gmail.com)  
earned her Ph.D. in biomedical engineering from George Washington University in 2020 with a research focus in cardiac electrophysiology. She is a 2022–2023 AAAS Science & Technology Policy fellow at the U.S. Agency for International Development. Follow her on Twitter: @jaclynb\_phd.



## CoA and CoA-derivatives: From biochemistry and molecular biology to human diseases across lifespan

**Aug. 16–18**

**Discovery Building**

**University of Wisconsin–Madison**

This conference will provide a forum where academic and industrial investigators from heterogeneous fields can exchange ideas and challenge the framework of our current understanding of the role of CoA and its derivatives in all aspects of health, disease and bioscience.

### IMPORTANT DATES:

**June 20: Early registration deadline**

**June 20: Abstract submission deadline**

**July 14: Regular registration deadline**

**[asbmb.org/meetings-events/coa-2023](https://asbmb.org/meetings-events/coa-2023)**





# Timing is everything

Stalled by the pandemic, an undergraduate research project gallops to the finish line

By Teisha Rowland



TEISHA ROWLAND

Much of the work Teisha Rowland, left, did to guide her student Ashlynn through her undergraduate research project had to be done remotely.

“Congratulations on the acceptance of your manuscript.”

It was strange to read this, since the project almost never happened.

Two years and seven months earlier, only sunlight illuminated the dim, silent hallway and adjoining quiet lab spaces. I hastened down the hall, slowing only to glance at flyers advertising seminars from March 2020. A month outdated, they were a relic from the time before COVID-19 froze academic life, despite the initial drumbeat of “We will remain open.”

As the stem cell center’s director, I’d become what the university termed an “essential worker,” tasked with minding the center’s frozen cell bank. While checking the cryogenic tank, I glanced at Ashlynn’s empty desk.

*When could undergrads return to the labs?*

Ashlynn was an impressive undergraduate assistant; we wanted to start a research project. It would use human induced pluripotent stem cells, or iPSCs — the center’s specialty — to investigate whether the extracellular matrix impacts cardiomyocyte differentiation.

Like many labs, we were pivoting. We were thrilled that Ashlynn’s summer research proposal had been approved but chose to delay funding until fall 2020.

*Then what to do over the summer?*

We decided a remote literature review project would be best, helping prepare Ashlynn for bench research in the fall. “This is going to be an incredible learning experience for me,” Ashlynn raved.

With few funding options as a director, I was grateful for departmental professional development funds for her stipend.

Over the summer, Ashlynn made great progress on the literature review. We met twice a week via Zoom and exchanged many emails to discuss papers and flesh out the manuscript. At the summer's end, we passed the manuscript torch to another undergraduate researcher, Tessa.

Ashlynn meanwhile attended one of the center's iPSC training workshops and then dug into her research in the lab that fall. Armed with a protocol we reviewed remotely, she finally tried the differentiation.

I remember going into the lab, excited to check on her cells. Carefully taking the plate from the incubator, I set it on the microscope and searched for cells. My heart may have skipped a beat when I saw Ashlynn's cardiac cells contracting. She had successfully executed the protocol, on her own, on her first try.

By April 2021, research was mostly back to normal, but now our clock was ticking. After two years as the center's founding director, I was ready for new career adventures, but Ashlynn's project was unfinished.

*How much data could we get before I left? Would it be enough?*

We selected extracellular matrix proteins and planned out our best-shot experiment.

And it worked. Sitting with Ashlynn in the center's dark, cozy fluorescence microscopy room, I gave her a crash course on collecting images. She continued collecting images after I left that day. With those and her detailed notes, it would have to be enough — and amazingly, it was.

Ashlynn graduated in spring 2022 with an honors thesis built upon these experiments. That fall, we wrapped up the literature review, including Ashlynn's data, and after peer review, it was published.

I was honored that, despite a pandemic, I published with an undergraduate listed as first author.

*(The manuscript Teisha Rowland writes about here with multiple undergraduate co-authors was published in the journal Bioengineering.)*

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**Teisha Rowland** (teisha.rowland@colorado.edu) is a principal scientist and iPSC team lead at Umoja Biopharma and former director of the Stem Cell Research and Technology Resource Center at the University of Colorado Boulder.

## Apply for the 2023 ASBMB Advocacy Training Program

The ASBMB Advocacy Training program is a three-month externship (May–August) that provides hands-on science policy and advocacy training. ATP delegates learn about science advocacy, the role of Congress and policymakers in funding science, and how to advocate effectively. With support from ASBMB public affairs staff, delegates then develop and execute an advocacy activity focused on policies affecting their communities.

**Apply by April 21.**

Learn more at  
[asbmb.org/advocacy-training-program](https://asbmb.org/advocacy-training-program)



# ‘What about all these other students?’

Carlota Ocampo, an expert on trauma, talks about how to reduce systemic inequities in higher ed

By Ankita Arora

**C**arlota Ocampo really likes her job. In fact, she calls it “the greatest job in the universe.”

Ocampo is an associate professor of psychology at Trinity Washington University in the nation’s capital. She’s also the university’s provost and vice president of academic affairs.

“It is such an exciting role because I have the opportunity to really influence how we do higher education in such a way that supports students to be successful,” Ocampo said.

Trinity is a private Catholic university. It was founded as a women’s college and continues that commitment to date through its College of Arts and Sciences, and it also is a predominantly Black- and Hispanic-serving institution.

Like a lot of the students she serves, Ocampo did not take a direct path to higher education.

“I didn’t even know what a provost was or have any idea what a neuropsychologist was. Just by taking the next step that was in front of me, I was able to come to this place. I feel like the luckiest person in the world,” she said.

Ocampo decided to give college a try when she was in her mid-20s.

“I always had a kind of deconstructive attitude toward my positionality in the world. We have words now like ‘intersectionality,’ but we didn’t have those when I was growing up,” Ocampo said. “As a Latina-identifying person, what were the expectations for me?”

She took a few random classes at the community college level and really liked it. When her professors praised her for her aptitude and critical thinking, she said, it was the first time she experienced that kind of recognition.

Ocampo patched together credits from a couple of different colleges to transfer to Howard University in Washington, D.C., where she “caught fire.”

“Howard, for me, was like being in a family. I felt safe and very connected to my professors. I felt like they cared about me. I felt like they nurtured my ideas and talents,” she said.



COURTESY OF CARLOTA OCAMPO

**Carlota Ocampo is an associate professor of psychology at Washington Trinity University. She is both the provost and vice president of academic affairs.**

A psychology class focusing on the Black experience made her feel seen. She recalled thinking: “This is helping me make sense of my place in the world.” Her interest in psychology consolidated when she took a course called Brain and Behavior.

With a National Science Foundation grant in hand to study the neuroscience of depression, she went on to earn her doctorate in neuropsychology at Howard in 1997.

She then joined the faculty at Trinity, and she’s been there ever since. Today she ensures that academic programs meet accreditation standards and that students have positive learning outcomes.

Ocampo is also on the advisory board of The Steve Fund, an organization that supports mental health and emotional well-being of students of color.

She talked to ASBMB Today about her experiences nurturing students and about the deep-rooted connection between racial trauma and mental health. This interview has been edited for clarity and length.



**Q: You've studied the psychology of trauma and oppression and its impacts on physical health. Tell me about that connection.**

**A:** Studies of trauma emerged from the idea of shell shock or battle fatigue. People who are traumatized in war develop symptoms or defense mechanisms to those events. Over time, the field evolved to include things like sexual violence or domestic violence.

But there was never an inclusion or acknowledgment of the violence and oppression that's inflicted on people of color in situations of hegemony or cultural supremacy. These include assaults on one's ethnic self-identification and can vary from verbal or physical attacks to threats to livelihood. There was not a recognition that these incidents could be exponentially damaging.

So my research was proposing a model for examining the ways in which racist-incident-based violence parallels other kinds of violence, such as war trauma, sexual violence or family violence.

Now we can make the argument that racist-incident-based trauma should also be included as a category of recognition with the professional psychotherapy organizations. There can be no healing until racist-incident-based trauma is recognized, and mental health providers have a role to play in liberating oppressed people and communities.

This project is still very much under way. The understanding of complex trauma — wherein a variety of multiple traumatic events of an interpersonal nature intersect with each other and might have different after-effects — is constantly evolving and gaining recognition.

**Q: Trinity recently launched a racial equity program. Tell me about that.**

**A:** In brief, Trinity DARE (Driving Actions for Racial Equity) is a five-pronged plan to address systemic inequalities and make sure that our students can access the same kinds of networks, experiences and education that privileged students have.

The first, and perhaps the most important, approach is widening career pipelines. It's focused on finding experiential learning, internship, and externship opportunities for students. A lot of higher education internships — they're sort of very closed networks. For instance, a corporation might have openings for a set of internships, but they always go back to the same two or three schools

COURTESY OF CARLOTA OCAMPO



**Carlota Ocampo speaks during an admissions event in Trinity Washington University's science building.**

to draw their interns, because they have partnerships there. It's a way in which we maintain the appearance of democracy in a highly stratified society, because we enable a few privileged students.

But what about all these other students?

So we're now building networks that can lead to these applied learning and employment opportunities for all the students.

The second piece of the program is broadening access by increasing our intake of students of color who show great potential. It's a great start, but you can't just enroll students. You must support them. You have to change what's happening on your campus to make sure that these students will get through.

Black women have the highest student debt load in the country. Reducing student debt by offering scholarships and financial aid packages improves the odds of them reaching the finish line and further supports long-term success.

The next step is using inclusive excellence practices. A few years ago, we obtained a huge grant from the Howard Hughes Medical Institute to examine the ways in which our science pathways were creating barriers to success or fostering the success of Black and Hispanic students. This is what laid the foundation of our inclusive excellence curriculum.

Students of color do not come into college with the same type of knowledge as students from predominantly white schools. I can tell you that, without making adjust-

# PERSPECTIVES

ments on campuses to accommodate the pedagogical needs of students who come from a variety of different backgrounds, you're not going to be successful.

Some of that involves changing the way we scaffold learning outcomes and courses. Some of it involves changing the sequence of the courses. Some of it involves having mentor moments and official mentor networks. It involves a complete revision of the curriculum, of the pedagogies, of the teaching modalities, of the kinds of projects that we engage students in, and it resulted in a huge boom in our science programs.

The fourth platform that DARE resides on is engaging students in community research. We ensure that our students have the opportunity to research the impacts of racial inequity and participate in activities that can bring lasting change in the community.

As an example, in our chemistry department, we have research projects that focus on environmental justice, the fact that there's unequal access to healthy environments. People of color are more likely to reside in neighborhoods with high local pollutants and lower air quality.

The last part of the program is self-examination. You can't claim to be a social justice institution without doing some self-reflection and acknowledging your own history. Trinity is a Black and brown institution now,

**Carlota Ocampo (seated at right with scarf) and Trinity President Patricia McGuire (in red in center) with students and other staff at a Washington Women's Foundation event.**

but back in the day, Trinity was a predominantly white institution.

What did that transformation look like? What was the experience of the pioneers? Those questions and others need to be answered. As a part of DARE, we recently completed a history project where we looked at what was it like to be one of the first few women of color who enrolled at Trinity, and we came up with an exhibit called "Faith in Women" that takes us through this journey of transformation.

## **Q: What advice do you have for administrators and professors at other universities?**

**A:** As university administrators, we cannot just say that diversity is enrolling more diverse students. That doesn't work. We must show outcomes.

There are many, many students who need higher education who might not look like the students who have always been on campuses. For institutions to thrive and maintain their accreditation, they need to enroll diverse students and improve their graduation rates. So it is also a good business decision to redesign one's curriculum, support faculty networks, provide faculty training, and create opportunities to make sure that you can not only enroll students from different backgrounds but also foster excellence in the students.

You must have diversity, equity and inclusion infused throughout all your programs. You need to have mental



COURTESY OF CARLOTA OCAMPO

health, wellness and programs that will support students from different backgrounds.

Most faculty are well meaning but are sometimes hesitant to have difficult conversations or to acknowledge a microaggression in class. There are a plethora of trainings that faculty can access that might help them examine their unconscious biases and gain a better understanding of what white privilege means. These might also help them develop empathy with themselves as well as students. They can also seek out training to learn more about what it means to be inclusive and to welcome all students into the room.

## Q: How do you encourage women from marginalized groups embarking on STEM career paths?

**A:** Don't be discouraged, and don't let anyone steal your joy. Know that you belong in this room and bring something essential to the room — without which our society can't really move forward.

We know from biology that diversity is strength; it is also true socially. When we don't see ourselves in these various spaces, we can internalize, "Do I really belong here?" We belong here more than anyone, because we bring the insight and a perspective that people need to hear, and that is currently missing.

The message that I particularly want to give to young women of color who are interested in science is to be armed with the research about the ways in which women are being stereotyped in these disciplines, so that when you are confronted with a microaggression or a macroaggression, you are able to understand what's happening and respond in a way that's both proactive and protective.

## Q: What keeps you going on this arduous path?

**A:** I truly believe in the power of education to promote democracy. And by "democracy," I don't mean a specific political system. I mean the ability for all citizens to contribute to a society and to have a good life. Education really allows people to deconstruct their intersectionality in the world and assess how they can contribute. So that's what my job enables me to do.

I owe every debt for who I am today to Howard and to Trinity for taking me on, and my intention is that, when I die, my tombstone will read, "She helped thousands of women achieve a better way of life in the area of their strength." That's my goal.



Carlota Ocampo (right) was one of three experts who spoke during a session on race and mental health at the 2022 ASBMB annual meeting in Philadelphia. Also on the panel were Cirleen DeBlaere (center), associate professor and coordinator of the counseling psychology doctoral program at Georgia State University, and Batsirai Bvunzawabaya (left), director of outreach and prevention at the University of Pennsylvania.

## Q: What are you reading?

**A:** The last book I read is called "What My Bones Know" by Stephanie Foo. It's about intergenerational trauma. She grew up in California and is a Malaysian-born American radio journalist, producer and author. And what's interesting to me is that her story is authentic, moving and very gritty. She really addresses a lot of the issues around complex trauma in a way that is accessible.

And then I have a book called "Pregnant Girl: A Story of Teen Motherhood, College, and Creating a Better Future for Young Families" by Nicole Lynn Lewis. As we at Trinity do support a lot of mothers in college, the story of a young Black mother and founder of an organization, Generation Hope, that provides support for teen parents and their children is inspiring and insightful at the same time.

Finally, a collection of short stories called "A Manual for Cleaning Women" by Lucia Berlin. It's about a woman growing up in in the American Southwest and exploring everyday lives of characters around her.

**Ankita Arora** (ankita.arora@cuanschutz.edu) is a postdoctoral research fellow at the University of Colorado Anschutz Medical Campus. Follow her on Twitter: @arorankita.





# Scientists who are caregivers need more support

The ASBMB suggests policy solutions to alleviate burdens that affect their research and careers

By *Raechel McKinley*

“There are only four kinds of people in this world: those who have been caregivers, those who are currently caregivers, those who will be caregivers and those who will need caregivers. Caregiving is universal,” Rosalynn Carter, the former first lady, said in 2011.

More than a decade later, Carter’s words ring truer than ever.

An estimated 40 million Americans today provide care for family members and other loved ones, and a quarter of those caregivers are between 27 and 42 years old.

Given that 44 is the average age for receiving a National Institutes of Health R01 research grant, and with a long-term care crisis just on the horizon, the biomedical workforce must prepare now for an influx of early-career scientists with caregiving responsibilities.

## What do we mean by ‘caregiver’?

While “caregiving” is often used as an overarching term that includes the raising of children, and while there is overlap in responsibilities (such as taking time off for medical appointments or to care for your sick dependent), caregivers who tend to aging and elderly parents or to disabled partners or disabled children face unique challenges.

For instance, caregivers of elderly parents often become legal guardians or hold power of attorney and are responsible for handling business matters and making medical decisions on the loved one’s behalf. They also have the added burden of securing specialized housing and managing in-home health aides, often paying out of pocket for them.

And some people, such as those in what’s known as the “sandwich generation” between ages 35 and 54, serve as parents and caregivers simultaneously.

“Women account for three in five sandwiched

caregivers, who as a whole account for 28 percent of all caregivers,” noted a 2021 National Academies report on women in academic science, engineering and medicine.

## The need and cost are rising

According to the U.S. Census Bureau, by 2035, adults 65 and older will outnumber children under 18 for the first time in history.

“This fundamental demographic shift is the result of the aging of the U.S. population, increasing longevity, and a declining birth rate,” a 2019 AARP report explained.

By 2025, the oldest baby boomers will have reached age 80, setting off what experts fear will become a long-term care crisis with huge impacts on boomers’ adult children.

“Most long-term care needs arise when people are in their mid- to late-80s,” Gal Wettstein of the Center for Retirement Research at Boston College told CNBC.

Almost half of baby boomers have no retirement savings; only a quarter have more than \$100,000.

“While the median yearly costs rose across all provider types, home-based expenses — such as home health aids for bathing, dressing or eating, and homemaker services for cooking, cleaning or errands — grew by double-digit percentages in 2021,” CNBC reported last year.

As the cost of care goes up, those who are poised to care for the aging population — their children — are expected to pony up whatever isn’t covered by their elders’ fixed incomes.

## How this affects the biomedical workforce

Caregiving can interrupt scientists’ training, delay their dissertations and other milestones, prevent travel for professional development, reduce time spent in the lab

or applying for grants, and even completely derail their careers.

The majority of family caregivers are women, and, as it has for many things, the COVID-19 pandemic has exacerbated the disparities that women in science face. In 2021, the National Academies found that 56% of women in the academic sciences, engineering and math have experienced increased eldercare demands as a result of the pandemic.

“While men may believe they more equally share household tasks, the data on actual household labor time show that women with children under age 6 spend ... more time on household tasks than do men, a trend that continues for school-age children and generally for eldercare,” the National Academies report noted.

Caregiving is time consuming and stressful. “About 60 percent of eldercare providers work while caregiving, with most reporting that caregiving negatively affects their work,” the National Academies report said.

Caregiving is exceedingly expensive. Assisted living and nursing home facilities can cost, on average, as much as \$8,900 per month. As an increasing number of early-career scientists must cover the cost of long-term care for their elders, many will have no choice but to leave science altogether.

In a 2019 report titled “The Caring Company,” Harvard Business School researchers noted, “A third of employees who left a position reported taking care of an elder with daily living needs as a reason for leaving their job. Almost 25% did so to care for an ill or disabled spouse, partner or family member.”

## Policies for caregivers

State and federal lawmakers have a lot of work to do to make sure seniors have access to resources and care they need, including affordable assisted-living and skilled-living facilities, prescription drugs, and medical care.

Academic institutions and federal science funding agencies, meanwhile, must ensure that caregivers are not pushed out of the research enterprise.

While policies exist to support and retain parents in the biomedical sciences, such as the National Institutes of Health childcare supplement for fellowship awards, support for trainees and investigators who are caregivers is lacking.

The American Society for Biochemistry and Molecular Biology offers the following recommendations:

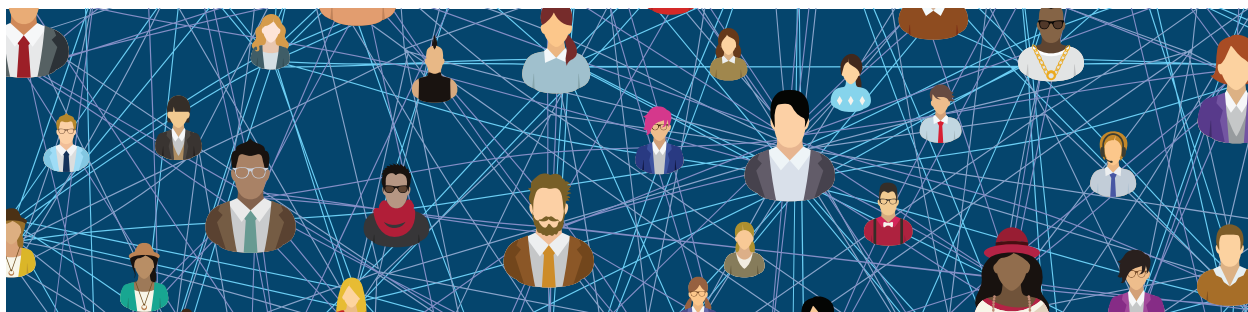


1. Expand the NIH childcare supplement for fellowship awards to include caregivers and allow the use of funds for eldercare.
2. Disseminate information about institutional resources (such as group therapy, support groups and employee assistance programs) for which graduate students and postdoctoral fellows qualify.
3. Provide paid family and medical leave. The Family and Medical Leave Act entitles workers to 12 weeks of unpaid leave to care for an immediate family member. However, most cannot afford to take unpaid leave. Legislation at the state and federal levels is needed.
4. Improve dissemination of information about programs to assist caregivers, such as the NIH’s reentry and reintegration supplements, which have been successful in helping investigators and trainees return to their careers in the biomedical sciences after taking a hiatus.

**Editor’s note:** During an ASBMB LinkedIn chat about parenting and caregiving, the author discussed the challenges she faces caring for her father, who has dementia. In particular, she shared how difficult it is to find affordable long-term care and how caregiving required her to interrupt her graduate studies.

**Raechel McKinley** ([rmckinley@asbmb.org](mailto:rmckinley@asbmb.org)) is the ASBMB’s science policy manager. Follow her on Twitter: [@Mckinley-Raechel](https://twitter.com/Mckinley-Raechel)





## 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

**Motifs, modules, networks: Assembly and organization of regulatory signaling systems**  
July 11–14 | Potomac, Md.

Explore all upcoming events at [asbmb.org/meetings-events](https://asbmb.org/meetings-events).

**Transforming undergraduate education in the molecular life sciences**  
July 27–30 | Boston

**CoA and CoA-derivatives**  
Aug. 15–18 | Madison, Wis.



## Motifs, modules, networks: Assembly and organization of regulatory signaling systems

July 11–14 | Bolger Center, Potomac, Md.

This interdisciplinary conference will bring together researchers in structural biology, biochemistry, computational biology and proteomics who investigate cellular signaling networks and leverage these insights into the development of new therapeutic strategies.

#### IMPORTANT DATES:

May 10: Early registration deadline

May 10: Abstract submission deadline

June 12: Regular registration deadline

[asbmb.org/meetings-events/motifs-modules-networks](https://asbmb.org/meetings-events/motifs-modules-networks)







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