Vol. 21 / No. 9 / November 2022

ASBMB TODAY

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

The climate change issue

ASBMB
American Society for Biochemistry and Molecular Biology

Calling all ASBMB members!

It's time to renew your membership for 2023.

Together we'll continue to advance science, connect researchers around the world and build a bright future for biochemists and molecular biologists everywhere.

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- Apply to host an ASBMB-sponsored networking event.

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asbmb.org/membership

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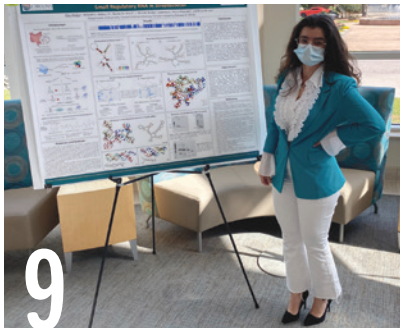

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The researchers aboard the schooner called Tara collected 40,000 ocean samples that allowed the discovery of more than 5,500 new marine RNA viruses.

Discover BMB | 2023

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

www.asbmb.org/asbmbtoday
PRINT ISSN 2372-0409

Talking membership

By Ann Stock

To increase awareness of American Society for Biochemistry and Molecular Biology activities, during my term I'll be talking to chairs of the committees that steer the society's initiatives.

First up is Ed Eisenstein of the Membership Committee. Ed is an associate professor of bioengineering at the University of Maryland, and he has chaired the committee since 2019.

This conversation has been edited. Read an extended version at asbmb.org/asbmb-today.

AS: When and why did you become an ASBMB member — and what attracts you to the society?

EE: When I was a postdoctoral fellow at the University of California, Berkeley, in the 1980s, my mentor Howard Schachman, then president of the ASBMB, suggested that I join. I had some scientific and career aspirations, and I was encouraged by what the society had available. It's been a great relationship. This society is a great organization where I can continue to learn a lot about molecular mechanisms and biology.

The other thing that keeps me engaged is the terrific benefits. I've urged my engineering students to join the ASBMB even though it's not their first discipline. A number of my students have taken the Art of Science Communication course, which has helped them get through their preliminary exams and defend their dissertations.

AS: What motivated you to join the Membership Committee?

EE: The committee had lapsed, and about four years ago they were recruiting members of various committees to reconstitute it. I was on the Public Outreach Committee. Barbara Gordon (former ASBMB executive director) asked me if I'd serve. She's very persuasive. So I said, "Sure, I'd love to join."

The committee was doing new activities: marketing, surveys and focus groups. Because I was at Maryland, so close to the ASBMB office, I was involved in a lot of those.

AS: What was the committee's most important new initiative during your term as chair?

EE: By far, it's the fellows program. The ASBMB is one of the oldest scientific societies in the country, and we were one of the last to recognize fellows.

Our committee thought our fellows would be a visible sign of

CORRECTION:
Due to an editing error, "Move over, DNA. The future is protein." in our September issue contained an error. A paragraph about midway through the text should read, "Bottom-up strategies, combined with RNA and metabolite data, will reveal the lineup. Top-down strategies will yield those sweet, sweet action shots."

the society's values: terrific science, outreach, education and commitment to life science ideals. Fellows are members who demonstrate an exceptional and sustained commitment to the society, particularly in ways that advance molecular life sciences. They reflect the breadth and diversity of our membership. It's not just about the best science.

AS: Tell me some things you learned from the ASBMB's 2020 member survey?

EE: Members want to network, especially with other members they share common interests with — whether it's developing educational programs or a scientific thrust in a new or multidisciplinary area.

Also, retention correlates with how active members are in the society. That was an important eye-opener and helped guide the elements of our strategic plan to find ways to keep all members engaged in ways that make the society vibrant.

AS: Are there new initiatives in this strategic plan?

EE: We're putting materials together and cultivating opportunities for fellows, Council members and others to be more effective ASBMB ambassadors. We get questions from young people about how to get involved, and we want people to have that information at their fingertips.

We aim to develop road maps for career stages — not just for people in academia but also industry, government science or policy institutes. We want members to know that at every step in their careers, this society has something to help them reach their goals.

Ed Eisenstein has chaired the Membership Committee since 2019.

And we're looking for ways to organize special interest groups — around education, research topics or outreach — so like-minded members can get together, kick the can, discuss ideas and maybe generate new programs.

AS: How do your committee members contribute?

EE: They contribute their time, their attention and their talent to figure out how well the benefits the society offers align with members' current needs. They also participate in our programs at the annual meeting. We have a new-member orientation, we recognize and engage with our ambassadors and fellows, and we interact with students and postdocs at the symposia to make sure the society's got their back as they advance their careers.

AS: How can ASBMB members interact with the committee?

EE: Members can write to anyone on the committee. Our names are listed on the ASBMB website on the "Meetings Committee" page.

The ASBMB recently hired a new membership manager, Nakera Dumas. She's a data-driven scientist herself. She's got great experience to help us identify programs that will add value for members. Members can reach out to Nakera with questions or interest in contributing or collaborating with us, even temporarily, if they have an idea for a symposium or workshop. And the committee is always looking for new members. People can contact Nakera or me with their interest.

AS: This is the season for membership renewal, so what's the value proposition for membership in the ASBMB?

EE: The ASBMB offers benefits for all members, no matter what their path or career stage — undergraduate students, graduate and postdoctoral trainees, young investigators, midcareer and senior scientists. Our training programs offer accredited certificates. We have seminars on managing your lab and your research team, writing successful grant proposals, transitioning from scientist to administrator and engaging with our public stakeholders.

Plus, we have three highly rated and impactful journals, and we run terrific scientific meetings. The ASBMB's got everything scientists can use throughout their entire career trajectory, and there's no reason not to be a lifelong member.

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

Boal, Gu, Cotruvo promoted at Penn State

Pennsylvania State University announced its list of academic promotions that took effect July 1. Three members of the American Society for Biochemistry and Molecular Biology were promoted: **Amie Boal, Ying Gu and Joseph Cotruvo Jr.**

Amie Boal is now a full professor of chemistry and biochemistry and molecular biology at the Eberly College of Science. Boal is part of the chemistry department's robust metalloenzymology group; her lab focuses on structural and mechanistic characterization of enzymes that use radical intermediates, including a group of enzymes called ribonucleotide reductases involved in DNA biosynthesis.

BOAL

Ying Gu is now a full professor of biochemistry and molecular biology at the Eberly College of Science. Her lab studies cellulose biosynthesis in plant cells, including lines of inquiry into how microtubules guide cellulose deposition and how cellulose synthase complexes, which operate on the extracellular side of the plasma membrane, are delivered to and recycled from those membranes.

GU

Joseph Cotruvo Jr. is now an associate professor of chemistry at the Eberly College of Science. Cotruvo studies metals in biological systems; his lab investigates how bacteria acquire and use rare earth elements called lanthanides and develops biochemical-based methods to detect, recover and separate these metals. His team also develops tools to study how iron and manganese function in infectious and neurodegenerative diseases.

COTRUVO

Emr receives award for ESCRT work

Scott Emr, a professor at Cornell University, got a lifetime achievement award in May during the American Society for Biochemistry and Molecular Biology's meeting on ESCRT biology in Madison, Wisconsin.

Endosomal sorting complexes required for transport, or ESCRTs, are sets of proteins that enable vesicles to bud out from, rather than into, the cytoplasm. They are required for formation of vesicles within endosomes, some types of viral envelope budding and release, and the final steps of cell division.

"Scott is generally acknowledged as the 'father' of our field, having discovered many of the ESCRT factors in yeast and defining their subcomplexes and different functions," meeting co-organizer Wes Sundquist of the University of Utah told ASBMB Today. Over the years, Emr's lab has identified more than a dozen ESCRT proteins in yeast and illuminated their roles in decoding lipid phosphorylation patterns, sorting cargo and bending membranes into new shapes.

Emr has been carrying out his research for four decades as a professor at Caltech; the University of California, San Diego; and most recently Cornell's Weill Institute for Cell and Molecular Biology, where he served as director.

He won the Shaw Prize in Life Science and Medicine last year and the ASBMB's Avanti Award in Lipids in 2007 and is an elected member of the National Academy of Sciences, the American Academy of Arts and Sciences, and the American Academy of Microbiology.

He's been a member of the ASBMB since 1991.

COURTESY OF JUAN MARTIN SERRANO

Scott Emr received a framed copy of his first ESCRT paper, which was signed by members of the lab, at the ASBMB's ESCRT biology meeting in May at the University of Wisconsin–Madison. Meeting co-organizer Anjon Audhya, left, presented Emr's lifetime achievement award.

NAS elects 2022 members

The National Academy of Sciences elected 120 new members in 2022. Nine of them are members of the American Society for Biochemistry and Molecular Biology: Joan Broderick, Alison Butler, William Clemons Jr., Jonathan Cohen, Jane Dyson, Daniel Goldberg, James Kadonaga, Benjamin Neel and Krzysztof Palczewski.

Joan Broderick is a professor of chemistry and biochemistry and chair of the department of chemistry at Montana State University in Bozeman. Broderick studies radical SAM enzymology and the assembly of iron–sulfur clusters. She earned her Ph.D. at Northwestern University. In addition to the National Academy of Sciences, she is a member of the American Academy of Arts and Sciences and a fellow in the American Association for the Advancement of Science. She has served on the ASBMB's Council since 2019 and is a longtime member of the editorial board of the Journal of Biological Chemistry.

Alison Butler is a distinguished professor of chemistry and biochemistry and associate vice chancellor for academic personnel at the University of California, Santa Barbara. Butler studies the biosynthesis, trafficking and activity of siderophores, small-molecule ligands that chelate iron to enable microbial uptake. Her lab also investigates analogs of catechol siderophores that mimic the wet adhesive properties of proteins mussels use for adhesion to surfaces, marine natural products that use vanadium to oxidize halides, and microbes that break down lignin polymers using metalloenzymes. She earned her Ph.D. at the University of California, San Diego, before pursuing postdoctoral research at the University of California, Los Angeles, and Caltech. Butler received this year's William H. Nichols Medal for significant and original contributions in chemistry from the American Chemical Society and is a fellow of the ACS and the American Academy of Arts and Sciences.

William Clemons Jr. is a professor of biochemistry at the California Institute of Technology. Broadly, his lab studies the structure and biogenesis of membrane proteins. Areas of focus include the tail-anchored membrane protein targeting pathway and the mechanism of membrane-bound enzymes that transfer glycans to and from lipid carriers. Clemons is a member of the Journal of Biological Chemistry editorial board and was elected an ASBMB fellow earlier this year. He earned his Ph.D. at the University of Utah and was a postdoc at Harvard Medical School.

Jonathan Cohen is distinguished chair in human nutrition research and a professor of internal medicine at the Center for Human Nutrition in the University of Texas Southwestern Medical Center. His lab, run jointly with Helen Hobbs, studies the genes involved in metabolism of cholesterol and triglycerides. Through human population genetics studies, they identified the drug target PCSK9 as an important determinant of plasma cholesterol levels and found the first genetic risk factor for fatty liver disease. Cohen earned his Ph.D. at the University of Cape Town and was a postdoctoral researcher at UT Southwestern before joining the faculty there.

Jane Dyson is a professor of integrative structural and computational biology at Scripps Research in La Jolla, California. Her lab uses nuclear magnetic resonance spectroscopy to study intrinsically disordered proteins, their folding and the complexes they form. She earned her Ph.D. in inorganic chemistry at the University of Sydney and was a postdoctoral fellow at the

NAS elects 2022 members CONTINUED

Massachusetts Institute of Technology. She returned to Australia as a lecturer at the University of New South Wales for five years before joining the faculty at Scripps. Dyson is the former editor-in-chief of the Biophysical Journal and received the International Society of Magnetic Resonance's ISMAR prize in 2019.

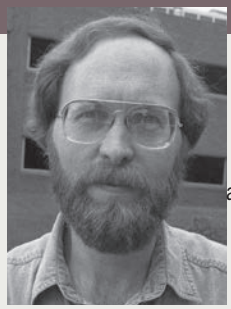
Daniel Goldberg is a distinguished professor in the departments of medicine and of molecular biology at Washington University School of Medicine in St. Louis. He studies Plasmodium falciparum, one of the family of parasites that can cause malaria. By combining biochemical, cell biological, genetic and proteomic approaches, Goldberg's lab looks for new drug targets in the P. falciparum proteome. They found, for example, that the parasite relies on isoleucine from its host, and they have started to define potential therapeutic targets involved in isoleucine metabolism. Goldberg is a fellow of the American Academy of Microbiology and received the 2013 Alice and C.C. Wang Award in Molecular Parasitology from the ASBMB. He earned his M.D. and Ph.D. at Washington University, held a postdoctoral fellowship at Rockefeller University, and completed further medical training in internal medicine and infectious diseases at Brigham and Women's Hospital and Washington University, respectively.

James Kadonaga is a professor of molecular biology in the University of California, San Diego, School of Biological Sciences. His lab studies transcription regulation and how core promoter elements interact with transcription factors. They also research changes in chromatin at the onset of transcription and previously investigated ATP-dependent chromatin assembly. Kadonaga earned his Ph.D. at Harvard University. As a postdoctoral researcher at the University of California, Berkeley, he developed a method for sequence-specific DNA affinity chromatography. Kadonaga is an elected member of the American Academy of Arts and Sciences, the American Academy of Microbiology, and the American Association for the Advancement of Science.

Benjamin Neel is a professor of medicine and director of the Perlmutter Cancer Center at New York University Langone Medical Center in New York City. His lab studies protein tyrosine phosphatases, which can act as important tumor suppressors, in cancer signaling; mutations to protein tyrosine phosphatases also cause roughly half of cases of a rare genetic disorder called Noonan syndrome. The lab also pursues research into cancer sensitivity and resistance to various therapies, including phosphatase inhibitors. Neel earned his M.D. at Cornell University and his Ph.D. at Rockefeller University, where he studied viral oncology. Prior to working at New York University, he was a faculty member at Harvard Medical School and head of cancer biology at Beth Israel Deaconess Medical Center, and before that he was director of research at Princess Margaret Cancer Center in Toronto.

Krzysztof Palczewski is a professor and director of the Center for Translational Vision Research and also belongs to the departments of ophthalmology, physiology and biophysics at the University of California, Irvine. Palczewski's research focuses on rhodopsin, a G protein–coupled receptor crucial for vision. His lab solved several structures of the photoreceptor in the early 2000s. Now they focus on understanding and developing treatments for retinal degeneration and diabetic retinopathy. Prior to joining the faculty at UC Irvine, Palczewski was a professor at the University of Washington and at Case Western Reserve University.

Rodney F. Boyer



Rodney Frederick Boyer, an emeritus professor at Hope College, a well-known biochemistry educator, and member of the American Society for Biochemistry and Molecular Biology since 1983, died Feb. 28. He was 79 and had Huntington's disease.

Boyer was born Aug. 25, 1942, in Omaha, Nebraska. He received his bachelor's degree in chemistry and mathematics from Westmar College in Iowa and then headed to Colorado State University, where he earned a Ph.D. in 1970 with a focus on physical organic chemistry. At the University of Michigan Medical School in Ann Arbor, he continued his research as a National Institutes of Health postdoctoral fellow with biochemist Minor J. Coon, a pioneer in the cytochrome P450 field who later served as president of the ASBMB.

Boyer spent two years on the chemistry faculty at Grand Valley State University before joining the department of chemistry and biochemistry of Hope College in Holland, Michigan, in 1974. He remained at Hope for 26 years, was promoted to professor in 1985 and served as a department chair for six years. During a 1991 sabbatical leave, he worked with Nobel laureate Tom Cech at the University of Colorado in Boulder as an American Cancer Society scholar.

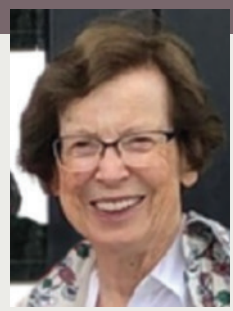
Boyer became interested in iron chemistry during his postdoc and continued to study the impact of oxidation and reduction of ferritin iron on various proteins and enzymes, such as apoferritin and superoxide dismutase, and plant phenolics. In addition to his research, he wrote textbooks for undergraduate students such as "Modern Experimental Biochemistry," and he continued to write after retiring from Hope College in 2000. He also served as an associate editor for the ASBMB-affiliated journal Biochemistry and Molecular Biology Education.

Boyer was fond of classical music and sang in the Bozeman Symphonic Choir after he retired to Montana. He is remembered as a "tough but fair" and helpful professor by students and as a kind, thoughtful person with a gentle spirit by his friends and colleagues, according to a family obituary.

He is survived by his wife, Christel I. Dröbig; brothers Dan and Roger Boyer; sister, LuAnn Thacker; sister-in-law, Joyce Boyer; and their families.

— Swarnali Roy

Doris Nicholls



Doris McEwan Nicholls, who helped develop the study of biosciences at York University and had been a member of the American Society for Biochemistry and Molecular Biology since 1975, died Aug. 17, 2021, the ASBMB learned recently. She was 94.

Born Jan. 24, 1927, in Bayfield, Ontario, to Fred and Ellen McEwan, Nicholls excelled academically from an early age. She earned bachelor's and master's degrees in botany, an M.D., and a Ph.D. in biochemistry, all from the University of Western Ontario.

Doris McEwan met her future husband, Ralph Nicholls, a physics professor, when a water leak in her lab overflowed into his lab, according to a memorial article on the YFile website. In 1965, the two were recruited to help establish York University in Toronto, where they both taught and conducted research into the 2000s.

Doris Nicholls studied numerous topics in her long career. In the 1950s, she published on how the adrenal gland responded to cold stress. In the 1960s, she studied how protein synthesis and phosphate metabolism changed in kidney disease. By the early 1970s, she was conducting fractionation and reintroduction experiments to identify protein factors that are important for translation; her lab identified a termination factor that was overexpressed in a mouse model of muscular dystrophy and also explored the ways that exposure to pesticides such as DDT upregulates protein synthesis. In the 1980s and 1990s, she investigated the effects of exposure to heavy metals on various tissues, with particular interest in how lead, cadmium and aluminum exposure changed mRNA expression and protein synthesis.

Nicholls mentored many graduate students and was considered an intelligent and caring professor. Ron Pearlman, an emeritus professor, described her as a colleague "who in her quiet but important way made strong contributions … to the development of the molecular biosciences at York."

Nicholls also was known for her ability to "recall a litany of facts on many subjects as well as names and places with a ferocity that was unparalleled," the article states, and all her life remained "compassionate, fun-loving and caring with an infectious laugh that seemed too big for her tiny frame."

Jacques Fresco

Jacques Fresco, an emeritus professor at Princeton University, a pioneer in DNA and RNA biochemistry, and a member of the American Society for Biochemistry and Molecular Biology for more than 60 years, died Dec. 5 of complications from heart disease. He was 93.

Born May 30, 1928, in New York to Sephardic Jewish immigrants from Turkey, Fresco spoke Ladino, a Judeo-Spanish language that originated in Spain in the 15th century, before he spoke English. After graduating from the Bronx High School of Science at the age of 16, he earned a B.A. in biology and chemistry, an M.S. in biology, and a Ph.D. in biochemistry, all from New York University, and then did a postdoc at Sloan Kettering Institute and worked as a research fellow at Harvard University.

Fresco joined the chemistry department at Princeton in 1960, and he helped found a biochemical sciences program that grew into a department he chaired for 20 years. He then moved to the molecular biology department soon after its creation in 1984. He served on the Princeton faculty for 53 years and was active in his lab until shortly before his death.

Beginning with his Ph.D. in 1952, Fresco worked on the chemistry of nucleic acids, Stephen Buratowski, a professor at Harvard Medical School who did his undergraduate thesis with Fresco in 1984, said in a Princeton obituary. "So when the famous Watson and Crick paper proposing a structure for DNA came out in 1953, he was perfectly positioned to ride the resulting wave of DNA mania. … He was a leader in showing that DNA and RNA conformations go well beyond the canonical 'Watson–Crick' base pairing of A–T and G–C within the double helix. Jacques' studies of triple helices and alternative base-pairings were foundational for understanding how DNA mutations occur and how RNA-based enzymes (for example, ribosomes, RNAi, and CRISPR) can function."

Fresco is survived by his wife of almost 64 years, Rosalie; daughters Lucille, Suzette and Linda and their husbands; eight grandchildren; and two great-grandchildren.

Thomas R. Tephly

Thomas "Tom" R. Tephly, a toxicology and glucuronidation researcher and a member of the American Society for Biochemistry and Molecular Biology for almost 50 years, died July 24, 2021, in Iowa City, Iowa, the ASBMB learned recently. He was 85.

Tephly was born Feb. 1, 1936, in Norwich, Connecticut, to Anna and Samuel Tephly. While recuperating from a broken leg, he started taking accordion lessons, and he had his own radio show by the time he was 10, playing popular polkas. He later learned to play the piano, clarinet and saxophone.

Tephly earned a B.S. in pharmacy from the University of Connecticut, a Ph.D. in pharmacology from the University of Wisconsin and an M.D. from the University of Minnesota, where he also did postdoctoral studies. He was on the faculty at the University of Michigan before he moved to the University of Iowa in 1971 to lead a new toxicology center. He retired 32 years later.

Tephly's early research on how methanol harms mammals through its conversion to formic acid led him to studies of aspartame, a dipeptide sweetener that was the subject of safety concerns linked to its metabolism to methanol during digestion. Studies found no evidence that ingesting aspartame introduced methanol into the bloodstream, and the Food and Drug Administration and National Cancer Institute concluded it was safe.

Tephly's lab identified several members of a family of enzymes called UDP-glucuronosyltransferases, or UGTs, which attach the sugar glucuronic acid onto hormones, drugs and xenobiotic molecules; Tephly studied their activity on opioids, chemotherapeutic drugs and other molecules.

Tephly married Joan Clifcorn in 1960, and the two raised three daughters. In addition to his lifelong love of music, he enjoyed college sports, cooking, birdwatching and telling his children and grandchildren stories about a naughty bear named Little Brown Bruno.

He is survived by his wife; daughters Susan, Linda and Annette and their husbands; and four granddaughters.

Building a focus on research

By Inayah Entzminger

Klea Hoxha and her family moved from Pogradec, Albania, to the United States when she was 15 years old. She was not fluent in English and unassimilated to the culture. Still, she applied for a research experience at Coastal Carolina University that she saw on a flyer in her high school chemistry professor's office, though she doubted that she would be accepted.

"The professor saw something in me, and I got accepted into the program," Hoxha said. "That summer, I did research on bacteriophages, and I knew that I wanted to come to Coastal Carolina."

Since then, she has not stopped doing research in the biomedical sciences.

Hoxha recently graduated with a major in biochemistry and a minor in applied mathematics and physics. She researched the structures of small regulatory RNA molecules in lactic acid bacteria and also did a separate physics project relating to therapeutic radiation on tissues. In addition to her research, Hoxha was president of the Chemistry and Biochemistry Club, vice president of the biology honor society TriBeta, and founder and president of the ASBMB Student Chapter at CCU.

Hoxha said she decided to establish the ASBMB chapter in the fall 2019 semester because she identified a disconnect between what the university provided and what the student body needed when it came to focusing on research. The ASBMB highlights recent research articles and scientists, and she wanted to share that with her classmates.

"We established a mentor–mentee program," Hoxha said. "We connected upperclassmen with freshmen based on their interests and personalities."

This program led to 80% of participating first-year students finding a research advisor and becoming involved with research.

The ASBMB chapter officers decided to pair new undergraduates with upperclassmen rather than professors because first-year students are often nervous about reaching out to professors, Hoxha said. The student pairing made the process of finding a research position less intimidating — and it built interest in the ASBMB. Hoxha's former mentee was elected as this year's chapter president.

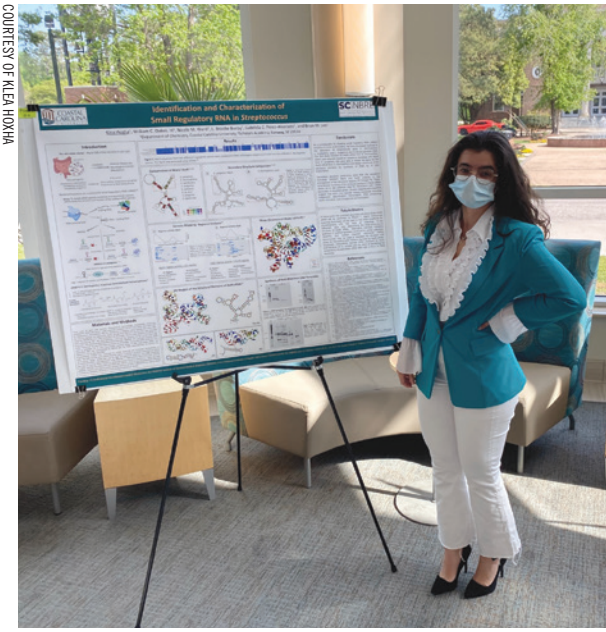
The CCU ASBMB Student Chapter hosts guest speakers who address topics such as how to get accepted into graduate school, how to read a research paper properly and how to apply to medical school. Hoxha also wanted to establish a journal club through the chapter.

The chapter also has collaborated with TriBeta and the Sustainability Club to do beach cleanups in the area. Attendance at these events has been high.

"You get to meet people from different backgrounds," Hoxha said. "I personally learned a lot about sustainability from these events."

Hoxha now is attending the medical physics doctoral program at the University of California, Los Angeles. She is interested in research in immunotherapy, particularly focused on cancer treatments and radiochemistry.

COURTESY OF KLEA HOXHA



Klea Hoxha presents her work on small regulatory RNA in Streptococus at the Undergraduate Research Competition at Coastal Carolina University in April.

Hoxha's interests extend beyond science. She is passionate about poetry and has written poetry since her first year of high school to help her cope with anxiety. One of her dreams is to compete in women's physique and powerlifting.

Her advice for undergraduates in biochemistry is to take risks. "Do everything you can and don't stop trying," she said. "If you figure out what you don't like, that's the biggest step to finding out what you want to do for the rest of your life."

Inayah Entzminger (ientzminger@gradcenter.cuny.edu) is a doctoral student at the City University of New York Graduate Center, researching the positive RNA strand barley yellow dwarf virus.

Dec. 6: Early registration deadline for Deuel

The ASBMB Deuel Conference on Lipids is a forum for the presentation of new and unpublished data. Attendees enjoy an informal atmosphere that encourages free and open discussion. The conference will be held March 7–10 in Dana Point, California. The early registration deadline is Dec. 6, and the abstract deadline is Jan. 10. Learn more at asbmb.org/meetings-events/deuel.

Two new publications team members

Emily Ulrich joined the publications department as a technical editor at the end of June. She earned her Ph.D. in chemical biology from the University of Illinois Urbana-Champaign and completed postdoctoral research at the Massachusetts Institute of Technology.

Tyrone Lofton provides administrative support to the publications department. A Towson University graduate, Lofton studied molecular biology, biochemistry and bioinformatics on the biochemistry concentration track. He is a native of Washington, D.C., and a two-time AmeriCorps alum. In his spare time, he enjoys reading, hiking, rock climbing and horseback riding. He also is a mentor with a nonprofit serving youth in the foster care system.

Call for virtual scientific event proposals

The ASBMB provides members with a virtual platform to share scientific research and accomplishments and to discuss emerging topics and technologies with the BMB community. Society staff will manage the technical aspects, market the event and present the event live to a remote audience. Seminars are typically one to two hours long. A workshop or conference might be longer and even span several days.

Prospective organizers may submit proposals at any time. Decisions usually are made within four to six weeks. Submit a proposal at asbmb.org/meetings-events/propose-event.

Society recommends improvements to T32 program administration

Ruth L. Kirschstein Institutional National Research Service Award, or T32, programs provide and/or enhance an institution's ability to conduct predoctoral and postdoctoral training. The ASBMB has recommended several changes to the program to alleviate the administration burden of these training programs. Read more at asbmb.org/advocacy/position-statements.

ASBMB Public Affairs Advisory Committee meets with federal science agencies

In June, the American Society for Biochemistry and Molecular Biology Public Affairs Advisory Committee held a series of meetings with officials at the National Institutes of Health, the National Science Foundation and the Department of Energy. The PAAC advocated for policy changes that will benefit the biomedical research enterprise, such as improving training programs and increasing re-entry research supplements. Read more at asbmb.org/asbmb-today/policy.

Headquarters welcomes new finance chief

Matthew Hilliker joined the ASBMB as the director of finance in August. Hilliker is a certified public accountant with 10 years of experience with scientific societies. He has worked with nonprofit organizations as well as in public accounting. He earned his B.A. in accounting from the College of William and Mary in Virginia.

Preventing missed diagnoses of hyperekplexia in newborns

By Ken Farabaugh

People with hyperekplexia react profoundly to sudden noises, movements and touch.

"Loud noises such as clapping your hands can cause an excessive startle in newborns," explained Ghada Aboheimed, an assistant professor at King Saud University in Saudi Arabia and the lead author of a new study of the condition in the **Journal of Biological Chemistry**.

In addition to excessive startle response, hyperekplexia is characterized by nonepileptic seizures and extreme muscle stiffness that even can prevent voluntary movement. This rare condition often is diagnosed at birth and is known to be caused by dominant genetic mutations in GLRA1, SLC6A5, GLRB and several other genes that play roles in glycine-mediated signaling in the nervous system.

In the new study, Aboheimed and co-authors discovered in a newborn girl a novel mutation in GLRB that caused a recessive form of hyperekplexia. "We collected samples from hyperekplexia patients and their families from different hospitals in Saudi Arabia and analyzed the genetic cause of their disease using advanced sequencing and analysis technologies," he said.

The mutation that the team identified led to decreased expression of the beta-subunit of the glycine receptor ion channel. Using coimmunoprecipitation and confocal microscopy, the researchers found altered cellular localization of the α/β receptor dimer. Using patch clamp electrophysiology, they demonstrated reduced glycine sensitivity of the mutant receptor. The mutated residue, found on an outer transmembrane helix, introduced steric clashes that destabilized the protein and led to decreased activation of the ion channel upon glycine binding.

Aboheimed said that he hopes the identification of this and similar mutations can help doctors accurately diagnose hyperekplexia in newborns.

"When added to the epilepsy gene screening panels, (the genes) will help to avoid misdiagnosing hyperekplexia with epilepsy, resulting in early genetic diagnosis of the disease and preventing the use of multiple antiepileptic treatments administered to newborns, and potentially death due to apnea," he said.

People with hyperekplexia usually are treated with the drug clonazepam, which is an anti-anxiety and anti-spastic medication. The girl in Aboheimed's study found to have the novel mutation in GLRB responded well to clonazepam and is in school, he said.

"Studying rare diseases such as hyperekplexia can help patients' families understand the genetic cause of the disease and the inheritance mode … But working on such cases sometimes leads to identifying novel genes and thus further understanding the pathogenesis of the disease," he said. "Our next step is to identify other possible genes related to this disease to help us broaden our understanding of its pathology, and eventually to develop personalized treatment using gene therapy."

DOI: 10.1016/j.jbc.2022.102018

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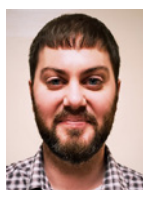


Targeting the lipid envelope to control COVID-19

By Chloe Kirk

Viruses can be grouped into enveloped or nonenveloped. When enveloped viruses are shed by the host cell, they take part of the cell's membrane and use it to surround themselves with a lipid envelope. Enveloped viruses include SARS-CoV-2, influenza and HIV. However, little research has been done on viral envelopes' composition or how they could be used to target the virus directly.

Early in the COVID-19 pandemic, governments around the world told people to wash their hands with soap and water for at least 20 seconds or use hand sanitizer with at least 60% ethanol to minimize the virus' spread; the idea was to dissolve the envelope. Valerie O'Donnell, a lipid biochemist and professor at Cardiff University, saw all this and asked one question: If soap can inactivate virus on our hands, could it do this in our throat?

"SARS-CoV-2 is being shed from the back of the throat, but no one is thinking about lipid membranes," she said. When she began her research, "All the focus (was) on vaccines."

In a recent **Journal of Lipid Research** publication, O'Donnell and a multidisciplinary team describe how they determined SARS-CoV-2's lipid envelope composition and began testing how to use this information to target virus envelope degradation with existing commercial products, such as oral rinses.

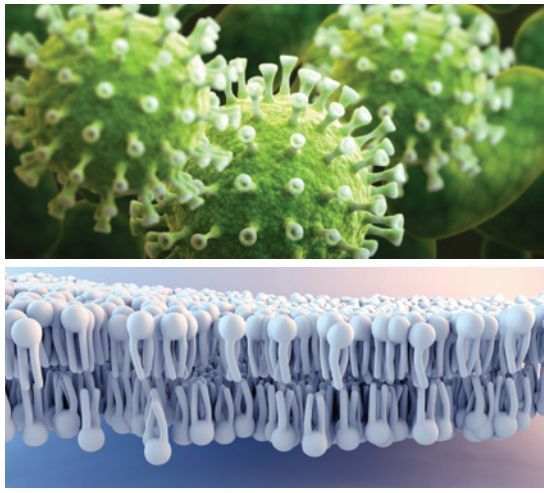
If the virus has a membrane similar to a cell, SARS-CoV-2 should be sensitive to detergents; by targeting the envelope, the researchers could target the virus itself. The team first focused on the composition of the envelope to answer the question, Is the virus' membrane similar to a cell membrane?

O'Donnell's team found that the SARS-CoV-2 virus envelope consists mainly of phospholipids with some cholesterol and sphingolipids. Compared with cellular membranes, the SARS-CoV-2 envelope has higher levels of aminophospholipids on the outer surface. Exposed aminophospholipids are known to promote a pro-inflammatory environment, which might contribute to inflammation-related problems in COVID-19.

The composition of the SARS-CoV-2 envelope is such that it should be disrupted easily using soaps (surfactants). O'Donnell next proposed testing this by teaming up with dentists and virologists to determine if any oral rinse or mouthwash on the market could target and destroy these virus envelopes.

In collaboration with Richard Stanton and David Thomas at Cardiff University, the researchers tested various mouthwashes on patients hospitalized with COVID-19. They found that mouthwashes containing the antiseptic cetylpyridinium chloride eliminated the virus for at least one hour in about half the patients tested, whereas povidone-iodine and saline mouthwashes had little or no effect.

In the future, the team plans to study how the inflammatory mechanisms of the cells might affect the composition of the viral lipid envelope.



Certain mouthwashes can disturb the lipid envelope of the SARS-CoV-2 molecule and affect the presence of the virus in patients.

"Vaccines are not a complete solution," O'Donnell said.

Preventive measures that target the virus in the throat or nasal passages have potential to combat COVID-19 transmission. Understanding the composition of SARS-CoV-2 lipid envelope membranes might provide new ways to target the virus and further elucidate how the virus interacts with host cells.

DOI: 10.1016/j.jlr.2022.100208

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Saving the bees with proteomics

By Elizabeth Stivison

You've probably heard about the bees dying. About a third of the world's food depends on pollinators such as bees, wasps, ants and butterflies — and we are losing them.

Boris Baer, professor for pollinator health at the Center for Integrated Bee Research at the University of California, Riverside, is an expert on this problem, and in a recent paper in the journal **Molecular & Cellular Proteomics**, he and his team describe how they have used proteomics creatively to help solve the pollinator crisis.

Many factors are hurting pollinators, including climate change, habitat loss and pesticide use. "We are losing all pollinators," Baer said. "But in the case of the bees, we are aware of it because beekeepers record the losses."

The U.S. has lost about two-thirds of its bee population since World War II; sometimes we resort to flying bees in from Australia or, as temperatures rise, even putting ice on top of hives so the wax doesn't melt.

Among the many threats to pollinators is one specific to honeybees: the mite Varroa destructor, which has infested most of the world's managed bee populations, weakening or killing whole colonies with the disease varroosis. And as if that weren't bad enough, mites also can act as vectors for other diseases.

"It's all doom and gloom. Why do we even continue to live on?" Baer said half-jokingly as he described this crisis. But he is, in fact, doing something about it.

BORIS BAER

A researcher collects naturally mite-resistant bees in the wild to bring back to the University of California, Riverside.

In his recent paper, Baer, collaborating with researchers in Ethiopia and China, compared three types of bees: the European honeybee, which is susceptible to the mite and is the honeybee most common in the U.S., and the African and Eastern honeybees (from Ethiopia and China, respectively), which are naturally resistant to the mite.

The researchers used proteomics to study this naturally occurring resistance and to begin identifying what factors may protect bees. They hope that down the line, beekeepers can use this information to breed resistant bees.

Baer hypothesized that the immune response of resistant bees might be different from that of susceptible bees. "Bees have immune systems," he said. "Bees can defend themselves. You just have to have the right bee."

Using bees of all three types, the lab exposed half of each type to mites and then compared the proteomes in the hemolymph (bee blood), identifying almost 2,000 proteins. As they had hoped, they found variation between those they had exposed to the mites and those they had not. Crucially, they also found variation between the types of bees.

When the researchers sorted through the data, the two resistant bee genotypes showed an enrichment of proteins related to the immune system and detoxification. This supported the team's hypothesis and could indicate that the resistant bees are mounting a stronger or different immune response to V. destructor, making it harder for the mites to take hold.

Baer's lab is planning next to figure out what exactly these particular proteins do and possibly set up a breeding program informed by this data. They also hope to study the Africanized bee, a hybrid cross between the susceptible European bee and the protected African bee that also shows resistance.

DOI: 10.1016/j.mcpro.2022.100257

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From the journals

By Isabel Casas, Preeti Karwal & Meric Ozturk

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

Essential lipids for a healthy skin barrier

Omega-O-acylceramides, or ω-O-acylCers, are essential components of the multilayered lipid assemblies and lipid envelope in the outermost layer of epidermis that forms the permeability barrier in mammalian skin. Consequently, changes in ω-O-acylCers levels cause skin abnormalities such as ichthyosis, characterized by dry, scaly skin. The synthesis of ω-O-acylCers via esterification of ω-hydroxyCers with linoleic acid requires a transacylase enzyme, PNPLA1.

In a recent paper published in the **Journal of Lipid Research**, Lukáš Opálka of Charles University in the Czech Republic and an international team of researchers studied ultrastructure of skin samples from neonatal mice lacking the Pnpla1 gene and reported disturbed lamellar lipid organization in the outer skin, indicating that linoleate moiety of ω-O-acylCers plays a role in lamellar pairing and lipid assembly.

The researchers also studied the impact of ω-O-acylCers deficiency on the skin barrier's lipid assembly using models composed of lipid subclasses containing ω-O-acylCers (healthy skin model), ω-hydroxyCers (Pnpla1 gene deletion) or a combination of the two. X-ray diffraction, infrared spectroscopy and permeability studies indicated that, although a medium lamellar phase is formed under favorable conditions, ω-hydroxyCers could not substitute for ω-O-acylCers in imparting barrier properties to the skin. The results of the study suggest that ω-O-acylCer supplementation is a therapeutic option in patients with dysfunctional PNPLA1.
DOI: 10.1016/j.jlr.2022.100226

A new target in stress granule formation

Eukaryotic cells exposed to insults such as heat, toxins, starvation or viruses assemble temporary stress granules localized in the cytoplasm. The structure and composition of stress granules depend on the nature of the stress; however, some proteins are key players in stress granule formation. G3BP1 is one of them.

G3BP1 is short for RAS GTPase–activating protein SH3 domain–binding protein 1. It's usually phosphorylated at serine residues, which affects stress granule assembly. However, scientists do not know yet whether G3BP1 is phosphorylated at tyrosine residues or completely understand the effects of this posttranslational modification.

In a **Journal of Biological Chemistry** article, Susana S-Y. Kim and colleagues at the Singapore Immunology Network and Agency for Science, Technology and Research describe their recent study of tyrosine phosphorylation effects on G3BP1.

The authors used a combination of immunoprecipitation and blotting to show that G3BP1 is tyrosine-phosphorylated when cells are stimulated with a simulator of viral infection. They used co-immunoprecipitation and inhibitor studies to show that Bruton's tyrosine kinase, or BTK, binds and phosphorylates G3BP1. Microscopy and mutational and biochemical cross-linking confirmed that tyrosine 40 residue is phosphorylated by BTK and is critical for G3BP1 oligomerization.

The authors conclude that G3BP1 phosphorylation by BTK induces its oligomerization, facilitating the condensation of ribonucleoprotein complexes into macromolecular aggregates, which shows how sensing of viral RNA by immune receptors leads to the formation of stress granules via tyrosine phosphorylation.
DOI: 10.1016/j.jbc.2022.102231

Shedding light on the omics of a model cell line

With half a billion people suffering from diabetes, scientists have long worked to cure the disease. Beta cells are a main focus of diabetes research because they produce, store and release the hormone insulin. When a person has diabetes, the body cannot produce or use insulin efficiently, indicating that beta cells do not maintain their normal function in patients with diabetes.

Beta cells are found in the human pancreas, so to understand their functions and malfunctions, scientists need high-quality pancreatic islets. Isolating beta cells from pancreatic islets is difficult, and primary human islets rapidly lose their functions in experimental laboratory conditions. To circumvent these limitations, several models for human beta cells have been developed for research purposes, including the widely used

EndoC-βH1 line.

Using functional and proteomic studies, researchers have validated EndoC-βH1 cells as a model for studying diabetes in the lab. However, no one had compared ectopic expression patterns in this cell line to those in human beta cells systematically until Maria Ryaboshapkina of AstraZeneca in Gothenburg, Sweden, and a group of colleagues performed these comparisons for their recent study published in the journal **Molecular & Cellular Proteomics**.

The researchers compared the transcriptome and proteome of the EndoC-βH1 cell line with adult human beta cells and found that they are 90% identical. Then, they analyzed the secretome of EndoC-βH1 cells using data-independent acquisition proteomics. The team found that the secretome of beta cells is more extensive than previously thought. While the results support previous findings about the validity of EndoC-βH1 cells as beta cell models, they also suggest the secretome of beta cells can provide environmental information about the cell. Because cellular environment is the most important factor for drug and diagnostic studies, this information can be helpful to develop new treatments and diagnostic tests.
DOI: 10.1016/j.mcpro.2022.100229

How cardiolipin mediates ADP/ATP carrier modulation

Cardiolipin, or CL, is a unique phospholipid found in the inner mitochondrial membrane. CL helps maintain membrane architecture and regulate the activity of proteins including adenosine diphosphate and triphosphate carrier, or AAC. AAC catalyzes the exchange of ADP and ATP across the membrane by alter-

Using infant hair to diagnose a rare disease

Smith–Lemli–Opitz syndrome, or SLOS, is a rare autosomal disorder caused by mutation in the gene encoding the enzyme 7-dehydrocholesterol, or 7-DHC, reductase, which is involved in cholesterol biosynthesis.

SLOS affects 1 in 20,000 to 1 in 60,000 babies and is noticeable before or shortly after birth. Symptoms can include microcephaly (small head), polydactyly (extra fingers and toes), syndactyly (fused fingers and toes), slow growth, mild to severe intellectual disability, and immune and endocrine malfunction. SLOS frequently is associated with low plasma cholesterol levels, and clinical diagnosis is based on physical findings and the presence of elevated plasma levels of the cholesterol precursor 7-DHC. No cure for SLOS exists, but early diagnosis and treatment with extra cholesterol can improve symptoms.

In a paper recently published in the **Journal of Lipid Research**, Yitao Luo, Chengqiang Zhang and a multi-institutional research team in China describe how they developed a simple method to measure 7-DHC and cholesterol in human hair simultaneously for SLOS diagnosis.

In this study, the researchers completely pulverized infant hair samples, extracted their biochemical components and then conducted microwave-assisted derivation and analysis by gas chromatography–mass spectrometry, or GC-MS. They found that the sensitivity of the GC-MS based analytical method was significantly higher and the linearity range was wider than reported for previously published methods. They validated the new method using authentic neonatal hair samples collected from 14 healthy infants and two infants with syndactyly whom doctors suspected of having SLOS.

The researchers believe that this method for measurement of two diagnostic biomarkers for SLOS using human hair is likely to be more accurate than conventional methods using plasma or serum whose biochemical composition can fluctuate in response to diet and environment.
DOI: 10.1016/j.jlr.2022.100228

— Preeti Karwal

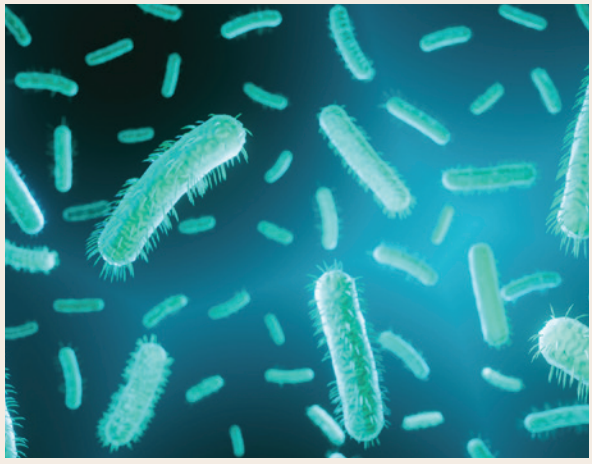
Protein interaction in the bacterial divisome

Bacterial cells divide using a protein complex called the divisome. In E. coli, more than 30 proteins form this complex, about 10 of which are essential. When the complex works, the mother cell undergoes cytokinesis, constriction and septation and divides into two daughter cells.

FtsQ, FtsB and FtsL are inner-membrane proteins that interact with one another and are essential for cell division; they play a critical role in regulating septal–peptidoglycan biosynthesis. Researchers have established the interactions among these three proteins but do not understand yet the mechanism in regulating peptidoglycan synthesis.

In a recent **Journal of Biological Chemistry** article, Wai-Po Kong and collaborators at the Hong Kong Polytechnic University used hydrogen–deuterium exchange mass spectrometry to investigate these proteins and their complexes. The authors also identified structural dynamic changes and related binding interfaces within the complexes.

The researchers showed that FtsB and FtsL interact at the periplasmic and transmembrane regions. The mass spectrometric results together with computational modeling showed that FtsBL



complexation may bring the constriction control domains in FtsB and FtsL into close proximity. The researchers also showed that in the FtsQBL complex, only FtsB interacts with FtsQ.

The authors state that this study provides experimental evidence of the interactions among these proteins and the role the FtsQBL complex plays in regulating divisome activity.

DOI: 10.1016/j.jbc.2022.102235

— **Isabel Casas**

nating between two conformations: cytosol-open, or ADP-waiting, and matrix-open, or ATP-waiting.

Qiuzi Yi, Shihao Yao and a team of researchers at the Children's Hospital, Zhejiang University School of Medicine, China, investigated how binding of CL affects structural dynamics of AAC by comparing molecular dynamics simulations on bovine AAC1 in lipid bilayers with and without CLs. The results published in the **Journal of Lipid Research** show that though CL binding does not affect overall stability or structural symmetry of AAC1, the pocket volumes of AAC1 and interactions involved in the matrix-gate network are more heterogeneous in parallel simulations with membranes containing CLs. The simulation results showed that CL is essential to form a strictly conserved arginine-rich stacking structure that can function as a structural switch for modulation.

While the study showed mechanisms of CL-mediated modulation of cytosol-open AAC function, further work on the matrix-open state and transition pathways between conformations may help better understand CL-mediated modulation of AAC function.

DOI: 10.1016/j.jlr.2022.100227

Interrogating the intricacies of the 'happy tree'

Terpene indole alkaloids help many flowering plants protect themselves against ultraviolet irradiation, fungal and bacterial infection, and attacks by hungry herbivores. These specialized metabolites also have been used for ages by people the world over for medicinal purposes.

A few species-specific pathways derive TIAs from common intermediates strictosidine or strictosidinic acid. The penultimate reaction in this pathway is catalyzed by either secologanin synthase or secologanic acid synthase — SLS or SLAS, respectively — depending on the precursor available in the plant. Researchers have identified SLSs and SLASs from different species but do not understand yet the determinants of selectivity.

In a recent **Journal of Biological Chemistry** article, Justin C. Miller and Mary A. Schuler at the Univer-

sity of Illinois Urbana-Champaign report findings that they say create opportunities for more tailored and varied production of TIAs.

The researchers combined molecular modeling and ancestral sequence reconstruction with biochemical techniques to identify the amino acid residues that affect SLS and SLAS selectivity in two enzymes from Camptotheca acuminata, a plant native to China whose Chinese name translates directly to "happy tree." The authors found key amino acid residues that, as they put it, "toggle SLS and SLAS selectivity."

The authors concluded, "As genetic and biochemical knowledge of specialized metabolism in plants continues to increase, studying the evolutionary development of biosynthetic pathways using methods like (ancestral sequence reconstruction) will aid the design of these pathways and the enzymes that constitute them."

DOI: 10.1016/j.jbc.2022.102237

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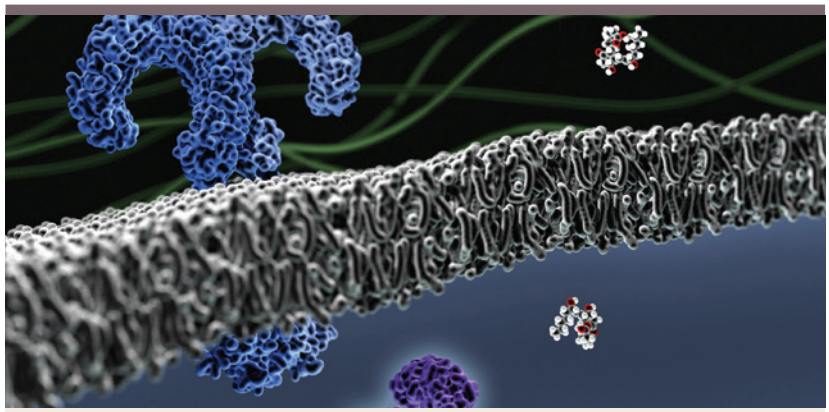


NIH MEDICAL ARTS

This image shows the extracellular matrix (upper), lipid bilayer (middle) and cellular components (bottom).

Effective washing for more membrane proteins

Nutrient transport, cellular respiration and photosynthesis, cell adhesion, and signal transduction are all essential for maintaining cellular homeostasis. Among the biological molecules that carry out these processes, membrane proteins play major roles. Thus, the more we learn about membrane proteins, the better we understand cellular processes, interactions and diseases.

Membrane proteins, especially integral membrane proteins, are embedded into membrane, expressed in low levels and unstable outside of the lipid bilayers, so purification is the most challenging step in studying them. Moreover, they interact with nonmembrane proteins using signal transduction, which makes it hard to get pure membrane protein samples. Although many scientists have worked on this problem, researchers still need more and better membrane protein purification techniques.

Sample preparation is the first step in membrane protein purification. The goal is to remove other proteins and molecules from the sample by membrane enrichment and then isolate the membrane proteins. Optimized membrane enrichment is crucial because contaminated samples give incorrect or low-quality results. Pornparn Kongpracha from the Jikei University School of Medicine and a team of colleagues in Japan focused on the initial step of sample preparation in a recent study published in **Molecular & Cellular Proteomics**.

Membrane enrichment includes a washing procedure that increases the proportion of detected membrane proteins by removing contaminant proteins. The group evaluated two membrane wash techniques, one using urea and the other alkaline. After the urea treatment, they detected twice as many membrane proteins as without treatment, and urea increased sixfold the numbers of multispanning transmembrane proteins such as ABC transporters and G protein–coupled receptors. The team concluded that urea wash is more effective than alkaline, and it's also easy to use; researchers who are not experts in proteomics easily can apply this protocol to their research.

DOI: 10.1016/j.mcpro.2022.100206

— **Meric Ozturk**

The climate change issue

EDITOR'S NOTE

What does biochemistry have to do with climate change?
More than you might think.

Biochemists are studying how organisms respond to escalating heat stress, altering global biogeochemistry. They are exploring new uses for DNA, to trace ecological shifts and archive information.

Industrial researchers investigate enzyme-based, sustainable manufacturing, while educators work to raise public awareness of climate change and to keep biochemistry relevant.

Even geologic carbon sequestration has a metagenomics story.

This special section explores a few of the many threads connecting biochemistry to the climate crisis.

— Laurel Oldach

What does biochemistry have to do with climate change?

A seminar course with a mission

By Laurel Oldach

Ask Karla Neugebauer about her journey to climate activism, and she highlights two moments.

The first was in 2006. She was on vacation in Australia's Northern Territory with her family, camping in the outback not far from Alice Springs. That part of Australia, known to some as the Red Centre, is beautiful, severe desert country — the kind of place where it's unwise to start a road trip without a five-gallon water tank and a spare tire. The rocks are russet. In the deep shade of narrow gullies in the MacDonnell mountain range, small pools of water cool the air around them, making small miracles of oasis.

Neugebauer read aloud on the road trip, as she often did when her children were young. She came to an article by paleontologist turned climate writer and activist Tim Flannery outlining the fiery future Australia faced if it maintained its inaction on climate change.

"Being immersed in the natural environment and then reading this thing was just kind of devastating," Neugebauer said. "I remember sitting in the back seat and just bawling."

At the time, she was a group leader at the Max Planck Institute of Molecular Cell Biology and Genetics in Germany. There was no clear link between her professional expertise, which concerns RNA splicing and gene expression, and the looming crisis.

YALE UNIVERSITY

Karla Neugebauer's interest in climate change was inspired by a driving trip in the Australian outback and a dinner conversation with her son.

More than decade later, she sat down to dinner with her son and a friend he had grown up with. The world had continued to careen down the path of escalating emissions and rising global temperatures Flannery had described. Neugebauer had moved to the U.S. by this time and had taken a faculty position at Yale, but her son, a young adult, had returned to Dresden for an internship. He and his friend had become involved in the Fridays for Future climate protests; sometimes, their friends had been arrested. If they did choose to go to college, both young men said, the only fields worth studying would be environmental engineering or politics — disciplines that could save the planet.

Their deep concern for the future galvanized her to act — and made her wonder why other areas of expertise did not also seem like productive tools for climate activists. "It disappointed me that other disciplines didn't come to their minds," Neugebauer said.

The more closely she looked at biochemistry, the less she could blame young people for overlooking its

COURTESY OF KARLA NEUGEBAUER

In her course, Karla Neugebauer encourages students to propose research projects that would answer open questions about the links between biochemistry and climate change — such as why red algae reduces cows' methane emissions.

relevance. When she canvassed other universities for ideas about how to teach the biology of climate science, she came up emptyhanded. At interdepartmental meetings she began to attend virtually a few years later, during the pandemic, she was the only biochemist in attendance.

Neugebauer argues that the field has become myopically focused on human health because of funding organized around diseases of individual organs. Even basic researchers must think and write in terms of curing disease to secure grants.

"I submit to you the work I'm doing on stress in HeLa cells is relevant to climate change — because I'm studying how gene expression changes to parameters that are going to change for the algae and the fish," Neugebauer said. Yet when she talks to her neighbors about her work, she hears herself describing applications in cancer. "I'm not curing cancer! I'm a basic scientist. I'm asking fundamental questions that I believe are terribly important for all of these reasons."

She illustrated that belief by launching an unconventional seminar in the fall of 2021. The course, called Biochemistry and our Changing Climate, explores the basic biochemistry that governs living systems' response to a changing world.

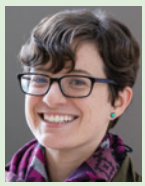
Neugebauer guides her students through discussions of articles that illuminate the core concepts of biochemistry in a climate context. She talks about the aromatic amino acid synthesis pathways that the pesticide Roundup inhibits and about how cell biological responses to heat stress contribute to coral bleaching. She talks about nitrogen fixation — a biochemical process that her department's core courses do not cover. She talks about engineering enzymes that could recycle plastics or entomb atmospheric carbon in building materials.

"People have a hard time understanding what I mean by a class about biochemistry and climate change," she said. The course isn't focused on ecology or on bioengineering. Instead, she seeks to explore on a molecular level the mechanisms by which climate change is affecting and will alter further the living world. It frustrates her when students ask questions that biochemistry clearly could answer — for example, What molecule from red algae reduces cows' methane emissions? — but has not.

She aims to show her students that biochemists have a role to play in understanding climate change and a role to play in adapting to and mitigating the crisis.

Neugebauer has spent time recently visiting other departments to tell them about her course. By the time you receive this magazine, she will be immersed in teaching it for a second time. "I'm on a mission to make people aware of this," she said.

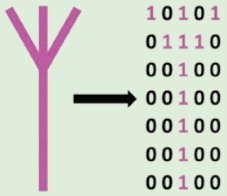
Laurel Oldach (loldach@asbmb.org) is a science writer for the ASBMB. Follow her on Twitter: @LaurelOld.



Artists, technologists bring data storage to life

By Heather Masson–Forsythe

The first time DNA was used for data storage was an art project. In 1996, Joe Davis' work titled "Microvenus" was published in Art Journal. The article described how he first converted the Germanic rune used to represent life and the female earth into binary code: a five-by-seven bitmap of ones and zeros. Subsequently, this was converted into a short DNA sequence to be put into living Escherichia coli cells.



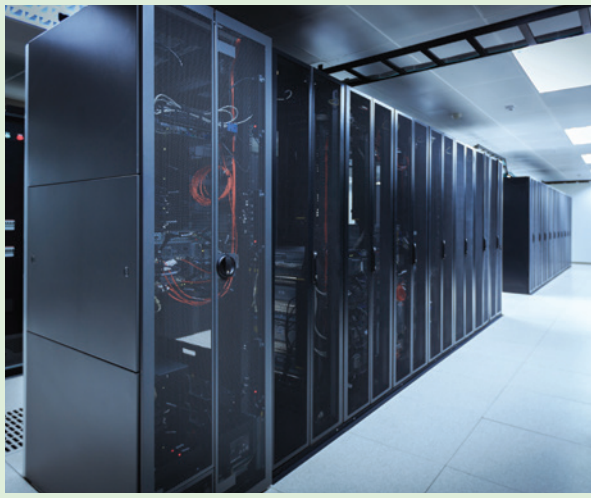
HEATHER MASSON-FORSYTHE

Microvenus, a Germanic rune used to represent life and the female earth, converted into a five-by-seven bitmap of ones and zeros.

This piece of art was left to reside in the E.coli. Still, it was a first step into a field that can help address the heavy climate impact of data storage. Instead of hard drives, data can be put into DNA by converting binary code into the four-letter nucleotide code. Today, other artists, bioengineering researchers and commercial stakeholders are working to make this technology as widespread as silicon chips for storing information.

Humans constantly are piling on to our data load. Saved emails, photos, medical records, browsing history, backups of all this data — it all has to go somewhere, and it takes a toll on the environment. By 2025, data generated globally is expected to reach 180 zettabytes, equal to 180 billion standard external hard drives that can hold 1 terabyte of data. Exabyte-scale data storage centers are environmentally and economically expensive. They take up significant space and require megawatts of energy and hundreds of millions of dollars to maintain. Additionally, scarce materials like silicon are required to manufacture the current data storage infrastructure. However, the need for data storage and the reality of its growth rate aren't going away. Ultimately, existing data storage technologies like tape and hard drive disks can't scale up to meet the impending demands — and if they could, the climate cost would be unsustainable.

"Even if you ignore the economics of the situation, it's gonna break," said Steffen Hellmold, the senior vice president of business development for data storage at Twist Bioscience, a synthetic biology company developing technology that overcomes inefficiencies and enables cost-effective, rapid, precise, high-throughput DNA synthesis and sequencing. Twist is also one of the founding members of the DNA Data Storage Alliance. The alliance, established in 2020, includes organizations from across industry and academia who are committed to harnessing DNA to alleviate the digital data storage burden. The group aims to educate the public about DNA data storage technology and plans to establish industry standards as the technology progresses.



Modern data storage centers demand significant energy, and advocates say that DNA could be a more sustainable alternative.

Jeff Nivala, a research assistant professor in the Allen School of Computer Science and Engineering at the University of Washington, said that DNA is advantageous for data storage because it is "super dense," allowing information to be stored without taking up much space. Additionally, DNA is incredibly durable, making it less energy intensive to maintain than current data storage centers. Nivala went on to say that DNA is "eternally relevant." Humans always will have reasons to read and write DNA, so storing information in this way does not run the risk of the language becoming outdated.

Hellmold from Twist noted similar benefits and said, "One of the wonderful things about DNA is that it has tremendous longevity. The longer you want to retain the data, the better

Grow Your Own Cloud, a group of artists, ran a mock flower shop to introduce visitors to the possibility of storing data in DNA.

DNA is for it." Because reading and writing DNA is still slow and expensive, for now, the best use of DNA storage will be for information that needs to be retained for long periods but not accessed often, such as big science data sets or health care records. Hellmold explained that another use is embedding DNA onto objects for labeling and record keeping. Nivala suggested some examples of how DNA labeling could be used, such as embedding DNA into paint to confirm that a piece of work is authentic. The technology also could be used to authenticate the source of food or other environmental resources, which could support more sustainable resource collection and distribution.

Since the creation of "Microvenus," scientists and entrepreneurs never have been the only ones pushing DNA data storage forward. A more recent art project imagines taking this technology a step further. The Grow Your Own Cloud team, including Cyrus Clarke and Monika Seyfried, invited people to a flower shop to encode their data, such as a picture of a loved one, into DNA and put it into a plant. At the event, participants learned about the concept of storing information in DNA and the possibilities it could open up. At the genesis of the project, it was mostly a thought experiment, and no data actually was being stored in plant DNA, but the project since has become more grounded in science with Nivala's help. Nivala learned about this art project when Clarke and Seyfried gave a public talk and soon became an advisor for the ongoing project. He since has contributed to several past exhibitions including SXSW 2020, Ars Electronica 2021 and Biennale Warszawa 2022 and upcoming exhibitions at ZKM and the Telefonica Foundation.

Nivala said that, at least for now, using DNA inside of plants is not necessarily more beneficial than using pure synthetic DNA for data storage. However, being able to store data inside of plants sets up potential for using plants to record new information about their environment. For example, cities all over the world already are filled with sensors monitoring factors like air pollution and water quality. One possibility is to replace these sensors by building biosensors into plants, which could store information about their environment inside of their own DNA for long periods. Additionally, cells are natural storage containers for DNA. Understanding how to move digital data into DNA and then into an organism could be used to expand and adapt DNA data storage technology. Researchers might incorporate plants or bacteria optimized for unique and extreme environments. But to reach this future of biologically contained data, more research is needed at each level of development.

From Twist, Hellmold, along with the senior vice president of corporate affairs, Angela Bitting, and DNA data storage senior director of product management, Daniel Chadash, talked about what they and others members of the DNA Storage Alliance would need to translate DNA storage into more common use. They said that they need more people with interdisciplinary backgrounds who understand both conventional data storage technology and biology. Ultimately, Hellmold said, all areas need more researchers to help reduce the cost and increase the efficiency of reading, writing and storing DNA. There is also work being done to automate all of these steps and scale up existing technology affordably. Alongside the ongoing engineering and research efforts, technology standards need to be established, biosecurity considered and an ecosystem of awareness built.

Hellmold said that science policy can help incentivize pushing this technology forward. For example, in 2019, the Office of the Director of National Intelligence launched the Intelligence Advanced Research Projects Activity (IARPA) Molecular Information Storage (MIST) program, which seeks to use sequence-controlled polymers like DNA to store digital information.

It won't completely replace other forms of data storage soon, but DNA storage is well suited for archiving data, offers a greener alternative to data centers, and it is on its way thanks to the intersection of scientists, artists, investors and policymakers.

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Microbes and minerals

As carbon mineralization projects ramp up, does subterranean ecology matter?

By Nicole Lynn

The need for negative emissions, the large-scale removal of carbon dioxide and other greenhouse gases from our atmosphere, has become increasingly important due to their contributions to our warming planet.

According to the NASA, Earth's surface temperature has risen approximately one degree Celsius since the 19th century, with most of the warming occurring in the last forty years, due to human activity. Another 1.5 to 2˚C increase in global temperature will lead to increases in extreme heat and weather events, rising sea levels, loss of global biodiversity, food shortages and more.

Carbon capture and sequestration, or CCS, technologies aim to capture excess atmospheric carbon dioxide to reduce greenhouse gasses. Geologic storage of CO_2 is a process that naturally occurs in Earth's subsurface. This naturally occurring phenomenon provides a safe and scalable means to reduce CO_2 in our atmosphere. CCS technologies still require a global effort in reducing emissions by reducing use of fossil fuels; however, CCS technology can help advance the efforts to reduce global warming.

One method of CCS is carbon mineralization, which involves sequestering CO_2 near industrial sites, like coal or geothermal power plants, and converting it into carbonate rock, such as calcium carbonate (chalk). There are two main types of geologic carbon mineralization: underground injection, and weathering in above-ground reactors.

During underground injection, CO_2 is captured as it leaves industrial sites and separated using chemical solvents. The captured carbon dioxide is pressurized to form a liquid, mixed with water, and then injected deep into the earth's metamorphous or igneous rocks, such as basalt. Water added to the pressurized CO_2 reacts and forms carbonic acid, a key driver in mineralization. The alkaline minerals in the rocks react with the pressurized CO_2 and fluid mixture, forming carbonate solids.

Above-ground mineralization uses reactors that mimic the natural weathering of silicate material. Industrial mineralization is accelerated compared to natural weathering, which occurs over timescales of

Most carbon mineralization research is dedicated to understanding technical challenges... researchers rarely consider the effects [it] may have on the ecosystems that may exist in these rocks.

The Hellisheiði geothermal plant at Hengill in southwest Iceland generates 303 megawatts of electricity and 404 megawatts of thermal energy.

CLIMATE BITS

Rising temperature imbalances carbon and nitrogen cycles' equilibria

Nitrogen fixation is a chemical process in which atmospheric nitrogen is converted to more reactive compounds such as ammonia, nitrates or nitrites. Bacteria and plants develop a mutualistic relationship where bacteria fix nitrogen and, in exchange, plants fix carbon. This leads to the largest input of nitrogen into the biosphere, which researchers have predicted is necessary for uptake of CO_2 by the biosphere. This led experts to believe nitrogen fixation mitigates climate change.

However, previous models did not account for the impact of rising temperatures on nitrogen and carbon fixation. In a new study, researchers at Columbia University sought to investigate this impact by growing tree seedlings at a variety of temperatures to find optimal temperatures for carbon fixation through photosynthesis and for nitrogen fixation. Studies on seedlings showed that a plant's uptake of CO_2 (as well as nitrogen) for growth may decrease with an increase in atmospheric temperature, leaving increased levels of carbon dioxide and atmospheric nitrogen in the environment. Photosynthesis was more efficient at lower temperatures than nitrogen fixation. Thus, a few degrees of warming potentially could increase or decrease nitrogen fixation rates depending on the species of trees and the rate of carbon fixation associated with the temperature rise.

— Meg Taylor

millions of years.

Most carbon mineralization research is dedicated to understanding its technical challenges and mechanisms as well as methods to improve the process. In contrast, researchers rarely consider the effects carbon mineralization may have on the ecosystems that may exist in these rocks.

In 2017, Emmanuelle Gérard and her colleagues at the Institut de Physique du Globe de Paris were the first to publish a study on the effects of underground carbon dioxide injection on microorganisms in basalt. The study was conducted in 2012 at the Hellisheiði geothermal plant, which lies on an active volcanic ridge in Iceland, encompassing three volcanoes.

Gérard's research focused on the fast-flow pathway, the arrival of the fastest flowing gas-charged water traveling through fractures and rubble in the basalt 400 to 800 meters below the surface after injection. They looked both at pure carbon dioxide dissolved in water and at a mixture derived from the purification of geothermal gas at Hellisheiði. "Our first idea was just to observe if there were microorganisms," Gérard said. "(Because of) how we think about carbonate formation, we were not thinking they will help form carbonate. But if they did, it would be good."

Gérard and her colleagues conducted their work on microorganisms and biodiversity at Hellisheiði during feasibility tests being done by Carbfix, a company focused on using carbon mineralization at industrial sites to reduce carbon dioxide emissions. The goal was to assess overall feasibility and method optimization. Carbfix still partners with the Hellisheiði power plant and is working to adapt and expand this technology into other industries, such as steel, iron and cement production.

The group reported "rapid and large" changes in biodiversity after CO_2 injection at high temperatures. Dissolution of basalt released ions such as magnesium, ferrous iron and calcium and stimulated growth of autotrophic and heterotrophic bacteria; these are bacterial species that use CO_2 and organic material for food, respectively.

Once the injections passed, the researchers observed a return of the resident bacteria. "We saw the microorganisms were perfectly adapted to each condition," Gérard said. "These community of bacteria are used to frequent change because they live in an area with natural plumes of volcanic gas. They can adapt to change and return to their normal state."

In contrast, the injection of the alternate gas mixture made from purified emissions from the geothermal plant (containing CO_2, hydrogen and hydrogen sulfide) dramatically shifted the ecosystem in favor of sulfur and iron oxidizing bacteria whose iron sulfate byproduct clogged the reservoir and made it impossible to continue the injection.

Gérard and her team's research offers insight into one portion of a much larger narrative. "We only have a window to one part of the story," Gérard said. "We were only able to observe the bacterial communities in the groundwater (or those) attached to the mineral particles in the regions of injection. What is happening to the carbon dioxide at the end of microbial fixation — for example, final storage in calcium carbonate, magnesium carbonate or iron carbonate — remains unknown."

Gérard and her colleagues tried analyzing mature microbes in deeper regions of rock, but the samples

were contaminated with clay, which absorbs DNA, making extraction nearly impossible. Follow-up studies were also increasingly difficult due to COVID-19 travel restrictions in 2020 and 2021.

Nonetheless, since 2017, research has increased in this field, including a 2021 study published in the journal Science of the Total Environment in which above-ground reactors were used to observe the effect of an increasing CO_2 gradient on microbial communities. Like Gérard's group, this study found certain elements of the injection mixture (specifically low versus high CO_2) could affect microbial life by suppressing certain bacterial activity and overall biodiversity.

While the research in carbon mineralization demonstrates a clear need to understand more about the impact on microbial life and biodiversity, it also offers a possibility to work alongside microbial life. Can we harness bacteria to enhance the carbon mineralization process?

In a 2017 study published in the Journal of Chemical Biology, scientists evaluated microbial mediated mineralization in sandstone using above-ground mineralization methods. Scientists found that acidic biofilms, clusters of microorganisms that stick to nonbiological surfaces, could accelerate dissolution of silicate minerals in a steel batch reactor. Proteobacteria and Firmicutes were predominant bacteria throughout the process. This suggests certain bacterial species may be useful in enhancing carbon mineralization; however, further research still is needed.

Understanding how the bacteria behave during these injections is important not only because it may be possible to aid carbon mineralization but also because unexpected bacterial blooms or behavior could impede the process.

The IPGP research group collect samples at the Hellisheiði geothermal plant in 2012 for microbial analysis. Left to right: Bénédicte Ménez, Rosalia Trias, Emmanuelle Gérard and Paul Le Campion.

"I think in every project for CO_2 injection into basalt, where life is possible, people should take microorganisms into account — some I am sure will decrease (or increase) mineralization," Gérard said. "We need to isolate these strains in the lab (helpful, or harmful), to understand their roles better."

While it remains unclear whether we can harness microbe metabolism to expedite carbon mineralization, it is apparent that these bugs both exist and are greatly perturbed in the process. "I think we need more study, but I hope that we can do something with this technique," Gérard said. "In Iceland we see it working at high temperatures, but not lower ones. … We need more testing to see if it is a feasible process for reducing CO_2 emissions at other sites."

While the research in carbon mineralization demonstrates a clear need to understand more about the impact on microbial life and biodiversity, it also offers a possibility to work alongside microbial life. Can we harness bacteria to enhance the carbon mineralization process?

Nicole Lynn (nalynn@ucla.edu) is a Ph.D. candidate at UCLA and a volunteer writer for ASBMB Today.

'A probiotic for the environment'?

Borgs on Earth potentially boost methane oxidation

By Ankita Arora

Scientists report in a preprint study that they have discovered extrachromosomal elements, or ECEs, that have the ability to assimilate genes from other archaea in wetland soils. According to a report in Chemical & Engineering News, when Jill Banfield shared the discovery during Thanksgiving dinner in 2020, her son proposed to name them "Borgs."

Remember the Borg, notorious villains in Star Trek? They were cybernetic aliens that assimilated technology and knowledge from other alien species to achieve perfection. However, the Borgs on Earth might be heroes, helping in methane oxidation that could mitigate climate change.

ECEs are genetic elements that exist independent of the chromosome; they can be anything from viral DNA to circular plasmids to linear megaplasmids. What exactly these Borgs are is still an unanswered question, but they are unique in that they share genes with archaea that oxidize methane.

Banfield, a geomicrobiologist at the Innovative Genomics Institute and the University of California, Berkeley, and the study's senior author, said, "I think that there's just a lot of extraordinary surprises out there in the natural world that we have not yet encountered. Some things we couldn't even imagine, and these Borgs just have a set of characteristics that are just beyond defying."

What makes Borgs unique?

Banfield's lab has a long history of using metagenomics to study terrestrial subsurface aqueous environments and soils across different habitats, from the deep subsurface in Japan to an aquifer adjacent to the Colorado River to wetlands in California.

"We work across various environments, because we hope that by looking at the different conditions, we can obtain general insights about microbial ecology and microbial community behavior," Banfield said.

While working on DNA from samples collected from soil of a vernal pool near Banfield's house in California, they found a mysterious linear element 1 megabase long. The enormous size and many novel features eliminated the possibility that the DNA belonged to either bacteriophages or plasmids.

Another possibility was that Borgs might be a new virus or bacterium. However, a further look into their genes ruled out that possibility; they lack genes that sustain life, such as ribosomal genes, and also don't have genes required for encapsulation of a virus.

"When I started looking at its genes, most of the genes, about 78%, were completely unknown. The ones that were getting hits were more archaeal in nature," said Basem Al-Shayab, a graduate student and the lead author of the study.

After identifying the first Borg sequence, the researchers extended their search to previously generated DNA datasets from different sites and identified nineteen different groups of Borgs that they named based on colors — black, orange, brown, and lilac Borgs.

Studying the common features among all the groups, the team con-

From left to right, geomicrobiologist Jill Banfield, grad student Basem-Al Shayab and lab alumnus Alex Crits-Christoph take samples at a vernal pool field in 2019.

ACC. SELFIE

cluded that what makes these Borgs novel is a set of properties together rather than a unique defining feature. They are large (660–1000 kilobases), and their DNA always ends with long inverted terminal repeats (1.5–2.0 kilobases). Their genome contains many rapidly evolving tandem direct repeats. Most importantly, they encode genes involved in methane oxidation.

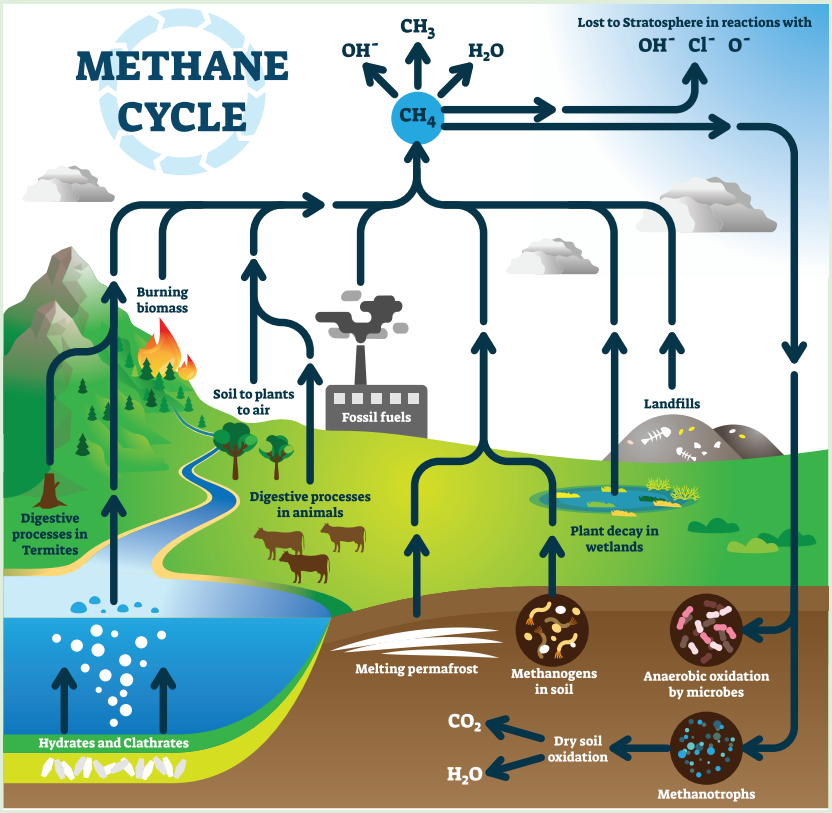
The Borgs were present mostly in deep, anaerobic, or oxygen-poor, soil and always cooccurred with DNA of a methane-oxidizing archaeon called Methanoperedens. In fact, many times, the copy numbers of the Borgs' DNA exceeded the Methanoperedens populations in these locales, signifying their importance to the ecosystem.

Further, specific local regions within the Borgs' DNA had a high GC content, matching the GC content in Methanoperedens, and a soaring similarity between some protein sequences suggests that these genes were transferred laterally from Methanoperedens. This implies that Methanoperedens host Borgs inside them, an inference supported by the observation that spacer sequences within the CRISPR array of Borgs matches the sequences from Methanoperedens.

"This is the first time to our knowledge that genes related to methane oxidation including the Methyl Coenzyme M reductase (MCR) were shown to be horizontally transferred," said Al-Shayab.

Cohabitation between Borgs and Methanoperedens

Given the enormous size and complexity of the Borg genome, there must be mechanisms in place that allow hosts and Borgs to coexist. In a follow-up preprint, the researchers hypothesized that the highly pervasive unique tandem direct repeats present between and within genes might help with cohabitation.



Soil microbes are an important source of methane. Methane-oxidizing species, such as Methanoperedens, can reduce total methane emissions.

"The repeats are a little bit reminiscent of some of these pieces of CRISPR repeats," said Banfield, who in 2006 introduced fellow University of California, Berkeley, scientist Jennifer Doudna to CRISPR . (Doudna, a co-author on the first Borg manuscript, later won the Nobel Prize for an invention to expand CRISPR for genome editing.) About the tandem repeats in the Borg genome, Banfield continued, "We don't understand the function fully, as we did not in the case of the repeats in the CRISPR locus originally. We found something enigmatic that, like CRISPR, is associated with microbial genomes."

On average, 50% of all the tandem repeats occur in protein coding regions, in stretches that are always divisible by three, suggesting very strong selection pressure to prevent disrupting reading frames. This means that these repeats result in amino acid tandem repeats.

Analysis using protein structure prediction software revealed that most of the proteins with these repeats have local flexible regions that can be modified posttranslationally by addition of phosphate or sugars and act as adaptors, allowing the Borg proteins to interact with the host proteome.

"While studying the Borg proteins, one thing that stood out to me was the sheer abundance of proteins that are involved in post-translational modification and sugar metabolism. Whatever this Borg is, it's probably going to change the cell decorations of its host," said Marie Schoelmerich, a postdoctoral fellow in the Banfield lab and the lead

author of the second preprint.

Banfield explained the phenomenon in simple terms in a Twitter thread. "Imagine an alien, landing on Earth with intent to cohabitate. Their alien technology wouldn't necessarily work natively with ours. In the same way, tandem repeats may be the adaptors that let the BORGs get to 'plug in' to the host's network!"

Borgs, wetlands and climate change

Methane is 30% more potent than CO_2 as a greenhouse gas and thus is an important driver of global warming. It is emitted from environments including wetlands and rice paddies under anaerobic conditions often caused by flooding.

Methanogens are archaeal microorganisms that produce methane as a metabolic byproduct under anaerobic conditions. Methanogens can be found in diverse habitats, from deep-sea hydrothermal vents to wetlands to the rumens of farm animals including cows and sheep. Hence, livestock, especially cattle, paddy fields and manure are among the top contributors to methane emissions.

Very few organisms can oxidize methane without oxygen, so the bulk of microbial methane oxidation to CO_2 happens very close to the surface, where the chances of releasing methane into the atmosphere are higher. Only a few archaeal microorganisms that use methane as a carbon and energy source, including Methanoperedens, can oxidize methane anaerobically under the surface, right at the source.

Bioinformatician Rohan Sachdeva and postdoc Marie Schoelmerich collect soil samples from the vernal pool field site in California in 2021.

DR. JILL BANFIELD

Grad student Basem-Al Shayab and lab alumnus Alex Crits-Christoph process soil samples at the vernal pool field site in 2019.

Methanoperedens conduct reverse methanogenesis coupled with either nitrogen or sulfate reduction to oxidize methane.

"The Borgs act as turbochargers, enhancing the capacity for methane oxidation anaerobically because they encode for genes/gene variants central to methane oxidation (MCR) pathway," said Banfield.

The lab thinks these genes either could extend the range of conditions under which methane can be oxidized or could increase the rate of oxidation. The Borgs could provide their hosts environmental resilience — that is, defense against challenges in the natural environment — by expanding their redox and respiratory capacity.

Recently, the Innovative Genomics Institute announced a new program funded by the Chan Zuckerberg Initiative to work on soils and crops to counter climate change. Banfield's lab is interested in finding ways to store more carbon in the soil and to preserve carbon reservoirs in the soil. Another facet is to develop methods to engineer plants to promote deeper carbon sequestration, where it is more likely to be stabilized.

What's in store for Borg research?

"I hope that we are going to be able to address questions like how Borgs are controlling and linked to their host experimentally. The Methanoperedens are hard to grow in a lab; I don't know if we will ever get Borgs into culture," said Schoelmerich. "I would like to knock out the MCR of the Borg and see if now the host is still able to oxidize methane with similar efficiency, so that we can actually validate what we are claiming."

An exciting possibility to pursue is to change environmental conditions such that Methanoperedens and its Borgs can achieve the widest range of capacity to oxidize methane. For instance, if a Methanoperedens host strain requires oxidation of methane coupled to iron reduction for its survival, then researchers could add oxidized iron to the soil.

"The dream might be to actually add those organisms … like a probiotic for the environment," said Banfield. "That's really pretty blue-sky, and we don't know it would work, but it's certainly worth thinking about."

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How to be a climate activist

A guide for biochemists

By Henry Jakubowski

When I walked into my chemistry class the morning of 9/11, the syllabus seemed irrelevant. We had to address the enormity of the unfolding events of that day, but how? All we could do was to hold those suffering in our hearts and minds and be kind to ourselves and others during that time of crisis.

Now we face an accelerating climate crisis, which will bring far worse consequences. How should we respond? As scientists and educators, we generally are held in high regard by our students and the public. We should use that regard as a platform to bring the tremendous financial and human costs of inaction on climate change to their attention. We should extend our professional ethics to include care for human and biosphere health, as well as issues of social justice, because climate change disproportionately affects those with the fewest resources.

I came to this conclusion five years ago when a new administration rolled back environment safeguards and withdrew the U.S. from the Paris Climate Accords. I started talking to anyone who would listen. A Ph.D. in biochemistry and decades of teaching and research experience gave me more than enough background to understand and distill the climate change literature. My experience teaching nonmajors' science and ethics courses made it easier to connect with the general public. Four years ago, I wrote for ASBMB Today on my climate change activism. I'll share some of my activities since then. I hope they will encourage you to try as well.

COURTESY OF HENRY JAKUBOSKI

Henry Jakubowski (center) and students from the College of St. Benedict/St. John's University attend Climate Change, Health of the Planet and the Future of Humanity, a conference held at the Pontifical Academy of Science in Vatican City in November 2018.

There are many ways to spread the message and many groups willing to listen to credible voices on climate change. I have discussed climate change on local radio talk shows and given talks at my institution and to church and civic groups. During a study-abroad semester in 2018, I arranged for my students to attend a climate change conference held at the Pontifical Academy of Science. Many students felt it was a highlight of the trip. On returning home, I worked with our theology department to invite a theologian to

We should extend our professional ethics to include care for human and biosphere health, as well as issues of social justice, because climate change disproportionately affects those with the fewest resources.

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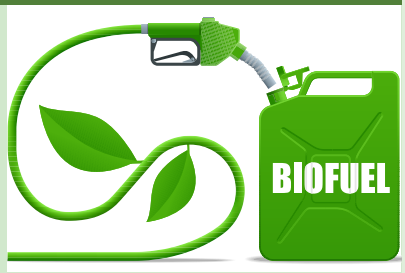

Engineering sustainable microbe factories to produce greener fuels

Plants often are thought of as the main consumers of atmospheric carbon dioxide, which they use to produce sugars through photosynthesis. Increases in the greenhouse gas CO_2, however, have led chemical engineers and synthetic biologists on a search for alternative life sources that could uptake these carbon molecules to help lower emission levels. Scientists at Northwestern University and Lanza Tech have harnessed a unique group of bacteria called acetogens to uptake carbon dioxide for the production of valuable industrial chemicals, such as isopropanol and acetate.

To harness the natural capabilities of these acetogens and maximize their output of desired products, these scientists engineered the microbes to be more efficient. They examined common metabolic enzymes and engineered pathways to increase enzyme production; given to the acetogens on plasmids, these pathways enabled optimal production of useful enzymes and minimized enzymes that may convert intermediates to undesired products. In addition, the scientists chose acetogen strains with knocked-out genes and pathways that further would increase the yield of their desired products. Finally, they examined industrial scale-up methods to ensure the products remained carbon negative.

They found that such products can be produced continuously in large bioreactors, with about 1.17–1.78 kilograms of CO_2 consumption per kilogram of product.

— Meg Taylor

speak on climate change and religion and tried to engage the local clergy in bringing climate change and creation/biosphere care into their routine ministries. I reached out to teachers in five local high schools to help organize students to develop a communitywide, student-led climate advocacy group. I've written multiple op-ed pieces for our local newspaper. Also, I led a team of graduate students and faculty to write an article for Biochemistry and Molecular Biology Education entitled "Introducing climate change into the biochemistry and molecular biology curriculum." In 2020, I retired and moved to New York City to help take care of grandchildren, who have made my mission even more urgent to me.

I've learned a lot about climate communication through these efforts. Here is my advice:

- Take every opportunity to link your course content to climate change. For example, when discussing carbonic anhydrase, talk about genetic engineering to enhance its carbon capture potential.
- Give talks to any community group you can. As scientists and educators, we are highly trained and generally respected. Use your agency and start talking! Use the 2022 IPCC report for background.
- Deemphasize scientific details. Studies suggest they won't help change people's minds. Start with the notion that we all know and feel that the climate is changing and simply state that the science is settled.
- Emphasize shared values such as environmental stewardship, care for life on earth, and concern for the quality of our children's and grandchildren's futures.
- Focus on solutions to address, mitigate and adapt to climate change. Emphasize renewable energy, which polling data show over 75% of people support, and the underappreciated and deadly health consequences of pollution from fossil fuel use.
- Give your audience hope but also an understanding of the urgent need to move on climate change.
- Give them a task — to reach out to their community (religious, civic, business) and elected leaders (local, state, national) and express their concern and request immediate action. The message can be simple: Take concrete climate action for the next generation now.

- Join organizations with likeminded people to sustain your efforts. I have found the Citizens' Climate Lobby a great source of support, motivation and outreach opportunities. They helped arrange for many of my outside speaking engagements.

The stakes are too high to do nothing. Do it for the generations that will inherit the warming earth we bequeathed them. You will feel better that you are trying to do your part to help.

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Bears, fungi and global warming

The exciting life of a climate researcher

By Caleigh Findley

If you are going to study the Alaskan boreal forest, there are a couple of things you need to know. First, if you encounter a bear, stand your ground. But if it's hungry enough, it still might eat you. Second, come rain, shine or storm that knocks the trees down around you, you must stay with your soil chamber and take measurements.

Kathleen Treseder, Ph.D., knows all too well the perils and wonders of studying the Alaskan boreal forest. Sometimes called "taiga," the boreal forest spans the interior and south central Alaskan landscape. It includes the Tongass National Forest, the largest national forest in the United States (16.8 million acres), and the Chugach National Forest, which comes in second place.

Treseder's fieldwork out in the Alaskan forest consisted of waiting for gas to build up in a chamber — most of the time. Many plants and wildlife adapted to the cold weather call this forest home, including grizzly and black bears. "One of the things we always had to keep an eye out for was bears. … You could run across some signs that a bear had been at the site just a few minutes before we arrived," Treseder said. "I'd be thinking, 'I've got to be sure if a bear charges me not to run.'"

But the conviction that drove Treseder to Alaska was undeterred by storm or possible bear sighting. After obtaining her bachelor's in biology from the University of Utah and her Ph.D. from Stanford, Treseder went to the University of California, Riverside, to study climate change. That's when she began her work investigating the Alaskan forest and the little creatures existing beneath the surface.

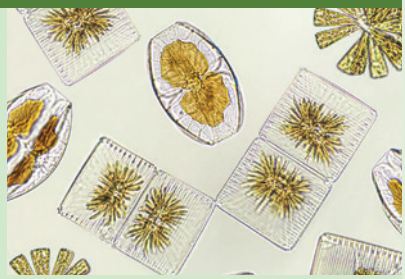
COURTESY OF KATHLEEN TRESEDER

One of many images of the Alaskan boreal forest landscape from Kathleen Treseder's private collection of field research photographs.

Climate change had gotten her attention in the 1990s during her time in college. "When I was an undergrad, I worked on restoring tropical rainforests in Borneo — restoring them from logging. I was thinking a lot about all the different ways that humans were harming the environment," Treseder says. As her studies continued, her concern grew for the environment and the impact climate change would have on her community.

Treseder's time at UC Riverside was transformative — the beginning of a wonderful career for the climate change activist and researcher. The Alaskan forest is a prime spot for climate research, because far northern

CLIMATE BITS



How zooplankton adapt to simultaneous oceanic warming and acidification

Climate change, particularly near coasts, is causing unprecedented levels of ocean warming, due to absorption of heat from the atmosphere, and of ocean acidification (a reduction in pH levels), due to carbon dioxide absorption. Predicting how these ecological factors could have niche-specific impacts on future generations of marine animals has been a challenge for scientists, as phenotypic changes could result from either genetic or environmental triggers. One way to account for these changes is by predictions of evolutionary rescue — where the rate of evolution outcompetes total extinction of a species. Using an estuary copepod to represent zooplankton present in marine food chains and ecosystems, scientists measured the plankton's evolutionary reproduction rate across 25 generations during which they increased temperature and CO_2 concentration. Although the plankton adapted to the environment after a few generations and maintained genetic diversity, the interaction between rising temperatures and acidification triggers from the environment complicated the interpretation of evolutionary rescue measurement for the species. Thus, the work calls climate biologists to use more robust measurements of evolutionary fitness of marine life.

— Meg Taylor

biomes house up to 30% of global terrestrial carbon in soils and plant biomass and have the potential to strongly influence atmospheric carbon dioxide concentration. Tundra and boreal forest ecosystems at higher latitudes are especially vulnerable to climate change, with projections indicating warming of 4-7°C by 2100.

"Wildfire is an example of climate change in the boreal forest because it's getting warmer up there, and … the forest floor dries out, and it makes it very easy to burn," Treseder said. While she was in Alaska, a huge wildfire occurred near one of her field sites. "So, we wanted to study right away — how did these fires affect the ecosystem, how fast would the ecosystem recover, and what role would fungi have in that recovery? I continued to work in that same system for the next couple of decades."

Fungi are the organisms at the heart of Treseder's longstanding research project in the Alaskan forest. This spore-producing kingdom includes a diverse range of species, such as yeasts, mushrooms and root fungi, that hold a vital role in the ecosystem. Fungi provide nutrients to plants and break down organic matter in the soil, releasing carbon dioxide, among other gases, during this process. They are a cornerstone for soil health — a fine balance that becomes disrupted by global warming, according to Treseder. "These fungi really are sensitive to climate change — all sorts of different aspects of climate change. Warming causes them to change their activities. Nitrogen pollution causes that. The fires cause them to change their activities. And a lot of times (we observe) really strong changes."

In her warming experiments, Treseder built an on-site greenhouse over the plots of boreal soil she wanted to study. The closed top chamber of the greenhouse passively warms the soil over time, allowing Treseder to simulate the effects of global warming on the soil. Evidence gathered from her previously published warming experiments showed that higher temperatures drive fungi to decompose microbes in the soil — releasing carbon dioxide in the process. Warming also causes fungal communities to shift toward lower abundance and higher diversity. This warming-induced shift favors fungi with an increased ability to break down carbon-storing molecules resistant to decomposition, which are called recalcitrant carbon.

COURTESY OF KATHLEEN TRESEDER

A greenhouse used for boreal soil warming experiments reported in Kathleen Treseder's 2008 publication in Global Change Biology.

Treseder's laboratory went on to show that the increased ability of fungi to break down organic matter reduces long-term soil carbon storage in the Alaskan forest. A potentially dangerous consequence is that carbon allocation moves above ground with the release of carbon dioxide during decomposition — feeding into the vicious cycle of climate change.

While fungi are small, their impact on the global environment is large. "We see plants — we know how important they are. And there are people who really care about trees … and try to protect (them)," Treseder explains. "But we just don't see the fungi in the soil … so it's not something that the average person really thinks about a lot."

Yet one type of fungi in particular fights to keep the peace — mycorrhizal fungi. Mycorrhizae are a biodiverse group of many fungal species that form symbiotic associations with plant roots and provide them with key nutrients. These root fungi combat climate change by offsetting greenhouse gases and keeping carbon in the soil. "That was a huge debate right when I started — do species matter with fungi? Now we know, absolutely they do," Treseder explains. Unfortunately, root fungi are not fire resistant. Increased wildfires driven by global warming worsen an already delicate system and drive down the root fungi population. Evidence shows that forest fires also stimulate microbial decomposition — promoting carbon dioxide release and depleting soil carbon storage over time.

Protecting the Alaskan boreal forest and other endangered ecosystems around the world is pivotal to fighting climate change. Longstanding efforts of scientists like Treseder have produced notable progress in climate understanding and research methodology. "In our field, I think we've been really hampered in the past by our technology," Treseder says. "Earlier at the start of my career, we were in a discovery phase, just kind of just discovering what is out there and all of that. And now I think we are in an analysis phase and an understanding phase."

Treseder no longer does fieldwork in Alaska, but she continues to work on the frontier of climate research as a professor at the University of California, Irvine. "What my lab's research is tending toward now is thinking really explicitly about humans and their role in the ecosystem … and again, there's that challenge with linking a fungus with society," she says. "If someone decides (whether) to drink their tap water in Santa Ana, how is that linked to a fungus that is growing in the neighborhood around them? That is a tough connection to try to study — but it's important."

COURTESY OF KATHLEEN TRESEDER

Kathleen Treseder (pictured far left) and her laboratory members stand among fireweed, a plant that is native to the Alaskan boreal forest.

Reaching for the human connection also has led Treseder to partner with social scientists to understand better what factors can impact societal response to climate change. One topic especially has invaded the collective consciousness of climate researchers. Often, when discussing climate change, an individual may feel grief and worry about future ramifications, a phenomenon called eco-grief. Such a reaction can interfere with public engagement and inhibit climate action, a problem Treseder hopes to continue working through. "(The) intersection between social science and natural sciences is, I think, the frontier now in my research."

Protecting the Alaskan boreal forest and other endangered ecosystems around the world is pivotal to fighting climate change. Longstanding efforts of scientists like Treseder have produced notable progress in climate understanding and research methodology.

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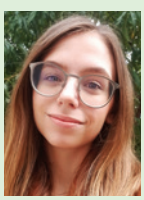


Regenerative agriculture: A boost for soil health

By Kamalika Saha

It is not an exaggeration to say that humans owe their existence to healthy soil. An unknown writer once said, "Man — despite his artistic pretensions, his sophistication, and his many accomplishments — owes his existence to a six-inch layer of topsoil and the fact that it rains!"

Soil is fundamental to agriculture, providing a global supply of food and raw materials for industry. It also can be an important tool in the fight against climate change. According to Jo Handelsman, director of the Wisconsin Institute for Discovery at the University of Wisconsin–Madison, there is three times as much carbon in soil worldwide as is in the atmosphere. She said, "It can be an enormous repository of carbon."

Currently, soil is under threat globally. Over the past few centuries, conversion of grasslands, peatlands and forests to agricultural land and pastures; urbanization; population growth; and climate change have led to unprecedented erosion and reduced soil fertility. The soil needs our help — and some farmers have begun to take action. Experts say that much more must be done to protect this fragile resource.

Handelsman said, "Soil is eroding much faster than it is being made. The average erosion rate in the US is 5 tons per acre per year. Soil is made at ⅒th to ⅒₀th of that rate, and the equation is not sustainable."

Duncan Cameron, a professor of soil and plant biology at the University of Sheffield, said, "A healthy soil has a breadcrumb-like structure, is dark brown or black in color (indicative of melanin and rich carbon content), and has an earthy wholesome smell produced by beneficial organisms." In contrast, degraded or unhealthy soil is dry and sandy, lacking structure and biodiversity. Degraded soils have reduced carbon content, cannot filter water effectively and do not support high crop yields.

According to a 2015 report by the United Nations Food and Agriculture Organization and the Intergovernmental Technical Panel on Soils, an estimated 90% of Earth's soils could be degraded by 2050 without any protective measures. Cameron said, "During my lifetime, we have lost a third of agriculture soils to erosion and degradation. The trends are continuing, and we haven't learned our lesson."

Those trends could have disastrous impacts on agriculture, food security and climate management. Handelsman said, "Soil degradation can

BOBBY TUCKER/OKFUSKEE FARMS

Bobby Tucker grows native grasses and fruit trees at Okfuskee Farms in Siler City, North Carolina.

generate greenhouse gases, and that's a problem. If soil cycles are driven in that direction, we can release a lot of carbon into the atmosphere."

Large-scale agricultural and land management practices are critical factors leading to soil degradation. Cameron said that intensive agriculture is analogous to in-field hydroponics and treats the soil as an inert medium holding the plants up. He said, "Total inversion plowing turns the soil to a significant depth and exposes it to the atmosphere, releasing carbon. It breaks the structure of the soil, which is a living, breathing ecosystem. When you destroy the soil to the scale at which intensive agriculture does, the natural processes are disrupted, making the soil incredibly vulnerable to erosion."

Plowing is not the only problem. Soil often is left barren between crops, promoting erosion, and excessive use of pesticides leads to the loss of beneficial soil organisms. Improper irrigation leads to soil salinification.

But there is hope for a healthier relationship between agriculture and soil. Cameron said, "The regenerative agriculture movement is the solution. It is a pragmatic framework to farming with the lowest possible footprint." Many smaller scale farmers have already adopted sustainable farming methods focused on soil health. There are also several large corporations that support regenerative agriculture practices in their operations, including PepsiCo, Walmart, GM, Unilever and Microsoft.

Meredith Leight, the owner of Granite Springs Farm in Pittsboro, North Carolina, has used regenerative farming techniques for the past 13 years. "Our agricultural practices can help mitigate climate change — the more carbon we can keep in the soil, the better it is. It is fascinating that the very practices that help us improve our food and make it more nutritious are the same practices that can help mitigate climate change — it is a no-brainer!" said Leight. At her farm, she adopts minimum tillage, cover cropping and liquid compost to add nutrients to the soil.

COURTESY GOOD HOPE FARMS

The manager of Good Hope Farm in Cary, North Carolina, and his team are putting nutrients back into the soil of this former tobacco farm.

Tom Saile, the farm manager at Good Hope Farm in Cary, North Carolina, said, "Conventional agricultural practices often involve the addition of chemical inputs, growing the plant and taking it away. Nothing is done to regenerate and rebuild the soil, resulting in nutrient depletion."

At Good Hope Farm, a historic homestead, a century of tobacco cultivation severely had depleted the soil of organic matter, biodiversity and critical nutrients such as nitrogen and phosphorus. With techniques similar to Leight's, Saile and his team are transforming the depleted sandy soil into fertile soil teeming with life. He said, "We are repeatedly putting nutrients back in the soil. Truly, the only sustainable way is to work with nature to grow our food."

Bobby Tucker, the owner of Okfuskee Farms, is a regenerative sheep farmer and a strong proponent of holistic land management. Tucker's sheep build soil health through rotational grazing. He packs them tightly in a strip of land where they feed on the plants, and their waste serves as an excellent soil amendment. Tucker said, "What drives me is creating more wildlife and a better environment for the critters. What's happening below the ground is as important as what's happening above!"

Handelsman said that currently, 30% of agricultural land in the US is no-till. She said, "We need to double that if we are serious about our soil." According to her, larger farms are well-positioned to adopt regenerative

Soil's many services

According to the Food and Agriculture Organization of the United Nations, soil provides many ecosystem services, including:

- Carbon sequestration: Soil can be a powerful agent to mitigate climate change. It sequesters carbon via the carbon cycle, in which organisms remove carbon dioxide from the atmosphere and store it in the soil. The most stable carbon pool is humus, or decomposed organic material, that stays in the deeper layers for centuries to millennia.
- Food security: Soil and agriculture are closely related. Humans and other terrestrial organisms depend on soil for their nourishment.
- Water quality: Soil biota regulates water retention and leaching of nutrients by nutrient cycling. For example, earthworms and ants are engineers and bioturbators, as they burrow into the soil and improve water filtration and retention.
- Biodiversity: Soil is one of the most significant biodiversity reserves; a handful of soil may contain 10 million to 100 million microbes, including bacteria, viruses, worms, fungi and more.
- Human health: Studies suggest that soil biodiversity impacts human health by boosting the nutrient content of our food and modulating our immune response. Well-fed plants lead to well-fed humans.
- Provisional services/raw materials: Soil provides the biomass required for raw materials such as wood, fiber and biofuel used to produce numerous goods.

practices. "They have the resources. The initial costs of the transition are made up in improved soil health and yield."

To speed up the transition, governing bodies must monitor soil resources closely and incentivize carbon-sequestering farming practices. Several agricultural agencies worldwide have launched programs to promote soil health. For example, the U.K.'s Healthy Soil, Healthy Food, Healthy People, or H3, program is a research consortium that aims to transform fundamentally the UK food system by focusing on the natural environment from the ground up. In Austria, the Humus Program of the Ökoregion Kaindorf awards farmers a success fee for improving their soil's organic content over time. The United States Department of Agriculture offers the Environmental Quality Incentives Program and the Conservation Stewardship Program to farmers and ranchers to promote soil health practices.

Cameron believes policies and market forces eventually will increase the adoption of sustainable farming practices. In the meantime, individuals can contribute to soil health locally.

Leight said that the collective effort of individuals growing a small amount of their total food sustainably could go a long way in destressing the environment, reducing transportation costs and preventing soil degradation in stressed lands.

"We also need to waste less food and relieve pressure on the agriculture system," Cameron said. According to the EPA, food constitutes 22% of solid municipal waste, and its decomposition in landfills increases greenhouse gasses in the atmosphere. Composting is a sustainable way of recycling food

COURTESY GOOD HOPE FARMS

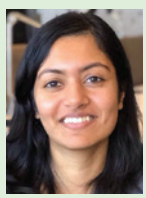
Lakshmi Ramakrishnan of LVS Organic Farms harvests potatoes on a plot at Good Hope Farm.

scraps and leaves into a nutrient-rich and valuable soil amendment. It is indeed a complete circle: The products originating from the soil return to the Earth to benefit it.

Finally, demand for food grown with soil health in mind can add up to promote better agricultural practices. Saile said, "Smart choices and consumer education are key. Your dollar is your vote for something that is sustainably produced. Building a local food system is our best strategy — get in touch with your farmers, and support the individuals who grow food sustainably."

It can take up to 1000 years to produce 2–3 centimeters of topsoil. Venture out, grab a handful of soil, feel the texture and see the life within! Let's all collectively build our soil — one particle at a time.

Kamalika Saha (Kamalika.saha@gmail.com) is a contributor to ASBMB Today.



CALeDNA: Tracking biodiversity at the molecular level

By Jen Elana Quick-Cleveland

An estimated 9 million kinds of plants, animals, protists and fungi live on Earth. Biodiversity loss is a major problem associated with human-made climate change. The current global rate of extinction is predicted to be nearly 100 times the baseline rate. But measuring those extinctions, or even accurately measuring the organisms that make up an ecosystem, is a challenge, since biodiversity assessment must include species from communities that cannot be observed by eye.

CALeDNA (pronounced cal-ee-DNA) is a partnership of scientists, universities and nonprofits focused on measuring ecosystems' biodiversity and how ecosystems change over space and time. To do this, they isolate environmental DNA, or eDNA — which organisms shed into the ecosystem — from water, soil or sediment samples. They use a method called metabarcoding to amplify and sequence specific genetic loci including ribosomes, internal transcribed spacers, and cytochromes and then identify a list of species with eDNA in each sample. Sample collections are archived at University of California labs as a resource for future projects.

The program emphasizes community involvement. CALeDNA organizes bioblitz events where community members and local organizations come together in the field to collect samples, photographs and geolocation data. The data from these projects are made publicly available through the CALeDNA website and data exploration web tool.

COURTESY RACHEL MEYER

CALeDNA director Rachel Meyer works in the field.

Rachel Meyer is the CALeDNA director at the University of California, Santa Cruz. She is also an adjunct assistant professor and part of the UCSC Paleogenomics Lab led by Beth Shapiro and Ed Green. I sat down with Rachel to learn what CALeDNA was all about.

What ideas led to this program? What challenges are you facing?

The idea was to get a biodiversity signature from DNA in the environment that could be systematically collected around the globe to balance out biodiversity observations and improve predictive models. The proof of concept came out of work with ancient DNA. Eske Willerslev and collaborators including Beth Shapiro were the first to show that you could extract ancient and modern DNA from environmental samples, be it ice cores, soil and sediment, or bones. Getting biodiversity data from eDNA was working, and people were excited about it in Europe but not as much in the States.

One of the reasons people have been reluctant to adopt eDNA in monitoring and modeling is people are skeptical about false positives and negatives. Another reason is we

COURTESY RACHEL MEYER

Community scientists and CALeDNA researchers collect samples.

just don't know how to put eDNA together with other data types to strengthen our analysis. When we started trying to analyze eDNA, the tools out there didn't meet our needs. We had to string together a lot of different software. Then, when we finally got results of species in different samples, we saw different species from what people recorded with traditional observations like photos. When you get an answer you don't expect, is that false? Or is there an eDNA realm we can't see? We have been answering these questions slowly with pilot studies.

Fascinating! What led you to your position as the CALeDNA program director?

I went to a Department of Defense conference on environmental conflict in 2016, and they were talking about predicting environmental conditions that cause conflict around the globe. A lot of this is based around water. None of their models included biodiversity; they said it was too hard. I felt like I could contribute to this work, and this led me to start looking for biodiversity research jobs.

What are your goals, and how close do you think you are to achieving them?

We want to be able to measure biodiversity accurately and measure how it changes, and we want to integrate eDNA data with as many other kinds of data as we can.

I think we are still 10 years away from making this standard, but we are getting out of perpetual pilot mode. We are repeating our pipeline now — not building it anymore — so we can start to stack up the pilot projects and glean patterns. And we have recently received financial support to start co-analyzing eDNA with remote sensing climate data from NASA, or functional chemical diversity data, hydrological or biogeochemical data, and anything else under the sun, so we can make sense of changes in biodiversity patterns. We need to broaden our collaboration community, and that takes time.

Rachel Meyer holds a CALeDNA tube with a barcode in archival ink to store samples as frozen collections.

COURTESY RACHEL MEYER

What do you mean by remote sensing and chemical diversity data?

Satellites can detect related species because they produce related spectral signatures, so you can map the community population of, for example, a forest canopy from space. You can detect stress responses from space. With models, you can map underground fungi from space. This is where we need to engage more with biochemists and molecular biologists. Let's ask questions about the rules of life, evolution and ecology and the missing metabolic or cellular links!

Wow! So what is the rate-limiting step to integrating all this data?

Honestly, it's collecting reference sequence data for species and understanding the different things we can measure from our environmental collections. 70% of DNA sequences from our data sets will be tossed because we don't know what species they are.

There are more interesting questions we want to get into. We track taxa, but what about genes? What about the proteins and their conformation or responses to the environment? We are building better analysis tools and infrastructure to ask these kinds of questions, and we hope researchers will play with the nearly 5,000 samples we have already archived.

Jen Elana Quick-Cleveland (jen.eqc@gmail.com) is a postdoctoral research fellow at the Center for Molecular Biology of RNA at UC Santa Cruz, and serves on the ASBMB editorial advisory board. Follow her on Twitter: @bi0_r0me0.

‘Filling the void of the virosphere’

Discovery of thousands of oceanic RNA virus species yields new insights into their roles in nature, including carbon capture

By Ankita Arora

Just one RNA virus, SARS-CoV-2, has changed the lives of billions of people in the past three years. What if I told you that a recent expedition found more than 5,500 new species of RNA viruses in oceans across the globe? Don’t be nervous. There’s little for humans to worry about. RNA viruses in the ocean are doing a lot more than just killing their hosts; they have a role in maintaining the equilibrium of the ocean ecosystem and may even help mitigate climate change.

The discovery of the new viruses was reported in the journal Science in April. The research team, led by microbiology professor Matthew Sullivan at Ohio State University, analyzed samples collected a decade ago by the Tara Oceans expedition.

Combining machine learning approaches, the team built a phylogenetic tree that, in the end, doubled the number of phyla (groups of species with similar characteristics) of RNA viruses from five to 10.

Guillermo Dominguez–Huerta, a postdoctoral scholar in Sullivan’s lab and a co-author on the paper, said, “What excites me the most is that we’re closer to understanding the real history of evolution and ecology of RNA viruses — what is happening with viruses in nature, specifically in the oceans.”

Tara: The unsung hero

The 36-meter schooner was built in 1989 for French doctor and explorer Jean-Louis Étienne, the first person to reach the North Pole by skiing solo. He used the ship to study the polar regions in Antarctica.

TARA OCEAN FOUNDATION

The researchers aboard the schooner Tara collected 40,000 ocean samples that allowed the discovery of more than 5,500 new marine RNA viruses.

A decade later, it was purchased by a famous regatta sailor, Peter Blake, who named it Seamaster and went on to win the America’s Cup twice for his native New Zealand. After retiring from sailing and driven by his love of oceans, Blake used the Seamaster to advocate for the importance of the oceans until he was fatally shot by pirates off the Brazilian coast in 2001.

The French fashion designer known as agnès b. and her son

CLIMATE BITS

Biocrusts in a changing climate

Biological soil crusts, or biocrusts, are fundamental communities in the world's deserts. Composed of photosynthetic soil organisms, including mosses, lichens and cyanobacteria, biocrusts increase soil fertility through nitrogen fixation and decrease soil erosion. Because these unique communities often are situated in regions that are warming at a rapid pace, ecologists recently have wondered about the resilience of biocrusts to mechanical disturbance and precipitation changes. Is their rate of recovery affected by the rise in warming temperatures globally? A study by U.S. Geological Survey scientists in the Colorado Plateau, published in Nature Climate Change, reviewed 15 years' worth of data to analyze the effects of warming on the composition of biocrust communities as well as downstream ecological effects, such as erosion control. Their findings highlighted the potential for rising temperatures to act as a new mechanism for land degradation via loss of soil stability and fertility.

— Meg Taylor

For more CLIMATE BITS, go to asbmb.org/asbmb-today.

TARA OCEAN FOUNDATION

Chris Bowler is research director at the Institut de Biologie de l'École Normale Supérieure in Paris and chair of the scientific committee at the Tara Ocean Foundation.

Étienne Bourgois acquired the ship, which they renamed Tara, in 2003 and founded the Tara Ocean Foundation to conduct scientific research for the protection of the ocean.

Tara left its French home port of Lorient for its first expedition in 2006 as part of the fourth International Polar Year, an interdisciplinary, collaborative and international program focused on polar research. With 11 crew members aboard collecting climate data, Tara spent months drifting with the sea ice of the Arctic Ocean.

"The Arctic Drift was a very difficult project. There were scientists on board who were alone for nine months," said Chris Bowler, research director at the Institut de Biologie de l'École Normale Supérieure in Paris and chair of the scientific committee at the Tara Ocean Foundation. "But they all made it, and it was a huge success as a research program, setting the foundation for using the ship to explore marine biodiversity and its relation to climate."

From 2009 to 2013, researchers aboard Tara collected samples from 210 sites in the Atlantic, Pacific, Arctic and Indian Oceans to showcase invisible aquatic life. At each sampling site, researchers sampled the whole water column from the surface to 1,000 meters below for all different kinds of microscopic life — from the smallest viruses (20 nanometers) to zooplankton (1–2 millimeters).

"These organisms cover five orders of magnitude. It's like going from an ant to a brontosaurus in a forest ecosystem," Bowler said. "These samples had been collected in a very standardized way, allowing ocean researchers across the globe to compare everything with everything else, and that was the beauty of our sampling."

Developing tools to study RNA viruses

Back in Ohio, Sullivan's group had studied DNA viruses in the ocean and their role in nutrient cycling for decades. However, studies of RNA viruses in the ocean have lagged, primarily due to lack of tools to identify them with high confidence. Also,

the fact that RNA is less stable than DNA in the environment didn't help.

Previous efforts to classify RNA viruses focused mostly on ones that cause livestock, plant or human illnesses. "But for viruses in the ocean, we didn't have any information about hosts, and there were no viral particles to study," Dominguez–Huerta said.

So the team decided the starting point was to sequence the RNA from organisms present in the ocean and then distinguish the RNA of the hosts from the RNA of the viruses.

"The journey from the expeditionary part of the project completed in 2013 by the Tara schooner to coming up with a catalog of RNA viruses from the ocean took us nearly 10 years," Bowler said.

The first hurdle was to establish a protocol to sequence the RNA from samples from the ocean, as they often are contaminated and degraded. The French National Sequencing Center (Genoscope) did that. The second challenge was to develop methods for analysis of the sequencing data, and that's where the Sullivan lab's expertise in bioinformatics and oceanic viruses was put in action.

The analysis to distinguish viral RNA was based on the sequence of a signature gene unique to RNA viruses called RNA-dependent RNA polymerase, or RdRp.

"RdRp has evolved for billions of years in RNA viruses and, hence, is highly divergent in its sequence, making it difficult to align through traditional methods," Dominguez–Huerta said. So the team resorted to using machine learning to organize the divergence of RdRp sequences by aligning only the functional domain of the protein, which should most accurately reflect its evolution.

Guillermo Dominguez-Huerta

In addition to the primary sequence of the RdRp, the team looked at the different kinds of genes the RNA viruses had, their genome architecture, and 3D structure of the RdRp to confirm the identification of five new phyla.

The most abundant newly identified species belong to a proposed phylum fittingly named Taraviricota.

"An intriguing feature of the phyla is that the 3D structure of the RdRp is very similar to reverse transcriptase (RNA-dependent DNA polymerase), suggesting that they might be a missing link in early RNA virus evolution and the origin of life," Dominguez–Huerta said.

RNA viruses and climate change

What are these viruses doing in the ocean? In a follow-up study, the

Reflection on the Tara Oceans expedition

Michael Sieracki of the National Science Foundation was among those aboard the Tara during the Tara Oceans expedition. In 2015, he published a reflection on the experience in the Bulletin of the Association for the Sciences of Limnology and Oceanography. Here's an excerpt:

"In some ways, Tara Oceans resembled an oceanography of the past — a throwback to the heroic era of expeditionary science — like the Challenger expedition or the voyage of the Beagle, or the early mountaineers and polar explorers. These days we get these experiences vicariously through robots on Mars, or GoPro videos of extreme gravity sports. To young scientists coming into our field I must say that the adventure of oceanography is not over. We must stay open to new ways of envisioning it and open to the risks to make it happen. Discovery is the soul of science. The rewards could be better than you can imagine."

TARA OCEAN FOUNDATION

Lea Olivier works in the wet lab aboard the Tara.

ON THE WEB

Look for these stories about climate change that we're posting this month on our website, asbmb.org/asbmbtoday:

Machine learning lends a hand to catalyze greener chemistry (Posts Nov. 2)
Enzymes are useful tools to catalyze chemical reactions at industrial scale — but sometimes, it's not obvious which enzyme to choose.

A mystery worm is threatening the future of Washington's oysters (Posts Nov. 5)
Clues from 1,000-year-old shells could reveal the parasite's past — and portend the future.

Climate change is altering the chemistry of wine (Posts Nov. 6)
Warming, wildfires and unpredictable weather threaten to disrupt the delicate processes that underlie treasured wines. Researchers and producers are innovating to keep ahead.

Tiny algae could help fix concrete's dirty little climate secret (Posts Nov. 12)
Four innovative ways to clean up this notoriously hard to decarbonize industry.

Sea turtle conservation gets boost from new DNA detection method (Posts Nov. 13)
University of Florida researchers sequence environmental DNA from genetic material shed as the turtles travel over beaches and in water.

Microbes enhance resilience of carbon-rich peatlands to warming (Posts Nov. 19)
Oak Ridge National Laboratory researchers discover that certain bacteria increase the climate resilience of a tiny plant responsible for storing a third of the world's soil carbon in peat bogs.

Proteins for a green energy future (Posts Nov. 20)
"We need giant steps, not small, if we are going to create the innovation in policies, political will, and technology needed to succeed with this existential problem," writes Vanderbilt's Borden Lacy.

TARA OCEAN FOUNDATION

The Tara collects water samples from 1,000 feet below the surface using Niskin bottles in a carousel that resists water pressure and collect samples at specific depths without them mixing with water from other depths.

Ohio team determined that they predominantly infect microbial eukaryotes, such as protist and fungal hosts, plus a few invertebrates.

These hosts play an important role in carbon export — the process by which carbon is pulled from the atmosphere, fixed into marine organisms and exported to the depths of the ocean as those organisms sink to the seafloor. By infecting these organisms, RNA viruses likely affect how carbon flows through the ocean at large.

RNA viruses also may drive carbon flux by splitting their hosts open during lysis and spilling sequestered carbon into the ocean.

"The team also unexpectedly discovered that 95 of the RNA viruses carried genes they'd 'stolen' from their host cells," Dominguez–Huerta said in an interview with Live Science.

In the host, these genes help to direct metabolic processes within the cell and hence were named auxiliary metabolic genes, or AMGs. This discovery suggests that the viruses manipulate their hosts' metabolisms to maximize production of new virus particles and evade host immunity.

The future for Tara and oceanic viruses

What the scientists aboard Tara and in labs on land have achieved is incredible, but the sampling is a mere snapshot of ocean diversity.

"What we have to do is to go back and do more longitudinal time series — to understand how the ocean is changing and what the future of the ocean looks like," Bowler said.

Dominguez–Huerta added: "This project was hard — to come up with the tools to identify viruses and make sure they're validated — but we're still very much at the beginning. We know about less than 1% of RNA viruses on the Earth. So many questions still need to be answered. Here, we're providing a roadmap for other researchers to start filling the void of the virosphere."

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

AWARD RECIPIENTS

OTHER DISCOVER BMB STORIES

ASBMB AWARD FOR EXEMPLARY CONTRIBUTIONS TO EDUCATION

K–12 to undergrad, Stevens–Truss helps all

By Jessica Desamero

"Education is the great equalizer. If you have an education, people can't take anything away from you. That's part of who you are."

This core belief motivated Regina Stevens–Truss to pursue her Ph.D. and remains a reason for all she does as a professor.

Growing up in Panama wasn't easy for Stevens–Truss; her unwed mother, who had immigrated from Colombia, died when she was 5. But she always loved science and math. After her father brought her to the United States, she continued her education.

With the encouragement of mentors over the years, Stevens–Truss earned a Ph.D. in medicinal chemistry from the University of Toledo. Now a professor in the department of chemistry and biochemistry at Kalamazoo College in Michigan, she will receive the 2023 ASBMB Award for Exemplary Contributions to Education in recognition of her commitment to students.

In addition to teaching and mentoring, Stevens–Truss has co-organized numerous ASBMB-sponsored workshops and meetings and co-chaired several interest groups, all focused on innovative teaching approaches.

A decade ago, when she was a member of the ASBMB's Minority Affairs (now Maximizing Access) Committee, Stevens–Truss said, the society had no programs to get high school students interested in science and ready for college. In 2012, she became a principal investigator of a National Science Foundation grant that funded a K–12 outreach initiative called the Hands-On Outreach to Promote Engagement in Science, or HOPES, project.

Also important to Stevens–Truss are social justice and inclusion. "I am always looking for the next way of impacting kids that look like me at all ages," she said.

Stevens–Truss teaches a class called Infection: Global Health and Social Justice, and she directs a Howard Hughes Medical Institute Inclusive Excellence grant that helps level the educational playing field for students from underrepresented backgrounds.

With creatively engaging teaching methods, Stevens–Truss brings science alive and sparks her students' continued interest in biochemistry. She's a compassionate role model as well as a pillar of support and guidance. And it's a two-way street.

"They inspire me, they keep me going, they really help me think hard about what I do," she said. "My students teach me, I think, just as much as they say I teach them."

HELPING, ENGAGING AND IMPACT

At Discover BMB 2023 in Seattle, Regina Stevens–Truss will recount how she got to where she is now.

"I'm a doer," she said. "I'm always going to try to figure out how to solve the problem, how to help others, how to help people that want to do this thing."

She also will talk about her educational philosophy: "I truly believe in engaging all parts of a human being in the process of learning. … If you're distracted by some things, you can't, in the moment, learn."

Her projects have had an impact on how others see the way they teach or approach learning. In a letter nominating Stevens–Truss for the ASBMB award, her colleague Ellis Bell wrote, "Those who have attended a workshop or meeting led by Regina know the infectious enthusiasm and passion she brings to her topic. … We all learn something that is of use to us in our teaching and pedagogy when we listen to Regina."

REGINA STEVENS-TRUSS

Jessica Desamero (jdesamero@gradcenter.cuny.edu) is a graduate student in the City University of New York's biochemistry Ph.D. program and volunteers with two science outreach organizations, BioBus and World Science Festival. Follow her on Twitter: @JessicaDesamero.

AVANTI AWARD IN LIPIDS

DeBose–Boyd has a recipe for success

By Christopher D. Radka

Two of Russell DeBose–Boyd's great passions are cholesterol synthesis and cooking. He says that being methodical, disciplined and focused are key ingredients of his approach to both, and this formula has guided his career.

Strong mentorship also has inspired his recipe for success, and he advises trainees on what to look for.

"First, find the right mentor, and that mentor doesn't have to look like you" he said. "I've never had a mentor who looks like me, and yet I've had great mentorship. Your mentor needs to give you honest and helpful advice and have a track record of mentoring other successful scientists."

"Second, build a mentorship team of people you trust who can guide your career and help you in professional development."

DeBose–Boyd is a researcher and professor at the University of Texas Southwestern Medical Center. His contributions to unraveling the complex regulation of cholesterol synthesis will be recognized at Discover BMB in March, where he will receive the American Society for Biochemistry and Molecular Biology's 2023 Avanti Award in Lipids.

His colleagues lauded DeBose–Boyd's expertise, life's work and collegiality in their letters of support for the award.

Robert Farese Jr. of the Harvard T.H. Chan School of Public Health (a 2022 Avanti Award recipient) described him as "an outstanding colleague, who is always available and eager to discuss ideas and think creatively."

Tom Rapoport of Harvard Medical School wrote that DeBose–Boyd's discoveries "have clarified important aspects of lipid metabolism. His work on the regulation of HMG CoA reductase degradation is simply outstanding. The experiments are beautifully designed and executed."

DeBose–Boyd serves on the ASBMB Finance Committee and as an associate editor of the Journal of Lipid Research and a member of the Journal of Biological Chemistry editorial board.

RUSSELL DEBOSE-BOYD

HOW CHOLESTEROL REGULATION IS LINKED TO VITAMIN K_2 SYNTHESIS

Russell DeBose–Boyd studies the highly regulated enzyme HMG-CoA reductase, the target of life-saving statin drugs that catalyzes a rate-limiting step in cholesterol synthesis. DeBose–Boyd has shown one mechanism for regulation of HMG-CoA reductase involving its sterol-accelerated degradation. He found that degradation of HMG-CoA reductase is inhibited by the protein UBIAD1, which uses geranylgeranyl pyrophosphate to synthesize a form of vitamin K_2. Binding of geranylgeranyl pyrophosphate to UBIAD1 enhances HMG-CoA reductase degradation.

Mutations in UBIAD1 that prevent geranylgeranyl pyrophosphate binding lead to the stabilization of HMG-CoA reductase and overaccumulation of cholesterol. In animals, this accumulation results in a corneal disease called Schnyder corneal dystrophy that significantly impairs vision.

When mouse embryos are genetically altered to remove UBIAD1, they do not survive. DeBose–Boyd discovered that this embryonic lethality is not caused by vitamin K_2 deficiency but by deficiency in HMG-CoA reductase that results from its enhanced degradation. He identified key residues in HMG-CoA reductase whose mutation blocked degradation and prevented the embryonic lethality associated with UBIAD1 deficiency. These UBIAD1-deficient mice are a novel model of vitamin K_2 deficiency, and studying them will show new physiological roles of the vitamin.

Christopher D. Radka (Christopher.Radka@stjude.org) is a postdoctoral fellow studying lipid biochemistry in the infectious diseases department of St. Jude Children's Research Hospital.

BERT AND NATALIE VALLEE AWARD IN BIOMEDICAL SCIENCE

Saphire is on the forefront of antibody therapeutics

By Caleigh Findley

Erica Ollmann Saphire's laboratory investigates the structure of deadly viruses such as Ebola and rabies to discover how they enter our cells and suppress our immune system — and what our antibodies do to stop them.

"I study the molecular interface where the human immune system sees a pathogen," Saphire said. "I take high-resolution images to understand what a successful immune response looks like or how the pathogens might negate that."

Saphire is a professor and the president and chief executive officer of the La Jolla Institute for Immunology. Her lab builds 3D models of viral proteins and finds clues in their molecular structure that reveal their methods and potential weak spots for therapeutic targeting.

"The high-resolution photographs also help explain how the pathogen works," she said. "How it manifests disease and where it is vulnerable to vaccines or treatments."

These insights help to inform vaccine development to combat some of the deadliest viruses known to humankind.

At Discover BMB 2023, the American Society for Biochemistry and Molecular Biology will honor Saphire with the Bert & Natalie Vallee Award in Biomedical Science for her work in basic biomedical research. This marks the second ASBMB award for Saphire, who received the society's Young Investigator Award in 2015 for discoveries made during the first 10 years of her career.

Not content to work in isolation, Saphire has harnessed the findings of her research to drive a collaborative innovation consortium of 44 previously competing laboratories to advance antibody therapeutics and international vaccine efforts against deadly viruses. She now leads another large consortium toward SARS-CoV-2 antibody therapeutics for the Bill & Melinda Gates Foundation.

"Molecular biology is a tremendously exciting frontier," she said. "There are new techniques and new ways of looking at things that didn't exist a few years ago. The opportunities to understand the secrets of how life works and make meaningful improvement for human health are endless."

EXPLORING VIRAL PATHOLOGY INSIDE THE CELL

Erica Ollmann Saphire's laboratory is running full speed ahead to the Discover BMB 2023 conference in Seattle. In her award talk, Saphire said she plans to present "some of the things my lab is most excited about now — which is developing structural biology beyond recombinant protein, beyond single particles, into studying the workings of the virus inside the cell that it infects."

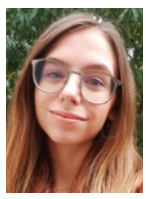
Diving into how viruses take over our cells can greatly expand our knowledge of how deadly infection occurs, she explained. "Viruses aren't alive by themselves. They need to take over and hijack your cell and conduct the molecules of your cell like how a conductor conducts an orchestra."

Saphire's research efforts could yield more potential targets for therapeutic intervention and aid in the fight against viral hemorrhagic fevers like Ebola.

"Understanding the structures and functions inside the cell is a new frontier for structural biology," she said, "and it's some of the most exciting work we are doing."

ERICA OLLMANN SAPHIRE

Caleigh Findley (cfindley68@siumed.edu) is a senior Ph.D. candidate in pharmacology and neuroscience at Southern Illinois University School of Medicine. Follow her on Twitter: @benchtopblog.



DELANO AWARD IN COMPUTATIONAL BIOLOGY

Ruppin synthesizes cross-field expertise to study synthetic lethality

By Laurel Oldach

Eytan Ruppin says one of his favorite talks to deliver is not about his research: "The title of my talk is 'How not to build a scientific career,' all the mistakes I made — and I made plenty."

Ruppin followed an unusual path to cancer functional genomics research. After medical school, he earned a Ph.D. in computer science in parallel to clinical training in psychiatry. For 10 years, he led a computational neuroscience lab. But around 2005, he became convinced that the brain would never be understood in his lifetime. "I went into computational biology and easier problems — like how to solve cancer," he said ironically.

By applying his expertise in predictive modeling to cancer metabolism, Ruppin came across synthetic lethality, a concept that has become important for cancer treatment. His work in this domain has earned him the American Society for Biochemistry and Molecular Biology's 2023 DeLano Award in Computational Biology.

Nowadays, Ruppin's lab uses insights into interactions between drug targets and cancer genomic events to try to predict how individual cancer patients will respond to specific treatments. Clinical trials using transcriptomic data from each patient's tumor to make a personalized treatment plan are under development at the National Cancer Institute, run by a company Ruppin founded but has since divested from. Meanwhile the lab continues to work at fine-tuning its predictions.

Recently, researchers in the lab have explored using single-cell transcriptomics to improve predictions about treatment efficacy. But to speed up progress, Ruppin said, the field needs many more public cancer transcriptomes. Projects like The Cancer Genome Atlas, he said, are "a drop in the sea," and the field has far to go to improve data availability.

EYTAN RUPPIN

MOVING SLOWLY FROM TRIUMPH TO TREATMENT

Synthetic lethality is a pairwise relationship between two genes; when either of the two loses function, the cell can survive, but when both are lost together, the combined effect kills the cell. Cancer inactivates many genes, especially tumor suppressors, so targeting their synthetic lethal partners can selectively kill tumor cells and spare normal ones. Eytan Ruppin's lab seeks data-driven ways to identify and harness synthetically lethal gene pairs.

In 2011, studying a rare cancer driven by a tumor suppressor mutation, Ruppin's and collaborator Eyal Gottlieb's teams found that inhibiting a synthetic lethal partner of a major tumor suppressor in kidney cancer, an intervention that is normally harmless, killed the cells. They could survive the loss of either function alone, but not both.

"It was a kind of triumph for genome-scale metabolic modeling," Ruppin said.

Moving to data-driven efforts, Ruppin's lab now looks for interactions across the whole genome of many cancers. With the increase in scale comes a loss in detail; the lab has little insight, Ruppin said, into the mechanisms by which synthetic lethal pairs interacts. Still, with experimental collaborators, they have identified potential treatments for uveal melanoma and pancreatic cancer that are now in clinical trials.

"This is just the beginning of a long journey," Ruppin said.

Laurel Oldach (loldach@asbmb.org) is a science writer for the ASBMB. Follow her on Twitter: @LaurelOld.

EARL AND THRESSA STADTMAN YOUNG SCHOLAR AWARD

Dixon uncovers a new type of cell death

By Renae Crossing

"Initially, no one believes you," Scott Dixon said. "The first time I gave a presentation about ferroptosis at a cell death conference and used that word, there were audible groans in the audience."

Yet scientists may one day induce ferroptosis in cancer, causing tumor cells to die, or put a stop to it in Lou Gehrig's disease, helping nerve cells to survive.

For spearheading the identification of an iron-dependent form of cell death and detailing its regulation ever since, Dixon has been awarded the American Society for Biochemistry and Molecular Biology's 2023 Earl and Thressa Stadtman Young Scholar Award.

In a nomination letter for Dixon, Brent Stockwell, a professor at Columbia University, wrote, "We learned more from his work on an erastin-driven cell death mechanism in two years than we cumulatively learned … over the preceding 11 years."

Dixon wasn't always decided on science.

"I won't pretend that I had the junior chemistry kit," he said. In fact, he didn't get excited about lab work until his third or fourth undergraduate year. Experiments in a lab course are "often a canned thing that people have been doing for decades, and it can feel a little bit unexciting," he said.

"But then you listen to a graduate teaching assistant tell you what they're doing … how they're building on some of this fundamental understanding to examine something really new … You can't help but get excited."

The words of graduate students grabbed him. "I realized I would like to experience research in that way and really ask a question that no one else has asked and see what kind of answers we can get."

Dixon has distributed tools that activate or inhibit ferroptosis so that other scientists can study it themselves. "Anyone can test this phenotype," he said. "Then they can see, 'Oh, wow. This actually turns up here, and it turns up here, and it turns up here.'"

SCOTT DIXON

BULKING AND SHREDDING

Ferroptosis comes from the words "ferro," meaning iron, and "ptosis," meaning dropping off (like leaves from a tree).

Before such a death, the inside of a cell swells. Eventually the membrane is "shredded," Scott Dixon said.

"If you'd asked people in the 1990s if it was possible for there to be a nonapoptotic form of cell death that is also regulated, the answer would generally have been no," Dixon said.

By the 2010s, hints existed in the literature, he said. Junying Yuan's work on necroptosis established the concept that there are nonapoptotic ways for cells to die that still require genetic and biochemical regulation.

"So, that cracked open the area quite widely for many others, including ourselves, to go on a few years later and propose additional mechanisms that weren't apoptosis, or (were) distinct from necroptosis."

Seeking examples of oxidation or the loss of certain metabolites associated with cell death, Dixon found older papers describing similar phenotypes.

His reaction? "Oh, that sounds a lot like ferroptosis," Dixon said. In some cases, the work was from decades ago, even before people realized that cell death is regulated.

"We just put the pieces together."

At Discover BMB 2023, Dixon, an associate professor at Stanford University, will present an update on the field of cell death.

Renae 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.

JBC HERBERT TABOR RESEARCH AWARD

Varki looks for clues in sialic acid

By Brian O'Flynn

"We published a major paper on cancer risks of red meat and went out to breakfast to celebrate," Ajit Varki said. "But the first author ordered bacon."

An unexpected connection to biochemistry has drawn Varki into, among other things, the human tendency to deny harsh realities.

The major paper he referred to illuminates such a reality: Red meat consumption significantly increases the risk of certain cancers. And Varki's group has found one culprit: A member of the sialic acid family of glycans that humans do not produce naturally and that can aggravate diseases such as cancer.

But Varki is no preacher. "It's hard to refuse Grandma's ham on Christmas Eve," he said. "Red meat is also part of many cultures and has important nutritive value."

For his work in the field of glycobiology, Varki will receive the American Society for Biochemistry and Molecular Biology's 2023 Journal of Biological Chemistry Herbert Tabor Research Award.

As a newly trained oncologist–hematologist wanting to study bone marrow transplantation, Varki realized that all cells in nature are covered in glycans, yet hardly anyone was studying this. He gained a postdoc spot in the lab of Stuart Kornfeld (the 2012 JBC Herbert Tabor awardee).

"I got so excited about studying glycans that I never went back to transplantation," Varki said.

His work led him to sialic acids. While seeing a patient with an immune reaction to horse serum (a previously administered antitoxin), Varki discovered that this reaction was linked to sialic acid. He was surprised; every vertebrate, including humans, has sialic acids.

Varki's group found that one kind of sialic acid with an added oxygen atom had been knocked out in humans probably about 2 million years ago. This was the first reported genetic difference between humans and our closest relatives, chimpanzees, of functional significance — and the first of many involving sialic acid biology unique to humans, which could explain several human-specific diseases.

GOING AGAINST EVOLUTIONARY DOGMA

AJIT VARKI

Ajit Varki's group at the University of California, San Diego School of Medicine recently has explored the grandmother effect, asking why human females can live so long after menopause. "The idea is that infertile grandmothers are selected for protection of infants and are helping their own genes," he said.

To aid this, a human-specific change in a sialic acid–recognizing gene, CD33, is recruited to combat Alzheimer's disease. "That goes against the evolutionary dogma that there is no selection against aging," Varki said.

Varki also suggests that the reality denial that helps humans cope with unpleasant realities is related to a "psychological evolutionary barrier" that only our species broke through. The negative consequences are very much with us today as the realities of climate change loom. But according to Varki, reality denial also gives us optimism.

"I grew up in India, and my grandfather was a friend of Mahatma Gandhi," he said. "I used to think, 'what the heck was this man trying to do — take on the British empire with nonviolence?' Totally ridiculous right? He paid the price, but a lot of good things came out of that optimism and sacrifice."

Brian O'Flynn (Brian.OFlynn@stjude.org) is a postdoctoral research fellow at St. Jude Children's Research Hospital in Memphis.

MILDRED COHN AWARD IN BIOLOGICAL CHEMISTRY

Kenworthy links quantity to theory

By Inayah Entzminger

Anne Kenworthy began doing lab science as an undergraduate at Kenyon College in Gambier, Ohio, but it was only after she moved on to graduate school that she realized the breadth of research at R1 institutions.

Kenworthy began doing biophysical studies as a grad student in the cell biology department at Duke University. Her adviser, Tom McIntosh, was a physicist by training and was investigating the forces between bilayers in the cell membrane.

"I found that work appealing," Kenworthy said. "It was very quantitative, and I enjoyed being able to take measurements that you could then relate back to a physical theory."

Now a professor at the University of Virginia School of Medicine, Kenworthy is the recipient of the American Society for Biochemistry and Molecular Biology's 2023 Mildred Cohn Award in Biological Chemistry. The award is named for the first female president of the ASBMB and honors scientists who have used innovative physical approaches to understand biological chemistry.

Kenworthy was nominated by Avril Somlyo, a UVA School of Medicine colleague who was previously Cohn's colleague at the University of Pennsylvania, for her contributions to the study of membrane structure and dynamics, including being one of the first researchers to apply fluorescence resonance energy transfer, or FRET, microscopy to the study of lipid rafts.

"Knowing Anne and having known Mildred as a colleague at the University of Pennsylvania, I believe it is an ideal match," Somlyo wrote.

In addition to her research, Kenworthy serves as an associate editor in the cell biophysics section of the Biophysical Journal and as faculty in the FLIM (fluorescence lifetime imaging microscopy) and FRET workshop at the Keck Center for Cellular Imaging at UVA. She considers it a natural part of her evolution as a researcher to contribute to the community by serving on editorial boards and study sections.

"You have an important role in helping to make sure that applicants get fair reviews," Kenworthy said. "You know that the best science can go on for funding agencies to make those final decisions."

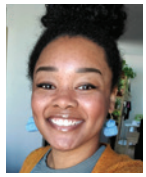
ANNE KENWORTHY

TAKING THE MEASURE OF LIPID RAFTS

Anne Kenworthy's lab in the Center for Membrane and Cell Physiology at the UVA School of Medicine studies cell membranes and the microdomains inside them, such as lipid rafts. Lipid raft microdomains contain certain concentrations of proteins in a small area that allow them to perform activities such as signaling and extracellular sensing. Caveolae, a special type of lipid raft, are dips in the plasma membrane that are built by caveolin proteins and that function in signaling and lipid homeostasis. Together with collaborators, the Kenworthy lab recently determined a high-resolution cryo-electron microscopy structure of the 3D form of a caveolin protein, a landmark achievement.

The lab also studies the structure and dynamics of lipid rafts themselves using techniques such as quantitative fluorescence microscopy, where the brightness level of fluorescence proteins is given a number compared to a control level of brightness and undergoes mathematical model analysis. Using fluorescence, the Kenworthy lab can measure on and off rates of transient protein binding events and measure the diffusion rate of lipids and proteins in the membrane.

Inayah Entzminger (ientzminger@gradcenter.cuny.edu) is a doctoral student at the City University of New York Graduate Center, researching the positive RNA strand barley yellow dwarf virus.



WALTER A. SHAW YOUNG INVESTIGATOR AWARD

Budin dives into the details

By Laura McCormick

As an undergraduate engineering major, Itay Budin discovered his love for biophysics and lipids during a summer research internship. His project focused on biochemically reconstituting membrane dynamics by adding purified proteins to lipid bilayers on a coverslip. While the lab was focused on the proteins' activity, Budin said he was struck by the dynamics of the lipids.

When he started graduate school at Harvard University, Budin discovered Jack Szostak's lab.

"Jack's lab is very interested in the origin of life. They're not a membrane biophysics lab," Budin said, "But I felt like they were the only ones that were really thinking deeply about the physical effects happening at the scale of lipids and single lipid molecules."

In the Szostak lab, Budin explored the biophysical properties that influenced the evolution of the cell membrane.

Near the end of his Ph.D., Budin won the Miller Institute Junior fellowship, which provided scientific independence during his postdoc. He chose to join Jay Keasling's lab at the University of California, Berkeley. Combining his love of lipids with the synthetic biology expertise of the Keasling lab, Budin learned to manipulate lipid composition to alter biological function. In particular, he demonstrated how changes in lipid saturation, and therefore membrane fluidity, influence cellular respiration.

Now an assistant professor of chemistry and biochemistry and bioengineering at the University of California, San Diego, Budin runs his own lab, exploring lipid research related to evolution, metabolism and human health. He is the 2023 winner of the American Society for Biochemistry and Molecular Biology's Walter A. Shaw Young Investigator Award.

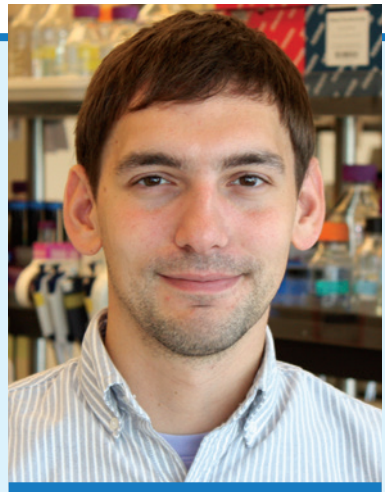
Although his lab encompasses numerous scientific fields, Budin still thinks of himself as a biophysicist.

"How my mind thinks is really at that level," he said. "Conformations and movements of molecules."

FROM SINGLE LIPIDS TO SYMBIOSIS

Itay Budin's lab focuses on the impact of lipid composition across many levels of biological organization.

Within the cell, Budin continues his postdoctoral work on mitochondria. Recently, his lab worked to predict mitochondrial membrane shapes — ranging from flat sheets to thin tubules or curvy cristae — based on lipid saturation. Elsewhere in the cytoplasm, Budin's lab explores membrane trafficking. Ultimately, he hopes to better understand human health and aging-related diseases by studying changes in the lipidome.



ITAY BUDIN

At the organismal level, Budin remains fascinated by the effect of environmental pressures upon lipids. Partnering with collaborators at the Monterey Bay Aquarium Research Institute, he demonstrated how the lipid composition of deep sea animals adapts to changes in temperature and pressure.

His lab also studies an unusual relationship between yeast and fruit flies. Although certain lipids are required for central nervous system function, fruit flies cannot synthesize them. Instead, they consume yeast as a dietary source of lipids. In turn, the fruit flies help transport yeast.

Studying wild Drosophila in an apple orchard, Budin found the flies consume different yeast populations — with distinct lipid profiles — as the seasons change.

"There's this kind of communication between yeast and flies," Budin said. "We're trying to understand how flies can choose or forage for yeast that gives them the right type of lipids that they need to withstand cold."

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

WILLIAM C. ROSE AWARD

Drennan makes science fun and accessible

By Sarah May

In high school, Cathy Drennan didn't want to study chemistry. An inspiring chemistry professor at Vassar College changed her mind. Now, she is a professor of chemistry and biology at the Massachusetts Institute of Technology and a Howard Hughes Medical Institute professor and investigator.

Drennan will receive the American Society for Biochemistry and Molecular Biology's 2023 William C. Rose Award for her outstanding contributions to biochemical research and commitment to training younger scientists.

Fresh out of college, Drennan taught chemistry, biology, physics and drama at Scattergood Friends School, a high school in West Branch, Iowa. Her theatrical experience became useful in the science classroom, where she found that being enthusiastic and sometimes over the top helped students learn.

Defying the stereotype of a serious professor, she wears themed outfits inspired by each lecture topic.

"Science is fun," she said. "Why are we not making this clear to people?"

Many students struggle to find role models in textbooks. That's why Drennan likes to provide her students with examples of chemists from diverse backgrounds.

The profession needs to highlight more scientists with disabilities, she said. As someone who has dyslexia and was told she wouldn't graduate from high school, she has become a role model for others with disabilities. Many students with dyslexia and their parents and teachers have reached out to her for advice, worried that it will be too difficult to pursue a science career with a disability. Often, she said, "they're the ones doing the best work in a creative way because their brain is working differently."

For Drennan, having people who believed in her made a huge difference. Now, she is paying it forward. In a letter recommending her for the Rose award, her former graduate student Lindsey Backman wrote, "She sees people's highest potential, and then she reassures them of their capabilities and brings out the best in them."

FORM EQUALS FUNCTION

When Cathy Drennan was being interviewed by graduate schools, it quickly became clear that she had a mind for structural biology. As she spoke with professors about their research, she said, she kept returning to the same question: "How can you understand something if you don't know what it looks like?

"Once I figured out that you could get the structural information, I was completely hooked."

CATHY DRENNAN

This devotion has led Drennan to solve many long-awaited protein structures using X-ray crystallography and cryo-electron microscopy. Her research mainly focuses on metalloenzymes, enzymes that use metal cofactors to catalyze chemical reactions.

Early on, Drennan solved the first structure of a vitamin B_{12}–dependent ribonucleotide reductase, a metalloenzyme that converts the building blocks of RNA into the building blocks of DNA. While she has solved structures of many other proteins, these vital enzymes have remained a long-standing theme of her research.

Recently, Drennan obtained the first snapshot of a ribonucleotide reductase in an active state, a groundbreaking feat that revealed how electrons move through the enzyme. Just as she's always recognized, she had to see the enzyme's form before she could understand its function.

Sarah May (sarahcmay@uchicago.edu) is a scientific writer at the University of Chicago. Follow her on Twitter: @sarahmayphd.

ASBMB EARLY-CAREER LEADERSHIP AWARD

Bhabha found creativity in hard science

By Heather Masson–Forsythe

As a high school student in India, Gira Bhabha was on a humanities track. It wasn't until she was an undergraduate studying psychology and English literature at the University of Chicago in the U.S. that she discovered her love of science while taking core science courses. When she switched to premed so she could attend veterinary school, her genetics professor, Jocelyn Malamy, reached out to her.

"She asked me if I had ever considered working in a lab, and I hadn't because I don't think I knew that research was a career," Bhabha said.

Malamy helped her find Elizabeth McNally's lab, which studied the genetics of cardiovascular and neuromuscular disorders, and there Bhabha "got sucked up into research," she said. "I don't think I realized how creative it was. Until you are immersed in it, you don't always associate the hard sciences with creativity and being able to explore."

Now an assistant professor at the New York University Grossman School of Medicine, Bhabha has won the 2023 ASBMB Early-Career Leadership Award, which recognizes a strong commitment to advancing the careers of women in biochemistry and molecular biology, along with excellence in research and/or service.

Along with colleagues at NYU, Bhabha directs an outreach and mentoring program in partnership with Queensborough Community College faculty that provides a week-long science-immersion experience. To encourage long-term connections and mentoring, each participant partners with a grad student or postdoc for monthly meetups.

Bhabha said she's had many mentors and supportive co-workers but too few women role models in her field of structural biology. "I felt like, from the very beginning, I did have a lot of support, and it's probably the reason I continued," she said. "In the end, it really matters what environment you're in; it makes you confident or not."

GIRA BHABHA

TWO PIS AND TWO BIG PROJECTS

"Running a lab is like running a small business," Gira Bhabha said. She wanted a business partner for her research, so she teamed up with Damian Ekiert, who is also her life partner. The lab is focused on two major projects.

The first is aimed at understanding how the cell envelope is built and maintained and how molecules move between the two membranes of double-membrane bacteria, which is important in processes like tuberculosis infection.

The second project is focused on the unique proteins and cell biology of a funguslike microbe, microsporidia, which can infect any cell in any animal, from worms to humans. Human infection usually starts in the small intestine and is primarily a problem for immunocompromised patients. During the U.S. HIV/AIDS epidemic of the 1980s and '90s, it was a common threat, and the microbe continues to infect other immunocompromised individuals, such as organ transplant patients.

During infection, an organellelike filament is packaged inside microsporidia, then ejected in a couple hundred milliseconds, piercing the host cell. The entire microsporidia cell then is transported into the host cell.

A joint lab "gives you a built-in collaborator with complementary skills, perspectives, strengths and weaknesses, which is synergistic and encourages you to try more different and interesting things that you're curious about," Bhabha said. While it's not conventional, "it's incredibly fun."

Heather Masson–Forsythe (heather.forsythe1@gmail.com) completed her Ph.D. in biochemistry and biophysics at Oregon State University. She is passionate about communicating science through writing and dance. Follow her on Twitter and TikTok: @heycurlytop

ASBMB MID-CAREER LEADERSHIP AWARD

Rye offers tools for success

By Inayah Entzminger

Kerry-Anne Rye does not believe that being a mentor is separate from being a researcher. Instead, she thinks students trust their supervisor to make sure they are developing the skills and applying for the opportunities they will need to succeed after they have completed their degrees.

"I've created an environment that gives people that are just starting out on their career path an opportunity to build those skill sets, and that to me is the crux of the matter," said Rye, who is deputy head of the School of Biomedical Sciences at the University of New South Wales in Sydney, Australia.

Many of Rye's graduate students and postdoctoral fellows have earned academic appointments or full professorships, and others have moved out of academia completely. She believes the logic and organizational skills her students develop in the course of their research can be applied anywhere.

Along with training scientists within her university, Rye uses her position as editor-in-chief of the Journal of Lipid Research to engage researchers in learning the scientific journal editorial process. Rye helped create junior associate editor positions that provide early and midcareer scientists with two years of mentorship from senior JLR associate editors in manuscript peer review.

After their term is done, junior AEs automatically become JLR editorial board members. This increases the journal's pool of experienced peer reviewers and keeps the junior AEs engaged. Associate editors often are appointed from the editorial board.

"We wanted to invest in the next generation of reviewers who will have the skills to run this show in the future," Rye said. "We wanted a pipeline of young and outstanding investigators invested in the journal."

Several women and members of historically underrepresented groups have been chosen as junior AEs to help increase the diversity and inclusivity of the JLR community.

Rye will receive the 2023 ASBMB Mid-Career Leadership Award recognizing a scientist who has advanced the careers of women and marginalized groups in the sciences. Nicholas Davidson, her co-editor-in-chief of the JLR and a professor at the Washington University School of Medicine in St. Louis, nominated Rye, citing her extensive history of mentoring women scientists, leading women not only to doctoral degrees but also to fellowships awarded by the National Heart Foundation of Australia and the Canadian Institutes of Health Research.

"I was hugely pleased," Rye said of winning the award. "It's a recognition of the support that you give to other people that are coming up behind you, and it's really an investment in the future. It's nice knowing if I look behind me that there are other people that are going to carry on and make (the research) bigger and better."

KERRY-ANNE RYE

A PIONEER IN HDL STUDIES

Kerry-Anne Rye's lab at the University of New South Wales researches the biology and functions of high-density lipoproteins, or HDLs, which are lipid–protein complexes that transport fat molecules out of cells. HDLs have cardioprotective functions and are inversely associated with cardiovascular risk.

Rye was the first researcher to report that HDLs have anti-inflammatory properties in cells.

She was also the first to report that HDLs improve the function of pancreatic beta cells, which make insulin and release it into the body and control blood glucose levels in people with diabetes.

Inayah Entzminger (ientzminger@gradcenter.cuny.edu) is a doctoral student at the City University of New York Graduate Center, researching the positive RNA strand barley yellow dwarf virus.

ALICE AND C.C. WANG AWARD IN MOLECULAR PARASITOLOGY

Wirth focuses on parasitology and policy

By Laurel Oldach

Dyann Wirth remembers exactly when she became interested in parasitology. She was a postdoc studying genetics, attending a departmental retreat where Nobel laureate Konrad Bloch gave a talk about bringing modern science to the study of malaria.

Wirth recalls sitting in the back with the other postdocs and "rolling our eyes" at first, but Bloch captured her attention with "absolutely fascinating biology and an important global health problem," she said. "I made the decision that afternoon to pursue parasitology — and to try to bring molecular biology to parasitology."

Wirth's contributions to that field are being recognized with the 2023 Alice and C.C. Wang Award in Molecular Parasitology from the American Society for Biochemistry and Molecular Biology.

From early in her career, Wirth has been involved with the World Health Organization and other nongovernmental organizations. "I feel, and have felt all along, that it's important that science be part of the equation in making decisions about these diseases," she said.

Decades ago, she helped to launch the Special Programme for Research and Training in Tropical Diseases, which provides scientific training to researchers from countries where malaria is endemic and then helps them to develop research centers at home. Daouda Ndiaye, who trained in Wirth's lab through that fellowship, now heads the department of parasitology and mycology at Cheikh Anta Diop University in Senegal.

"Professor Wirth wants her team to be the best … in terms of expertise and also impacting the community," Ndiaye said. "She keeps pushing you, in a very sensitive way, very pragmatic way, very diplomatic way, very supportive way — and on a daily basis."

Ndiaye's and Wirth's labs continue to collaborate on projects including drug-resistance surveillance, which can inform health policy decisions in real time. They meet weekly to discuss the research and are connected by a robust exchange program.

Meanwhile, Wirth's policy work continues; she now chairs the WHO's Malaria Policy Advisory Group, which last year recommended approval for a new malaria vaccine — advice the WHO followed.

A MOVING, CHANGING TARGET

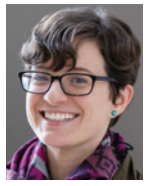
Of the four parasite species that can cause malaria, Dyann Wirth's lab at the Harvard T.H. Chan School of Public Health focuses on Plasmodium falciparum, the most deadly, using of genetics and drug-development approaches to tackle infection. Her lab has worked over the years to understand the P. falciparum genome.

Their genetic research probes how parasite populations are changing, paying particular attention to genetic variants that confer drug resistance. They have applied selective pressure with drugs to study how the genome changes as resistance arises. This has led the lab to explore combination therapies and potential new drug targets that may be less vulnerable to resistance.

Wirth is interested in the many environments the parasite traverses: In mosquitoes, it inhabits the gut and salivary gland, and in humans, the liver and red blood cells. The biology of these environments is diverse, and the parasite's gene expression changes to adapt to each tissue, with different implications for treating disease. Drugs that can kill the parasite at the blood stage are good for treating acute infections, but killing the parasite in the liver is a more effective prevention strategy.

DYANN WIRTH

Laurel Oldach (loldach@asbmb.org) is a science writer for the ASBMB. Follow her on Twitter: @LaurelOld.



ALICE AND C.C. WANG AWARD IN MOLECULAR PARASITOLOGY

Matthews' career long search for truth

By Elizabeth Stivison

When he first heard about the African protozoa that cause sleeping sickness, Keith Matthews was hooked. "I heard a lecture as an undergrad on trypanosomes," he said, "and I thought it sounded really fascinating."

He wrote to potential grad school supervisors, eventually enrolling at the University of Glasgow to study how the parasite evades the host's immune response.

After earning his Ph.D., Matthews moved to Yale University on a NATO fellowship and then to the University of Manchester before moving his lab to the University of Edinburgh, studying the trypanosome's life cycle.

"Innovative and groundbreaking research is a trademark of Keith's research group," former mentor Christian Tschudi wrote in his letter supporting Matthews' nomination for the American Society for Biochemistry and Molecular Biology's Alice and C.C. Wang Award in Molecular Parasitology. Matthews will receive the award at Discover BMB 2023 in Seattle.

Such work doesn't come out of nowhere. Matthews has established a lab environment where members feel free to innovate and help each other. "It comes down to the people in the lab and their willingness to help each other," he said. "A lot of the breakthroughs have been a direct result of the Ph.D. students' work in the lab."

KEITH MATTHEWS

HOW A TRYPANOSOME KNOWS IT'S TIME TO CHANGE

Transmitted by tsetse flies, trypanosomes infect mammals, including humans and livestock, causing trypanosomiasis, or sleeping sickness. Keith Matthews has studied how the protozoa's life cycle in mammals and flies is regulated and how the parasite controls its growth and infectivity.

Trypanosomes replicate in the host's bloodstream in what's known as their "slender form." But to transfer back to the tsetse fly successfully, they must be in their "stumpy form," in which they stop dividing. Matthews' lab works to explain how and why this change happens.

The team first used an RNAi screen to identify signaling in the trypanosome that tells it to transition to the stumpy form. Then they walked back up the pathway and searched for the external signal that sets off the cascade.

"In some ways we did things backwards," Matthews said.

They identified the parasites' mechanism of quorum sensing, or communicating that there are enough of them in the host's blood to be transmitted by the fly and it's time to ready themselves.

The lab discovered that peptidases released by trypanosomes cleave host proteins, releasing small oligopeptides. When a high enough concentration of parasites is in the bloodstream, these oligopeptides are at a correspondingly high level and are transported by a molecule on the parasite's surface, setting off the signaling cascade and transforming the slender forms into stumpy, ready for life in the tsetse fly.

He also makes mentorship a priority. "No one is not trying their best," he said. "You need to be constructive and help keep their enthusiasm."

And he's still chasing answers about trypanosomes as he was as an undergrad. "There is research where I still have no idea what the results are telling us," he said.

While that can be frustrating, there's an upside: "We are fortunate in parasitology; there are so many interesting questions out there. Ultimately, we're looking for the truth. It's as simple as that."

Elizabeth Stivison (Elizabeth.stivison@gmail.com) is a postdoctoral researcher at Vanderbilt University studying inositol signaling and an ASBMB Today careers columnist. Follow her on Twitter: @E_Stivison.

ASBMB–MERCK AWARD, RUTH KIRSCHSTEIN DIVERSITY IN SCIENCE AWARD

Booker catalyzes progress in science and outreach

By Courtney Chandler

Growing up in Beaumont, Texas, with an uncle who worked at NASA, Squire Booker's first childhood scientific love was astronomy. Another uncle was a math professor at a local university, and between the two, Booker's lifelong interest in science was sparked.

After studying chemistry at Austin College, Booker earned his Ph.D. from the Massachusetts Institute of Technology. He researched an enzyme involved in DNA synthesis called ribonucleotide reductase that uses free electrons, called radicals, to facilitate a chemical reaction — this was his introduction into the world of radical chemistry.

After graduate school, Booker went to Paris on a National Science Foundation–NATO fellowship to do research at the Université René Descartes and then took a second postdoc at the University of Wisconsin in the Institute for Enzyme Research. There, he continued to study how enzymes use radicals to catalyze reactions.

"During my second postdoc, doing enzyme research, was when I started getting interested in iron–sulfur clusters and how they were involved in radical chemistry," Booker said.

Enzymes that rely on radicals can generate and use the radicals in many different ways, some depending on associated groups called co-factors. Around the time Booker was starting his second postdoc, a researcher at Wisconsin described a new mechanism that enzymes use to make radicals that involves iron–sulfur clusters, a widespread and ancient metal co-factor, and a molecule called S-adenosylmethionine, abbreviated SAM. The radical SAM superfamily was named after this discovery.

"The radical SAM superfamily of enzymes just blossomed into this incredibly large group of enzymes that catalyze an amazing array of different types of reactions," Booker said. "And they all need to have iron–sulfur clusters to generate the radicals."

Booker, now a professor at the Pennsylvania State University and a Howard Hughes Medical Institute investigator, has dedicated much of his research to understanding the structure and function of enzymes with iron–sulfur clusters, with particular focus on radical SAM enzymes. In recognition of his work, Booker has won the American Society for Biochemistry and Molecular Biology's 2023 ASBMB–Merck Award, which honors outstanding research in biochemistry and molecular biology.

In his letter of nomination for the award, Penn State colleague J. Martin Bollinger credited Booker's deep curiosity, technical acumen, creativity and courage with allowing "him to lead and even transcend the field" of enzymology research. Vahe Bandarian, a professor at the University of

A RADICAL SOLUTION TO CARBON BOND FORMATION

Chemical bonds are essential for holding chemical entities together — without these connections, life would be impossible. Covalent bonds are the strongest bonds in nature and are formed when two atoms share their electrons. The bond formation process varies greatly and often relies on enzymes that can help move around single electrons, called radicals.

During his award talk for the 2023 ASBMB–Merck Award, Squire Booker plans to focus on how enzymes can tackle the feat of forming a covalent bond between two chemically inactive carbons. Carbon is present in all known life forms, and the formation of bonds between carbon atoms is therefore an essential process.

Booker's research on enzymes that contain iron–sulfur clusters, which are an ancient and versatile group associated with many proteins and enzymes, has yielded clues about how these enzymes can use radicals to form carbon–carbon bonds. Specifically, he has found that iron–sulfur proteins that also use a molecule called S-adenosyl-L-methionine, or SAM, are capable of producing the chemistry needed for covalent carbon–carbon bond formation. His talk will focus on his research leading to this discovery.

ASBMB–MERCK AWARD, RUTH KIRSCHSTEIN DIVERSITY IN SCIENCE AWARD

Utah, added that "Squire has the gift of being able to collaboratively solve complex problems."

Of his research career, Booker said he has enjoyed the freedom to study what he's most interested in.

"Other than scientific freedom, the other enjoyable aspect (of research) is working with and training young people and students," he said, "and seeing them blossom into incredible scientists themselves and do incredible things on their own."

Throughout his career, Booker has been committed to supporting young scientists, particularly those from historically underrepresented backgrounds. He helped establish and currently serves as principal investigator for the ASBMB Interactive Mentoring Activities for Grantsmanship Enhancement, or IMAGE, workshop program, which is designed to teach early-career scientists and postdoctoral fellows how to write effective grant proposals.

Booker also serves on the advisory board and as a mentor for the ASBMB's Maximizing Opportunities for Scientific and Academic Independent Careers, or MOSAIC, program, a National Institutes of Health–funded effort to enhance diversity within the academic biochemical research community.

In recognition of his work related to advocacy and outreach, Booker is also the recipient of the ASBMB's 2023 Ruth Kirschstein Diversity in Science Award. This is the first time a single person has received two ASBMB awards in the same year — a testament to Booker's character and consistent efforts to advance science and expand the research community.

In her nomination letter for the Kirschstein award, Ruma Banerjee, a professor at the University of Michigan, described Booker as an "inspiring role model" and praised his "tireless and outstanding contributions to advancing STEM diversity."

Booker said he was happy when he found out about both awards.

"I'm always excited to be recognized for my science, so I was thrilled about the Merck award," he said. "I think my award and the Avanti Award in Lipids given to Russell Debose–Boyd is the first time an underrepresented minority (or at least an African American) has gotten a science award from ASBMB."

Booker was on the ASBMB team that helped conceptualize and implement the Kirschstein award, which he said was intended originally to help underrepresented minorities gain recognition and have a chance to give award talks at the society's annual meeting. The 2023 award recognizes his long-standing efforts to make the sciences a more diverse and equitable place.

"I'm happy to get this particular award as well," Booker said. "I'm happy that (the awards committee) recognized that I do the best I can to contribute to outreach to scientists."

CREATING A COMMUNITY FOR ALL

In addition to moving science forward in the lab, Squire Booker is committed to improving the scientific community as a whole. He has been involved in numerous outreach and advocacy activities throughout his career, including many with the ASBMB. He is a former chair and longtime member of the society's Minority Affairs (now Maximizing Access) Committee, and last year he was named a member of the inaugural class of ASBMB fellows.

SQUIRE BOOKER

Outside of the ASBMB, Booker serves on the steering committee of the American Biomedical Research Conference for Minority Students, and at Penn State, he is director and co-chair of the National Science Foundation's Research Experience for Undergraduates program and chairs the Department of Chemistry's Climate and Diversity Committee.

Booker said he also takes time to reach out to scientists who are members of historically underrepresented groups to let them know he is available to provide guidance and support. During his talk for the Kirschstein award at Discover BMB 2023 in Seattle, he plans to highlight his research on antibiotic resistance while also focusing on outreach activities.

Courtney Chandler (courtneyec19@gmail.com) is a biochemist in the Baltimore area and an industry careers columnist for ASBMB Today. Follow her on Twitter: @CourtneyCPhd.

It's all about making connections

Five grad students who received ASBMB travel awards talk about their experiences at the 2022 annual meeting

By Comfort Dorn

The American Society for Biochemistry and Molecular Biology's Graduate Student Diversity, Equity and Inclusion Award provides up to $1,000 for travel expenses to attend the society's annual meeting. But it's more than that.

"I would really say that getting the award helped me to embrace science and research, because it opened my eyes to the endless, endless possibilities of research," Samuel Okpechi said.

Chioma Aloh said the award was "a continuous reward for me."

The award is about making connections at the meeting as much as it is a financial boost to get there. Students from historically underrepresented backgrounds often find it challenging to network with more senior scientists and researchers. That's part of what this award addresses. This year's 24 recipients had multiple opportunities to spend time with scientists at all career stages — and sitting on the sidelines was not an option.

Breakfast with bingo

In Philadelphia in April, the connections began with a lively breakfast that included a special get-to-know-you game of bingo, where attendees had to find out about each other by checking off boxes about family, pets, hobbies and other nonscience interests.

"Bingo was a neat way to just get total chaos in the room," Cameron Lee–Lopez said. "Everybody was running around asking, 'Do you play an instrument? Do you do this? Do you do that?' And as soon as you hit off one of their checkboxes, everybody would swarm over to you, and you'd be suddenly taking part in 10 conversations at once."

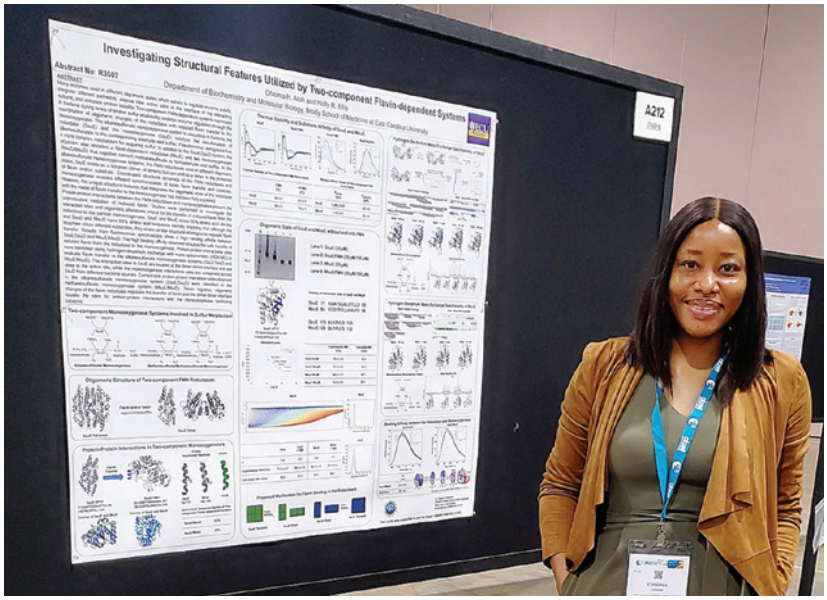
Those conversations led to exchanges of more information — and business cards. Aloh said one card was particularly memorable. "I met a postdoc who had a card (that) had her face on it."

The postdoc invited Aloh to attend her presentation on liposomes. Because, of course, all conversations at the annual meeting eventually turn to science.

Sam Okpechi ran into a team that runs the proteomics core at their institution. "I was trying to explain to them what I do," he said, "and they quickly told me that's similar to what they do … So it was easy for us to communicate. Our research questions are different, but the tool is the same."

As a result of the breakfast, Alhaji Janneh opened a Twitter account. Before, he said, "I didn't know Twitter was something very important in the scientific community."

Chioma Aloh stands in front of her poster at the 2022 ASBMB annual meeting.



COURTESY OF CHIOMA ALOH

Good science and good food

In addition to displaying their posters in the big exhibition hall, DEI award recipients get to share their science in a more intimate setting — the Maximizing Access (formerly Minority Affairs) Committee's evening reception. While guests balanced plates of donuts and sliders, the 24 posters drew intense interest.

"I forgot to eat," Janneh said. He had expected one or two people but drew a nonstop crowd. "And then I was talking, talking throughout the whole night."

Most people were interested in hearing about Janneh's research, but a few invited him to contact them about joining their labs or coming to their universities as a postdoc.

Lindsey Backman especially enjoyed her interactions with undergraduates.

"I felt like half of my time was spent just talking about the summer research programs I did as an undergrad that got me into grad school," she said. "And that part was really fun."

Backman said she's stayed in touch with a number of students interested in the Massachusetts Institute of Technology's summer research program, which, like the DEI award, is geared toward students from underrepresented backgrounds.

Aloh also enjoyed interacting with younger students. "They were doing research quite similar to mine, and they wanted to know what next steps to take," she said. "It was kind of fun, when after all your work, somebody looked at you, and you're the expert."

COURTESY OF SAM OKPECHI

Sam Okpechi said the poster hall, seen here, was less intimate than presenting his research at the Maximizing Access Committee reception.

But Aloh didn't spend time with just undergrads. She explained her poster to one visitor only to learn later that it was outgoing ASBMB President Toni Antalis.

"She was talking to me about my research," Aloh said. "She asked if I wanted to do a postdoc. Then I asked her about her own research."

Lee–Lopez also had a memorable conversation with a principal investigator, one who shared some common ground: "He's looking in mammalian systems, whereas I look at bacterial, but he works with a protein that's very similar to mine and the way it behaves with redox chemistry. So we have that connection there."

Okpechi found the reception more intimate than the general poster session. "It was more of a family coming together," he said. "The atmosphere was fun — was lively. Also, the food was great."

But more important to him was talking about science.

"I communicated what I do on a daily basis and communicated what keeps me up at night," he said, adding that he focused on three topics: exchanging information about research to see if he and whoever he was talking to had common ground, then finding out how they felt about their institutions and labs, and finally discussing the future of research "and what would be the hot jobs of the future."

Backman also wove careers into her conversation with former MAC chairman Squire Booker of Pennsylvania State University, who works in her field. In March, Backman was months from starting an independent lab, and Booker wanted to hear her ideas. The two talked even after the reception ended, and Booker introduced Backman to other faculty members.

She was also happy to mingle with scientists at a variety of career stages, from undergrads to PIs. "There wasn't a weird separation of all of the professors in one area," she said. "It felt like a more inclusive environment, the way it was laid out. … I felt comfortable. And I felt included."

Meet these five 2022 Graduate Student DEI Award winners

Chioma Helen Aloh, fourth-year Ph.D. candidate at East Carolina University:

"My work is focused on evaluating two-component, flavin-dependent enzyme systems that are involved in the acquisition of sulfur when it is scarce in the environment. Sulfur plays a key role in various processes, making these systems pertinent for the survival of bacteria. These complex enzyme systems utilize several strategic mechanisms such as oligomeric changes, protein–protein interactions and distinct secondary structure to catalyze the desulfonation mechanism. The virulence of pathogenic bacteria is directly linked to adequate sulfur levels, so understanding the structural and functional properties of these enzymes would promote the development of targeted inhibitors."

Lindsey Backman, fellow at the Whitehead Institute for Biomedical Research:

"I am interested in understanding the strategies that offer some bacterial species a competitive advantage in the human microbiome, such as consuming niche nutrients that other bacteria cannot metabolize or possessing unique, protective abilities that enable survival in extreme environments. I employ biochemical and structural biology techniques to study pathways that provide such competitive advantages. With the global increase of antibiotic-resistant pathogens, there is a critical need for developing new antibiotics."

Alhaji Janneh, Ph.D. candidate at the Medical University of South Carolina:

"My research focuses on the mechanisms involved in the crosstalk between sphingolipid metabolism and the complement system in regulating tumor metastasis. I am trying to understand how specific lipids in our body communicate with the complement system, an integral part of our immune system, to promote cancer metastasis. The ultimate goal is to discover a novel therapeutic strategy that prevents cancer cells from spreading."

Cameron Lee–Lopez, graduate research assistant at New Mexico State University:

"I research the regulation of bacterial biofilm formation/dispersal through families of nitric oxide– and redox–sensing proteins. Biofilms are a serious public health concern because they provide protection from several external factors, including antibiotics. By understanding what mechanisms control these biofilm-related behaviors, we can potentially work to prevent their formation in health care and industrial settings."

Samuel Chukwudi Okpechi, Ph.D. candidate at the Louisiana State University School of Medicine and Health Sciences Center in New Orleans:

"Triple negative breast cancer, or TNBC, is a clinical subtype of breast cancer that is more proliferative and highly metastatic. Patients harbor cells that lack critical receptors that can be utilized in the delivery of drugs across cellular surfaces. My project is specifically to screen by examining the efficacies and potential mechanism of action of different small-molecule therapeutic compounds in reducing the viability and proliferation of TNBC cells. Overall, the aim is to provide more chemotherapeutic options, with low toxicity and high efficacy."

A different kind of mentor

One benefit of the DEI award lasts for a year — and sometimes longer. Each recipient is paired, based on career goals, with a senior scientist. The pairs meet at the conference and at least once a quarter in the year after the meeting, but this is just the bare minimum and many mentors exceed it.

Janneh said Kayunta Johnson–Winters, an associate professor at the University of Texas at Arlington, "gave really honest advice," which included, "You have to be able to know how to approach your PI and committee members. You can't just get up and go to your PI and say, 'I want to graduate.' You have to get your stuff together and know what to say. It's about communication, self-awareness and accountability."

Lee–Lopez found that he and Juan Mendoza, an assistant professor at the University of Chicago, had a lot in common. "He grew up in a Hispanic community like I did, and so we were able to connect on the attitudes that people had in those communities," Lee–Lopez said. "We started talking about the advisers that we worked for. And we noticed that a lot of these guys have very similar attitudes … toward research, toward us, how they handle things in their labs."

Lee–Lopez appreciated his mentor's perspective on his work. "Up to this point, I've had a set of methods that I've been working with," he said. "You get in your rut — what works, what doesn't. But when I was talking to him, he started incorporating different methodologies."

Mendoza also addressed Lee–Lopez's imposter syndrome. "It was reassuring to hear him say, 'Your

research is super important.'"

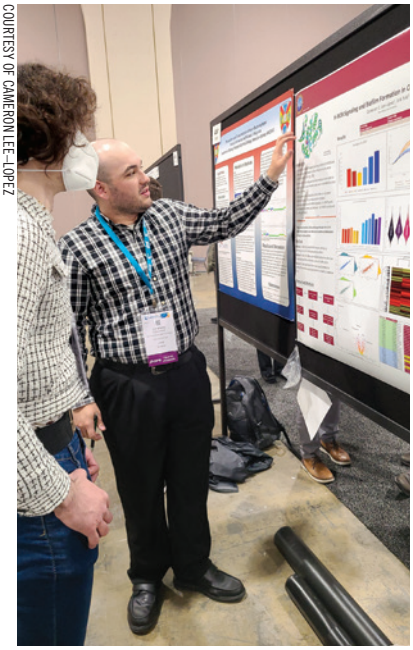
Okpechi's mentor, Bede Portz, an associate principal scientist at Dewpoint Therapeutics, was unable to attend the meeting, but that didn't stop him from making contact and doling out advice. The two have monthly Zoom meetings to discuss science and Okpechi's career.

"We speak a similar language," Okpechi said. "I never understood the magnitude of what I'm doing and how it can translate to what has been done in the industry. But he opened my eyes."

Backman said she didn't realize when she applied that the award had such a significant mentoring component. She and Carlos Castañeda, an associate professor at Syracuse University, bonded both on a professional and on a personal level. They talked about disordered proteins, starting a lab and being a Latino scientist.

"He's really focused on mentoring other people, and I'm really focused on mentoring future generations, so we had a lot in common on that level," she said.

Cameron Lee–Lopez discusses his work with a visitor to the poster hall at the 2022 ASBMB meeting in Philadelphia.



COURTESY OF CAMERON LEE–LOPEZ

COURTESY OF LINDSEY BACKMAN

Lindsey Backman makes a presentation at the Whitehead Institute for Biomedical Research where she recently became a fellow.

Authoritative advice

Lee–Lopez is still deciding whether to go into academia, industry or government, and he appreciated Mendoza's input. "It was really nice to get his perspective on academia and realize that with everything that you hear about it — underpaid, overworked — that there are people who have things that are really good to say about it. You're able to go in and be your own boss."

Aloh, who aspires to a career in industry, got valuable advice from Nihmat Morjana, a director at Siemens Healthcare Diagnostics, who encouraged her to do a postdoc in industry to experience a culture that highlights teamwork rather than the individual projects she has worked on in academia.

"He said, as a scientist working in industry, you have to be able to bridge the gap between people that have different degrees and different functions and skills in the company," she said. "You have to be able to communicate with everybody in your group."

Portz gave Okpechi advice on what do to before he starts to apply for positions. "First and foremost is to make sure that I published my thesis research … because industry recruiters want to know that I can start and finish a project," Okpechi said. "And he told me to cultivate the habit of beginning tasks early — because if I start early, I would escape those procrastination pitfalls."

Okpechi said Portz also advised him to keep a "flexible and open mindset" when it comes to career opportunities both in and out of industry.

A ticket into the arena

A big scientific conference can be intimidating and bewildering for younger scientists. The experiences provided by the DEI award program help mitigate these feelings.

Janneh said he enjoyed the meeting more than any other he's attended. "It felt like a family," he said. "It just had a different vibe, like you can easily talk to people and people are really willing to talk to you. Like, you don't have to work as hard."

Seeing unfamiliar technologies

DETAILS

Interested in applying for the ASBMB's DEI travel award? It's easy to do when you submit your abstract at discoverbmb.asbmb.org/abstracts. Don't forget — the deadline for abstracts and travel awards is Nov. 30!

ASBMB

Alhaji Janneh, pictured at the 2022 ASBMB annual meeting, is already looking forward to 2023.

at the meeting, Lee–Lopez began thinking about a whole new career path — starting a company in Europe with a friend who now lives in Germany. "It got the wheels turning for what we want to do later on," he said.

Having just accepted a new position, Backman said the timing of the meeting was perfect for her. She was able to talk to professors in a variety of disciplines about her research and get advice about starting a lab, "like establishing a research program, making sure your lab has a good healthy culture and prioritizing our values."

Okpechi summed up his feelings this way: "It's like a pass or a ticket that helps people to get into the arena where they can be reminded of the possibilities of science and research. And it's very important that young scientists like ourselves, mostly minorities, are provided with this opportunity to be among researchers, to be among scientists, to be amongst innovators."

Comfort Dorn (cdorn@asbmb.org) is the managing editor of ASBMB Today. Follow her on Twitter: @cdorn56.

Upcoming ASBMB events and deadlines

NOVEMBER

1	Discover BMB early-decision abstract notification sent to authors
2	**ASBMB Virtual Career Expo**
14	ASBMB fellows nomination deadline
15	Student Chapter renewal deadline
30	Discover BMB on-time abstract and travel award application submission deadline

DECEMBER

4	Discover BMB late-breaking abstract submission site opens
6	Deuel early registration deadline

JANUARY

4	Discover BMB late-breaking abstract submission deadline (poster presentation only)
10	Deuel abstract deadline
31	Discover BMB early bird registration deadline
31	Deuel deadline for cancellation/refunds

Discover BMB abstract categories

When you present your research at Discover BMB 2023 in Seattle, you'll get the recognition you've earned and the constructive feedback you need to make your work even better. Submit an abstract for the opportunity to:

- **Present your work** — Get noticed when you share your findings at this highly regarded research forum. Practice communicating your science to audiences of varying interests and specialties.
- **Circulate your findings** — Contribute to the community's collective body of knowledge by sharing your successes and challenges.
- **Gain a competitive advantage** — Get a step ahead of other job seekers by presenting your findings in front of experts and employers whose work you know and admire.
- **Find new collaborators** — Forge partnerships with other scientists with shared interests.

Abstracts presented at #DiscoverBMB will be published in a supplement to the Journal of Biological Chemistry.

The on-time abstract and travel award application submission deadline is Nov. 30. Submission instructions and a link to the submission system are at discoverbmb.asbmb.org/abstracts.

Abstracts will be accepted in the following categories.

- DNA recombination, structure and topology
- Chromatin structure, remodeling and gene expression
- RNA: Processing, transport and regulatory mechanisms
- Protein synthesis, structure, modifications and interactions
- Enzyme chemistry and catalysis
- Chemical biology, drug discovery and bioanalytical methods
- Genomics, glycomics, proteomics and metabolomics
- Signal transduction and cellular regulation
- Bacteria and parasites: from microbiome to antibiotics
- Metabolism and bioenergetics
- Lipids and membranes
- Glycans and glycobiology
- Computational biology
- Organelles and compartments
- BMB education and professional development

For a more detailed list of categories, go to discoverbmb.asbmb.org/abstracts/categories.

Why we take undergrads to research conferences

By Bonnie Hall & Rebecca Roberts

"Other scientists wanted to talk about what I was doing."

That's how Kaitlin Hart recalls the connections she made at the 2014 American Society for Biochemistry and Molecular Biology Annual Meeting. It was her first scientific conference, back when she was a sophomore at Rochester Institute of Technology.

Hart recently defended her Ph.D., and she said that early exposure to a scientific conference provided a confidence boost that inspired her to pursue graduate school.

Many students don't get to attend conferences until later in their undergraduate or graduate careers. But we know that scientific meetings can have a big impact on first- and second-year undergraduates.

Allison Rupert attended the ASBMB meeting when she was a sophomore at Grand View University in 2019. This year, she completed her master's degree in medical science with a concentration in molecular medicine.

"I think attending the ASBMB conference early on in my academic career played a large role in identifying my initial interest in research by showing me the wide scope of research and its seemingly endless disciplines and possibilities," Rupert said.

We both had great experiences taking undergrads to the 2022 ASBMB annual meeting in Philadelphia.

Bonnie Hall: *I took four students to the meeting. One was a Grand View University senior who had done a year of research, but the others were sophomores who had spent a year reading articles and doing biomolecular modeling, ultimately printing a 3D model of the seipin protein.*

It's more typical to take a senior research student to a meeting, but I had seen the benefits of taking first- and second-year students as well. I first took sophomores to the ASBMB annual meeting in Orlando in 2018 as part of their involvement in a National Science Foundation–funded biomolecular modeling project. Their interest in research blossomed. They went to the conference seeing themselves as students but returned seeing themselves as part of the scientific community. This has inspired me to keep looking for ways to bring younger students to conferences, especially those who historically are underrepresented in science.

This year, my student Isabelle Juhler and two other sophomores presented a poster about their seipin model and spoke with seipin researchers as part of their poster presentation. Attending a national meeting was "extremely beneficial to my growth as a scientist," Juhler said. "I was able to

Bonnie Hall (second from left) strikes a pose at the ASBMB annual meeting in Philadelphia with students Sarah Jordan, Brooklyn Mills, Isabelle Juhler and Lucas Kramer.

COURTESY OF BONNIE HALL

learn about the research process from fellow undergraduates as well as from scientists working in academia and industry. I was also exposed to many intriguing topics within my field of interest, which got me excited about pursuing independent research in the future."

Grand View is a small liberal arts institution, and attending a national meeting allowed these students to see how science and research happen outside the classroom and on a much larger stage. Attending the undergraduate poster competition sparked their excitement, and they said it helped them see how they could be part of the scientific discovery process.

Rebecca Roberts: *I took 30 students to the 2022 ASBMB meeting. The majority were first- and second-year students at Ursinus College who had yet to participate in undergraduate research. I've seen early-career science students make the transition from high school to college, where they begin learning from primary literature rather than textbooks. I wanted them to make the next transition — to show them that science isn't just what's going on in the classroom.*

Catie Wrinn, a sophomore, said she "was able to better understand the professional applications of what we are learning, not only in the various research projects that were presented but the other parts of the biology sphere, including the industrial market for lab products."

I helped the students with the registration process and went over conference etiquette and how to navigate the meeting at a lunch the week before the meeting. The week after, I held a debrief meal where they could reflect together. A few felt overwhelmed by the size of the convention center in Philadelphia, but most said they felt an energy about their careers that wasn't there before.

Rebecca Roberts (second from right) and Ursinis College students Michael Landis, Tyler Chin and John Doherty attended the 2022 ASBMB meeting in Philadelphia.

Taking students to meetings early helps them gain a sense of belonging and validation that they are on the right career path. They learn about professional communication and how to handle pushback on their ideas. If they are doing undergraduate research, they return from the conference with enthusiasm and a personal commitment to their role in the project (which also benefits their principal investigator).

As mentors, we need to include those students who may not be the stars of a research lab; we need to encourage those who have not yet found their place. We need to guide younger students as they prepare abstracts to submit, put posters together and navigate how to schedule their time at a conference with concurrent sessions.

Smaller meetings are also great for engaging undergraduates. Mike Pikaart of Hope College routinely brings students to local or regional meetings.

"I want to have seen them at a local or regional meeting first," he said, "and I ask a colleague present to push them a bit to see how they work under pressure before bringing them to a bigger national conference."

Local conferences are also an economical way to engage students, especially those who are attending and not presenting.

Young undergraduates who attend scientific conferences often realize that they are scientists with important questions to ask — and even some answers to give.

Bonnie Hall (bhall@grandview.edu) is an associate professor of chemistry at Grand View University. Follow her on Twitter: @BonnieHallGV.

Rebecca Roberts (rroberts@ursinus.edu) is a professor of biology at Ursinus College. Follow her on Twitter: @ProfRRoberts.

ASBMB
American Society for Biochemistry and Molecular Biology

ASBMB FELLOWS

Nominate the next ASBMB fellows

Selection as a fellow of the American Society for Biochemistry and Molecular Biology is an honor bestowed upon our most distinguished members.

The program encourages nominations that reflect the breadth and diversity of the society's membership. Nominees must be regular, industry, emeritus or affiliate members of the ASBMB.

Submit a nomination by Nov. 14.

asbmb.org/fellows

Getting certified in DEAI

The ASBMB staff takes a deep dive into diversity, equity, accessibility and inclusion in the workplace

By Ciearra Smith

Stepping out of my comfort zone has been a theme throughout my career journey — from switching labs in my sixth year of graduate school to switching careers from bench research to diversity, equity and inclusion after defending my thesis in 2020. Leading the staff of the American Society for Biochemistry and Molecular Biology through a seven-part course that included challenging conversations and self-reflection about diversity, equity, accessibility and inclusion in the workplace has been the latest step in this journey.

My background

When I tell people that I used to do neuroscience research and now work in DEI, I often get puzzled looks; they are shocked that I would stop doing research. Research is very stressful, especially for students of color, like me, who not only have to ensure that experiments are properly run but also have to deal with microaggressions and the added pressure of feeling we must be perfect to prove that we belong. In graduate school, I constantly felt impostor syndrome, and I knew I wasn't the only student with this feeling, so I took action.

I served as co-president of the Diversity Interest Group at the University of Massachusetts Chan Medical School. We organized programs that centered on the intersection of personal identity and science — topics not discussed in the lab. I saw so much value in my work with the Diversity Interest Group that I wanted to pursue a career that supported scientists beyond the bench, particularly underrepresented ones.

I next took a postdoc position in DEI at UMass; I planned a program that exposed students from historically Black colleges and universities to the programs at the medical school and created a seminar series that highlighted the research of scientists with diverse backgrounds.

Today, I manage ASBMB's DEI programs and work to establish new ones.

About the course

Earlier this year, the ASBMB staff took the seven-part University of South Florida "DEI in the Workplace" course. It was my job to moderate weekly discussions.

The course starts by diving into participants' emotional intelligence and demonstrating that DEI core values are empathy and self-awareness. The content then shifts from looking inward to understanding how DEI efforts can be sustained by and benefit an organization. Each two-hour module has a lecture and a panel discussion with people from a variety of backgrounds describing their perspectives and experiences.

For seven weeks, the staff met in small groups, both in person and virtually, to discuss each module, how DEAI relates to their individual roles in the society and to the ASBMB as a whole, opportunities for DEAI at the ASBMB, and related topics.

I created ground rules, a confidentiality agreement and discussion questions to guide the conversations.

Staff members shared their perspectives and personal stories, which allowed us to get to know one

another better. I opened up about my experience with microagressions in graduate school, such as being told after giving a presentation that I spoke so well, as if it was a surprise that I used proper grammar. Of course, the comment likely was meant to be a compliment; however, the impact was negative. I had many wonderful experiences in graduate school, but far too often students who look like me experience such microagressions.

Some staff members said they found it difficult to understand fully how a microagression such as "you speak so well" can be offensive; I explained the difference between intention and impact. Some staff members shared stories from their own lives and examined their words and actions through this lens.

A major highlight in the discussions was the topic of accessibility, which often is overlooked. We came up with great ideas to make the ASBMB annual meeting and other offerings more accessible.

Each participant who passes all seven course quizzes receives a certificate badge for their LinkedIn page. After we completed the course in May, I was proud to see staff members post about their experiences.

Evaluation

About a month later, I sent out a survey to obtain staff feedback about the course, discussions and the society's DEAI efforts in general. I also created a supplementary document with notes from each module to help respondents complete the survey.

The survey results indicated that the overall experience was positive. The module about stereotypes and biases was rated as the most helpful; it spurred engaging conversations about intention versus impact, and those discussions highlight the importance of having a space where people can ask uncomfortable questions without fear of judgment.

One staff member commented, "For me, the best outcome was getting to know my colleagues better, in particular the new ones. We've had a lot of new hires in the past couple of years, and I hadn't had the chance to get to know them really. The discussion groups, either in person or on Zoom, removed barriers. If I saw someone in my group in the break room or hallway, it was nice to know we had a shared experience."

This type of interaction is

Details

The University of South Florida Diversity, Equity and Inclusion in the Workplace online course consists of these seven recorded two-hour modules, each of which includes speakers and a panel discussion. It can be viewed free of charge and costs $99 per person for a certificate.

Module 1: Emotional Intelligence
An introduction to self-awareness and empathy — core to a diversity and inclusion leadership strategy.

Module 2: Stereotypes and Biases
Building more insightful awareness in the workplace of biases and systematic discrimination against any group of people.

Module 3: Understand Your Organization
Tools to analyze your organization's diversity and inclusion mission, as well as how to be aware of customers' or vendors' expectations for policies of diversity and inclusion.

Module 4: The Future of Your Organization Through Diversity and Inclusion
Shifting your mindset from understanding diversity and inclusion within and around you to creating action to drive a more diverse and inclusive workplace. Discover what diversity and inclusion can look like at your organization.

Module 5: Recruitment and Retention
Learn strategies to bring in diverse talent and retain your diverse workforce once it's established.

Module 6: Community Outreach
Support diversity and inclusion in the communities in which your organization operates to align with your corporate social-responsibility goals and employer branding.

Module 7: Sustainable Business Model
Design an all-encompassing sustainability model for ensuring diversity and inclusion are part of your organization's long-term focus.

invaluable, especially after the limits imposed by two years of fully remote or hybrid work.

Reflection

Moderating the group discussions was fantastic professional development for me, and I am glad I did it.

One major thing I learned from facilitating the discussions, especially on sensitive topics, was to allow time for silence. I hate awkward silence; it makes me very uncomfortable. Nevertheless, continuing the theme of stepping out of my comfort zone, I had to learn to get comfortable with the uncomfortable and allow time for staff to think about their responses.

I gained confidence about my ability to lead discussions and create space to be vulnerable, and I appreciated the opportunity to connect with my co-workers on a deeper level than our brief "How was your weekend?" morning chats in the office kitchen.

I learned more about the various roles of staff members as we brainstormed ways we could integrate DEAI in their work. This knowledge, and feedback from the survey, will help to establish a general framework for the ASBMB's DEAI initiatives.

Moving forward

The course and group discussions are only the beginning of the ASBMB's journey in DEAI. We plan to take a deeper dive into DEAI with the help of a consultant and develop a DEAI strategic action plan for the society.

I would like to see the ASBMB become a leader in integrating and supporting DEAI in the sciences.

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

'I wanted to go where I was needed'

By Martina G. Efeyini

Yuliya McAnany works as a senior associate scientist at Amicus Therapeutics, a biotechnology company developing therapies for people living with rare metabolic diseases. McAnany has been with Amicus since she earned her master's degree in 2019.

1 Tell me about your employer.

Amicus Therapeutics is a midsize biotechnology company focused on rare diseases. There is an opportunity to potentially make an impact on patient populations that are often not focused on — certainly not as much as more common diseases such as diabetes, cancer, Alzheimer's, etc. One of the things about Amicus that I really like is their patient focus and dedication to the rare-disease community.

2 What does a day in your life at your job look like?

I mostly do bench work.

Right now, my main role is to develop reagents. I purify proteins. I screen constructs. Usually, I will have some variation of DNA prep to take care of. I might check on a transfection. I also do a lot of stable cell-line development. I transfect our lead constructs or our reagent construct that secretes in a protein-production line, and make sure that they're expressing what they need to be expressing.

If it's a harvest day, that's pretty intensive work. I centrifuge everything and get my batch ready. I'll do the column chromatography on it and characterize.

Yuliya McAnany

CURRENT POSITION
Senior associate scientist at Amicus Therapeutics

EDUCATION
M.S. in biochemistry and molecular biology, University of Rochester, and B.S. in biochemistry from the State University of New York College at Geneseo

FIRST JOB OUTSIDE OF ACADEMIA
Associate scientist at Amicus Therapeutics

FAVORITE MOLECULE OR PROTEIN
"I was trained as an epigeneticist, and so I like the nucleosome and the histone. I still have a soft spot in my heart for epigenetics and post-translational modification, such as histone modifications."

3 Why did you pursue a career in industry?

I was in a Ph.D. program at the University of Rochester, and I left that program with my master's, which is kind of unorthodox.

I knew a few years into my program that academia was not the place for me. I wasn't interested in writing papers. I wasn't making important change. I was working in infant leukemia, and I was disheartened thinking about all the work I was doing that wouldn't directly help an infant with leukemia.

I wanted something more fulfilling. I wanted to go where I was needed. I would much rather be doing work that a person living with a rare disease could potentially benefit from. At Amicus, even the smallest contribution that I make could be worth something.

4 Tell me about a proud moment.

In May, I presented a poster at the American Society for Gene and Cell Therapy meeting. That was my first professional conference presentation. I was very proud of my poster. I'm also listed as a co-inventor on the patent for a project I presented.

5 Any advice for job seekers?

Having a specialized skill raises your value. I was the protein purification person in my graduate lab. Oftentimes, in pharma, having one very specialized skill is what gets you hired. At startups, you're going to be working on a variety of projects because they don't hire quite as many people. Being able to say, "I know how to work a project backward and forward, and I also have this very specialized skill" can really make you an asset.

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

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

CLASSIFIEDS

Lab Technician — Department of Biochemistry

West Virginia University

The Department of Biochemistry at West Virginia University is currently recruiting for a Laboratory Technician position. The purpose of this position is to work with the Principal Investigator (PI) on research in the field of regulation of energy metabolism, including obesity and diabetes, involving molecular biology and model animal (mice) approaches. The selected candidate will be responsible for basic laboratory duties including but not limited to laboratory and mouse colony organization and maintenance, ordering reagents and supplies, preparing buffers and media, enzymatic assays, western blotting, PCR and RT-PCR. Candidates with prior laboratory experience will be given priority, but training in all the procedures will be provided.

https://careers.asbmb.org/job/lab-technician-department-of-biochemistry-20292/65424230/

NIH Funded Postdoctoral Positions in Structure-based Protein Discovery & Immunoengineering

University of Chicago

The University of Chicago is seeking two Postdoctoral Associates to work within the lab of Dr. Juan L. Mendoza. Dr. Mendoza has appointments in the Pritzker School of Molecular Engineering and the Department of Biochemistry and Molecular Biology. One position may be funded as an NIH NIAID T32 Fellow and a second may be funded through a recently secured 5-year NIH NIGMS MIRA grant.

The Mendoza Lab focuses on utilizing structure-based protein engineering to better understand cell signaling in the context of human immunity with an emphasis on cancer and viral immunity. Candidates should have a strong interest in protein biochemistry, membrane proteins, and methods in structure determination such as x-ray crystallography and/or an interest in learning cryo-EM.

https://careers.asbmb.org/job/nih-funded-postdoctoral-positions-in-structure-based-protein-discovery-immunoengineering/65374556/

Assistant Professor in Cellular and Molecular Biology Tenure Track Position, Fall 2023

Providence College

The Department of Biology at Providence College invites applications for a tenure-track position at the Assistant Professor level, beginning July 1, 2023. We seek outstanding candidates who hold a Ph.D. (post-doctoral experience preferred) in Cellular Biology, Molecular Biology, or a closely related field. Successful candidates are expected to develop and maintain an active, extramurally funded research program with outstanding scholarship and to demonstrate excellence in teaching and mentoring of undergraduate students. The successful candidate should be able to teach Cell Biology and Molecular Genetics, Genetics, and courses in their specialty area, as well as propose a research program that complements but does not overlap with the scientific interests/model systems of the current faculty. Preference will be given to candidates who can also teach Developmental Biology and/or Cancer Biology. We have a strong preference for candidates who demonstrate a deep commitment to and proven ability in supporting the success of students from historically marginalized economic, social, and cultural groups.

https://careers.asbmb.org/job/assistant-professor-in-cellular-and-molecular-biology-tenure-track-position-fall-2023/65373867/

Tenure-Track Faculty Positions in Neuroscience

McGovern Medical School at The University of Texas Health Science Center

The Department of Neurobiology and Anatomy at McGovern Medical School at The University of Texas Health Science Center at Houston (UTHealth) invites applications for two tenure-track faculty positions in the areas of brain aging and neurodegenerative diseases. We seek applications from candidates who explore molecular, cellular, neuroimmunological, and/or circuit mechanisms underlying these conditions, or who develop novel approaches to treat these disorders. The appointed individuals will be expected to develop a strong, independent research program, establish interdisciplinary collaborations, and secure extramural funding. Additionally, they will be expected to contribute to our departmental teaching mission and mentor graduate students, medical students, and postdoctoral fellows.

https://careers.asbmb.org/job/tenure-track-faculty-positions-in-neuroscience/65330794/

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

ASBMB
American Society for Biochemistry and Molecular Biology

Have you marked your calendar?

ASBMB has a new annual meeting.

American Society for Biochemistry and Molecular Biology

Discover BMB | 2023

SEATTLE | MARCH 25-28

Nov. 30 is the deadline for submission of on-time abstracts and travel award applications.

Visit discoverbmb.asbmb.org