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ASBMB TODAY

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



THE **CAREERS** ISSUE



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One Meeting at a Time

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NEWS

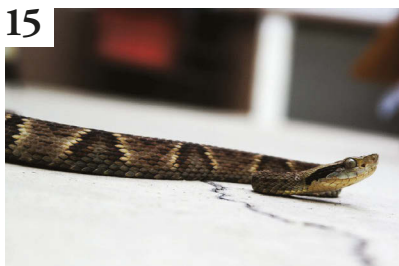
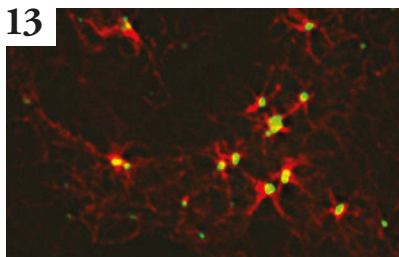
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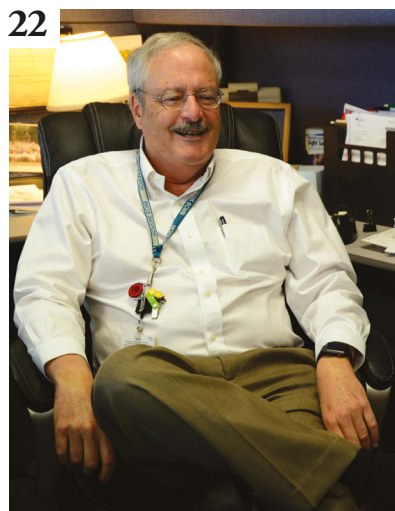
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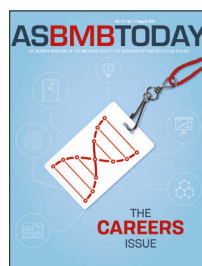
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ASBMB TODAY

Angela Hopp
Executive Editor,
ahopp@asbmb.org

Comfort Dorn
Managing Editor,
cdorn@asbmb.org

John Arnst
Science Writer,
jarnst@asbmb.org

Valery Masterson
Designer,
vmasterson@asbmb.org

Ed Marklin
Web Editor,
emarklin@asbmb.org

Allison Frick
Media Specialist,
africk@asbmb.org

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bgordon@asbmb.org

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PRESIDENT'S MESSAGE

The ASBMB is here for you

By Gerald W. Hart

It is a special honor for me to serve as the president of the American Society for Biochemistry and Molecular Biology for the next two years. First, I'd like to congratulate and thank Natalie Ahn for the great job she did as president. Natalie worked tirelessly over the past two years, and her contributions will benefit both our field and the society for years to come.

I have been involved with the ASBMB throughout my career.

The society was founded in 1906, shortly after the founding of the Journal of Biological Chemistry. The society and the journal were both founded by John Jacob Abel of Johns Hopkins University. Abel also founded my department in 1908 and hired our first chair, Walter Jennings Jones. Counting myself, all five of the past chairs of our department have been very active in the society and served as its president.

As a postdoctoral fellow and as a young faculty member in the department of biological chemistry (previously called physiological chemistry) at Johns Hopkins, I was expected to join and become active in the ASBMB (then called the American Society of Biological Chemists). Clearly, my mentors knew that actively participating in the ASBMB would help my career development greatly.

What is the ASBMB? At the 2018 national meeting in San Diego, the ASBMB Council approved the following position statement: "The ASBMB is a dynamic community

dedicated to fostering discovery and helping people get to their next level in molecular life sciences."

The ASBMB has benefited my own career in many ways:

- It provided me with a national platform to present my research to other molecular life scientists and to become visible to the community of scientists.

- It provided many networking opportunities with both early-career and more established investigators, including social interactions at meetings.

- The ASBMB greatly amplified my voice to advocate for improved funding of fundamental discovery research and to influence policy change.

- The ASBMB published many of my papers in its journals, all three of which are widely regarded as the top places to publish high-quality discovery-level research in biochemistry, proteomics and lipids.

Like many ASBMB members, until serving as president-elect over the past year, I had little appreciation for all the great work done by the society. The ASBMB is an organization run by scientists for scientists.

However, the day-to-day operation of its many activities is carried out by an amazing group of dedicated professionals who run the journals, plan meetings, manage finances, promote outreach and amplify our voices to promote fundamental science to government funding agencies.

During my tenure as president, I hope to accomplish several things, including the following:

- I will work with the ASBMB marketing staff to convince more young people to join the society and to attend the annual meeting. This effort is already underway and is key to the viability of our organization.

- I hope to help to better integrate the activities and goals of the three society journals into the ASBMB's operations and communications. The journals are among the most important things that the ASBMB does for our fields. We will explore ways better to highlight the benefits of publishing in our journals rather than publishing in for-profit journals that do not reinvest the revenue to benefit fundamental discovery science.

- I plan to tweak the structure of the annual meeting to maximize the number of young people selected to give oral presentations. More than 200 young scientists gave oral presentations at the 2018 annual meeting. I hope to increase this number greatly by integrating "flash talks" into the program. These very short talks will allow young people to give snapshots of their posters and invite attendees to come and learn more. Hopefully, this also will increase interest and attendance at the poster sessions.

- ASBMB staff members are very active on Facebook, Twitter, email, etc., but the membership often is unaware of how important and relevant the society is to their careers and to their voice in our community. We will brainstorm how we can communicate more effectively, for example, by developing a useful ASBMB mobile phone app.

- Many of our students and fellows now are going into careers in industry and biotechnology. Yet only a small percentage of our members are from these sectors. Together with the membership committee, we will explore mechanisms and needs of researchers in industry and biotech and entice these folks to join and actively partici-

"As a postdoctoral fellow and as a young faculty member in the department of biological chemistry at Johns Hopkins, I was expected to join and become active ... Clearly, my mentors knew that actively participating in the ASBMB would help my career development greatly."



ASBMB

Natalie Ahn, the outgoing ASBMB president, and Jerry Hart at the 2018 annual meeting in San Diego.

pate in the society.

- Finally, we will look for ways to get more of our members actively in important society committees, small meetings and other activities that not only will benefit their careers but also will help advance the importance of fundamental discovery science.

It is my fervent hope that we can revitalize the ASBMB by attracting more young people to join and participate actively. In addition, we need to expand the breadth of our members to include people in industry. If you have any ideas to help advance our society, please contact me.

Related article

Learn more about Gerald Hart and his research in ASBMB Today science writer John Arnst's interview on page 22.



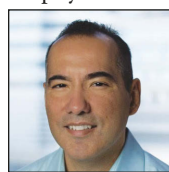
Gerald Hart (gwhart@jhmi.edu) recently was appointed an eminent scholar at the University of Georgia after two decades as chair of the department of biological chemistry at Johns Hopkins University. He is the president of the ASBMB and an associate editor of the Journal of Biological Chemistry and Molecular & Cellular Proteomics. Follow him on Twitter @gwhart13.

Member update

By Erik Chaulk

Garcia wins Biemann Medal

Benjamin A. Garcia, presidential professor of biochemistry and biophysics in the Perelman School of Medicine at the University of Pennsylvania, has received the 2018 Biemann Medal.



GARCIA

Presented by the American Society for Mass Spectrometry, the Biemann Medal is an early-career award recognizing significant research in basic or applied mass spectrometry. The award carries a \$5,000 cash prize.

The ASMS honored Garcia for research contributing to the understanding of the histone code, the set of post-translational modifications in histone proteins that are involved in gene expression. Garcia's lab has developed novel mass spectrometry analysis techniques for proteomics research.

The award was presented at the ASMS Annual Conference in June.

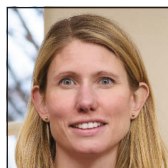
Grimes, Shoulders win Dreyfus honors

Catherine L. Grimes and Matthew D. Shoulders are among 13 young educators selected as 2018 Camille Dreyfus Teacher Scholars.

The Dreyfus Foundation awards program recognizes outstanding young faculty members in the chemical sciences. Camille Dreyfus Teacher Scholars are chosen for demonstrating leadership in both research and education.

Catherine L. Grimes is an assistant professor of chemistry and biochem-

istry at the University of Delaware. Her research explores the breaking down and building up of bacterial cell walls to understand inflammation.



GRIMES



SHOULDERS

Matthew D. Shoulders is the Whitehead career development associate professor in the department of chemistry at the Massachusetts Institute of Technology. Shoulders' lab seeks to understand the molecular mechanisms of protein folding and evolution in living cells.

Award winners each receive an unrestricted research grant of \$75,000.

McMaster to lead genetics institute

Christopher McMaster has been appointed scientific director for the Canadian Institutes of Health



MCMASTER

Research's Institute of Genetics.

The Institute of Genetics is one of 13 virtual institutes that make up the Canadian Institutes of Health Research. A network of researchers and scientists, the IG supports research on all aspects of genetics, basic biochemistry and cell biology related to health and disease.

As scientific director, McMaster will focus on identifying research priorities and funding opportunities as well as developing scientific policy.

McMaster is professor and head

of the department of pharmacology at Dalhousie University and serves as director of the Cheminformatics Drug Discovery Lab. He is co-founder and CEO of the pharmaceutical company DeNovaMed, which develops therapeutic treatments for bacterial infections.

McMaster assumed his role July 1.

Fuchs named to pontifical academy

Pope Francis has appointed Elaine Fuchs to the Pontifical Academy of Sciences.



FUCHS

Headquartered in Vatican City, the Pontifical Academy of Sciences promotes research and policy across a wide spectrum of scientific disciplines.

Fuchs is a professor and head of the laboratory of mammalian cell biology and development at the Rockefeller University. She also serves as an investigator at the Howard Hughes Medical Institute.

Highly regarded for her research on the biology of skin stem cells, Fuchs' lab explores the molecular mechanisms by which skin stem cells make and repair tissues. She is working to develop therapeutic treatments that target cancer stem cells without affecting tissue stem cells.

Baumann wins research prize

Peter Baumann has received an Alexander von Humboldt professorship at the Johannes Gutenberg

NAS elects new members

Ten members of the American Society for Biochemistry and Molecular Biology are among the 84 new members and 21 foreign associates elected to the National Academy of Sciences.

Comprising 2,382 members and 484 foreign associates, the NAS inducts new members in recognition of novel scientific research.

The newly elected members include:

- **Natalie G. Ahn**, professor of chemistry and biochemistry, University of Colorado Boulder and immediate past president of the ASBMB;
- **Roger J. Davis**, investigator, Howard Hughes Medical Institute, and professor of molecular medicine, University of Massachusetts Medical School, Worcester;
- **Sarah C. R. Elgin**, professor of biology and of genetics and education, Washington University in St. Louis;
- **Michael M. Gottesman**, deputy director for intramural research,

National Institutes of Health, and chief, laboratory of cell biology, National Cancer Institute, NIH;

- **Daniel Herschlag**, professor of biochemistry, professor of chemistry and chemical engineering and ChEM-H Institute fellow, Stanford University;
- **Karolin Luger**, professor of chemistry and biochemistry, University of Colorado Boulder;
- **Andrej Sali**, professor of bioengineering and therapeutic sciences and associate dean, School of Pharmacy, University of California, San Francisco; and
- **David G. Schatz**, professor of immunobiology and molecular biophysics and biochemistry, Yale School of Medicine.

The newly elected foreign associates include:

- **Eva-Mari Aro**, professor of molecular plant biology, University of Turku, Finland, and
- **Tomas Lindahl**, emeritus group leader, Francis Crick Institute, London.



AHN



DAVIS



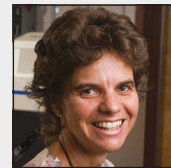
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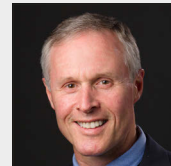
HERSCHLAG



LUGER



SALI



SCHATZ



ARO



LINDAHL

University Mainz, Germany's highest endowed research prize.

An expert in the field of chromosome biology, Baumann's research focuses on the study of telomeres. He has made significant contributions to the study



BAUMANN

of aging, cancer and evolutionary biology.

He previously held positions at the University of Kansas Medical Center, the Howard Hughes Medical Institute and the Stowers Institute for Medical Research.

Along with the construction of

new research facilities and realignment of the faculty of biology, this professorship award represents a move toward establishing Johannes Gutenberg University Mainz as a pre-eminent leader in biomedical research.

Schnell elected to Latin American academy

Santiago Schnell has been elected as a foreign corresponding fellow to the Latin American Academy of Sciences.

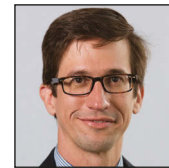
The Latin American Academy of Sciences is a nonprofit organization established to promote scientific research and development in Latin

America and the Caribbean.

Schnell is the interim department chair and John A. Jacquez collegiate professor of physiology at the University of Michigan Medical School.

Schnell's research aims to develop standards-based methods in biology and medicine to obtain high-quality measurements.

Schnell is one of six foreign corresponding fellows elected in 2018. The academy now has 235 members who have distinguished themselves through their excellence in scientific research.



SCHNELL

Stillman receives honorary degree

Cold Spring Harbor Laboratory president and CEO Bruce W. Stillman received an honorary doctor of



STILLMAN

science degree from Clarkson University in May.

This honorary degree, Stillman's sixth, recognizes his achievements

in the study of DNA replication. A biochemist and cancer researcher, Stillman studies the mechanism and regulation of DNA and chromatin duplication in cells.

Stillman began his career at the Cold Spring Harbor Laboratory in 1979 as a postdoctoral fellow. He succeeded Nobel laureate James D. Watson as director in 1994 and was appointed president in 2003.

Among his numerous accolades, Stillman received the ASBMB's Herbert Tabor Research Award in 2014.

Walker appointed to ChromaDex board

Nobel laureate John Walker has been appointed to the ChromaDex scientific advisory board.



WALKER

Walker joins ChromaDex to aid in the research and development of new applications for nicotinamide riboside and mito-

chondrial health.

Globally recognized in the field of chemistry, Walker was one of three researchers jointly awarded the 1997 Nobel Prize in chemistry for elucidating the enzymatic mechanism underlying the synthesis of adenosine triphosphate. He was knighted in 1999 for his contributions to molecular biology.

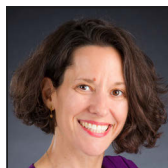
Walker serves as the emeritus director of the Medical Research Council Mitochondrial Biology Unit at the

University of Cambridge.

ChromaDex is a nutraceutical company working to develop therapies to improve the way people age.

Schulman, Luger elected to EMBO

Brenda A. Schulman and Karolin Luger are among the new members and associate members elected to



SCHULMAN

the European Molecular Biology Organization.

The EMBO, comprising more than 1,800 scientists, promotes research and collaboration in the life sciences.



LUGER

Members are life scientists who reside within the 17 European Molecu-

lar Biology Conference member states, while associate members reside outside the member states.

Schulman, director at the Max Planck Institute of Biochemistry, has been elected as a member. Schulman's research focuses on understanding the mechanisms and functions of the ubiquitin system.

Luger, professor and the Jennie Smoly Caruthers endowed chair of biochemistry at the University of Colorado Boulder, has been elected as an associate member. Her research explores the structure and function of chromatin.

Read receives chancellor's award

Laurie Read has received a 2018 SUNY Chancellor's Award for Excellence in Scholarship and Creative Activities.



READ

Read is professor in the department of microbiology and immunology at the Jacobs School of Medicine and

Biomedical Sciences at the University of Buffalo.

Chancellor's awards recognize outstanding achievements of faculty and staff members at the State University of New York in the areas of faculty service, librarianship, professional service, scholarship and creative activities, and teaching.

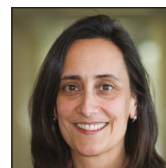
The Chancellor's Award for Excellence in Scholarship and Creative Activities is given to faculty members whose scholarly and creative efforts go beyond their teaching responsibilities.

Read's research lies in the fields of parasitology and microbiology, where she focuses on the study of trypanosome cell and molecular biology. She has published two book chapters and more than 70 peer-reviewed papers.

Additionally, she has served as a member of two study sections with the National Institutes of Health.

DuBois, Arnst win EXCEL awards

Jennifer DuBois and John Arnst have been honored by Association & Media Publishing for work published in ASBMB Today in 2018.



DUBOIS

DuBois, an associate professor of chemistry and biochemistry at Montana State University and secretary of the American Society for Biochemistry and Molecular Biology, won a gold EXCEL award for her essay

"Disappointed — by cancer," which kicked off the ongoing series "When Science Meets Sickness" in September. She has written a number of essays for the magazine.

Arnst, ASBMB Today's science writer, won a bronze EXCEL award for his feature article "Mouse lemurs — a model in the wild," published in November. He has written features



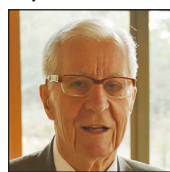
ARNST

about a variety of topics over the past two years, including kratom, health disparities and Parkinson's disease.

Association & Media Publishing is a membership organization serving the needs of association, nonprofit and alumni publishing teams. The awards were presented in June.

In memoriam: Eric Shooter

Eric Shooter, professor emeritus of neurobiology at the Stanford University School of Medicine, passed away in March at the age of 93.



SHOOTER

Shooter was born in a village north of Nottingham, England, on April 18, 1924. He

studied chemistry at the University of Cambridge, where he earned his bachelor's in 1945, his master's in 1946 and his Ph.D. in 1949.

He held several positions in the U.S. and United Kingdom before he was appointed as a U.S. Public Health Service international fellow with the department of biochemistry at Stanford's school of medicine in 1961.

At Stanford, he served as an associate professor of genetics and a full professor of biochemistry and of genetics. Shooter became the founding chair of the department of neurobiology in 1975, a position he held until 1987. He also chaired the school's doctoral program in neurosciences from 1972 through 1982.

Shooter was highly regarded for his research on the structure and mechanisms of neurotrophins. He was the first person to characterize the neurotrophin nerve growth factor, which plays a significant role in restoring damaged nerve cells.

He was also a mentor for numerous young scientists throughout his career.



Erik Chaulk (echaulk@asbmb.org) is a peer-review coordinator and digital publications web specialist at the ASBMB.

Upcoming ASBMB events and deadlines

AUG August is for Advocacy Month

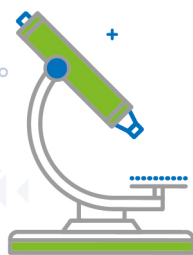
- 9: Frontiers in RAS Pathobiology and Drug Discovery registration deadline
- 14: Frontiers in RAS Pathobiology and Drug Discovery registration cancellation deadline
- 14: Transcriptional Regulation by Chromatin and RNA Polymerase II early registration deadline
- 30: Transcriptional Regulation by Chromatin and RNA Polymerase II poster deadline

SEPT Ovarian Cancer Awareness Month

- 3: The Art of Science Communication online course application site open
- 4: Transcriptional Regulation by Chromatin and RNA Polymerase II registration deadline
- 12: The Many Faces of Kinases and Pseudokinases oral abstract deadline
- 13–16: Frontiers in RAS Pathobiology and Drug Discovery, Stratton, Vt.
- 25: The Many Faces of Kinases and Pseudokinases early registration deadline
- 20: Webinar- Image is Everything: Preparing your Figures for Publication

OCT National Breast Cancer Awareness Month

- 1–5: The Art of Science Communication online course begins
- 3–5: Science Outreach: Models, Methods and Measures, New York, N.Y.
- 4–7: Transcriptional Regulation by RNA Polymerase II, Snowbird, Utah
- 11–13: ASBMB exhibits at Society for Advancing Chicanos Hispanics & Native Americans in Science (SACNAS) National Conference, San Antonio, Tx.
- 14: The Many Faces of Kinases and Pseudokinases poster deadline
- 15: Accreditation deadline

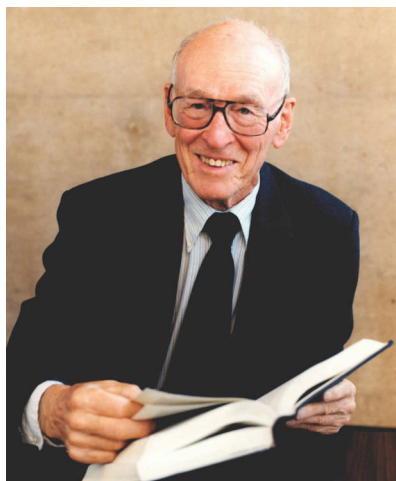


Paul D. Boyer (1918–2018)

By Steven G. Clarke

Paul Boyer often said he never met an enzyme he couldn't love. He worked on many enzymes but focused much of his passion on the one that was responsible for making the energy coin of the realm, adenosine triphosphate. His studies culminated in the description of the ATP synthase as a rotary motor — one that used the proton motive force to drive ATP formation by modulating the binding and release of its substrates. For this work, he shared the 1997 Nobel Prize in chemistry with the British chemist John Walker, who determined the first crystal structure of the enzyme. Paul's clever use of isotope labeling coupled with mass spectrometry provided a picture that was beautifully confirmed by subsequent 3D structures.

Paul gave a wonderful description of his research career in 2002 in the *Journal of Biological Chemistry Centennial Series* "100 years of biochemistry and molecular biology," reflecting on the 325 papers published from his laboratory. Ninety-six of these papers were published in *JBC*, from the fourth paper of his career in 1942 to his final paper in 2002. He was honored throughout his career for his research contributions but never lost his modesty. In addition to the Nobel Prize, these honors included the 1955 American Chemical Society Award in Enzyme Chemistry, election to the American Academy of Arts and Sciences in 1968, election to the National Academy of Sciences in 1970, the American Society for Biochemistry and Molecular Biology William C. Rose Award in 1989, and the Seaborg Medal from the University of California, Los Angeles, in 1998. Paul also received honor-



COURTESY OF UCLA

In a career that spanned almost half a century, Paul Delos Boyer was an enzymologist and an institution builder.

ary degrees from the University of Stockholm in 1974, the University of Minnesota in 1996 and the University of Wisconsin in 1998.

Paul was born in Utah and earned a bachelor's degree in chemistry from Brigham Young University in 1939. He was a graduate student in biochemistry at the University of Wisconsin in Madison, working with Paul Phillips, and received his Ph.D. in 1943. After a short postdoctoral stint at Stanford University, he joined the faculty of the University of Minnesota, first in the division of agricultural biochemistry in St. Paul and then as the Hill professor of biochemistry in the department of physiological chemistry and subsequently biochemistry in Minneapolis. In 1963, he moved his laboratory to UCLA to the department of chemistry, which became the department of chemistry and biochemistry. That Paul's academic units included designations of agriculture, physiology

and chemistry as well as biochemistry reflected his lifetime interest in integrating the biomedical sciences. Paul formally retired from UCLA in 1990 but stayed active in campus life until his death on June 2, less than two months shy of his 100th birthday.

An impressive footprint

A natural leader, Paul worked hard to develop the field of biochemistry and his specialty of enzymology. His influence was strong in scientific publication. He served the community as editor of the third edition of the authoritative series "The Enzymes," producing 18 volumes from 1971 to 1990. He guided the internationally recognized high-impact *Annual Review of Biochemistry* from 1963 to 1989 as an associate editor and editor. His wisdom also was appreciated as an editorial board member of a number of journals, including terms with *JBC* from 1977 to 1983 and from 1987 to 1992.

Outside of his own research, Paul worked tirelessly for biochemistry and biomedical sciences at the national level. He joined the American Society of Biological Chemists (now the ASBMB) in January of 1944 and was in his 75th year of membership when he died, its longest-standing member at the time. He was chair of the Biological Chemistry Division of the American Chemical Society from 1959 to 1960 and subsequently became active in the ASBC leadership. His long service to the ASBC/ASBMB included elected positions as a Council member from 1965 to 1971 and as president from 1969 to 1970. He also chaired the Public Affairs Advisory Committee from

1982 to 1987. With his passion for molecular biology, he was a strong supporter of the society's name change in 1987. He was a member of the American Academy of Arts and Sciences Council and served as its vice president for biological sciences from 1985 to 1987. In these roles, Paul was a force in bringing together chemists and biologists; he always knew the synergy that could come from interdisciplinary efforts.

Building molecular biology

In 1965, Paul was selected as the founding director of UCLA's Molecular Biology Institute, or MBI. His vision included not only recruiting faculty at the confluence of biology and chemistry but also providing an attractive space where they could support each other's science.

His dedication resulted in the opening in 1976 of the Molecular Biology Building housing 30 laboratories, many directed by faculty new to UCLA, as well as common facilities and seminar rooms. The economic challenges of the times resulted in a struggle to fund the construction of the building; the long story of how Boyer prevailed is well described in Dick Dickerson's 2009 history of the MBI, "The Making of an Institute: The MBI at UCLA 1960–1978."

In Paul's 18 years as MBI director, more than one generation of scientists was recruited to establish a cadre that defined molecular biology at UCLA. He provided them intellectual and physical resources in a culture that allowed them to take full advantage of collaborative opportunities. It is a testament to Paul that, in an era when buildings almost always are named



ASBMB

Paul Boyer accepts the William C. Rose Award from ASBMB President Minor J. Coon at the February 1989 joint meeting with the American Society for Cell Biology in San Francisco. In his Nobel Prize biography, Boyer stated that "it was a pleasure to receive peer recognition in the form of the Rose Award of the American Society for Biochemistry and Molecular Biology, the preeminent society in my field." In his office, there was no indication of his Nobel Prize, but he kept this photograph and the Rose Award plaque displayed prominently.

for financial donors, the building was renamed Paul D. Boyer Hall in 1999. In Paul's case, he donated his vision, leadership, inspiration and collegial glue. Paul taught us that the intersection of chemistry and biology could be understood best as the new field of molecular biology; his successful development of this field at UCLA contributed to its worldwide ascension.

His 1997 Nobel Prize allowed Paul to instigate a program to reward scientists who were between their graduate degrees and their first jobs; the UCLA Postdoctoral Awards in Molecular Biology were given out between 1999 and 2015. Paul's leadership was clear when his friends and colleagues, including James Peter, his former postdoc, and Phyllis Parvin, the wife of the building's keystone donor, added to the funding.

Remembering Paul

I had the privilege of having my office and laboratories across the hall from Paul from my arrival at UCLA in 1978 as an assistant professor. Since my undergraduate days at Pomona College, Paul Boyer had been one of my giants of biochemistry, especially for his voice of reason and civility in the heated controversies of how ATP was made.

In my early days at UCLA, my laboratory of young graduate students and undergraduates took full advantage of Paul's generosity with laboratory equipment and supplies — to the extent that his laboratory manager once took me aside to tell me that, at least in her opinion, the Boyer lab was not a free stockroom for us. We still cherish the glassware and tools in our laboratory with the Boyer



COURTESY OF STEVEN CLARKE

As founding director of the UCLA Molecular Biology Institute, Boyer worked tirelessly for the construction of a building that would house researchers from different departments but with complementary interests. The building opened in 1976 and in 1999 was renamed Paul D. Boyer Hall in his honor.

signature markings.

Richard Cross, a postdoctoral fellow in the Boyer lab from 1970 to 1973, recalls how Paul's mentoring style of "setting high expectations for performance while at the same time providing an exceptionally supportive, cooperative, and stimulating environment to insure one's success, made him a role model with integrity, fairness, and infectious enthusiasm." He remembers Paul's words on discovery: "Most of our accomplishments in science are the coal we mine while looking for diamonds." This statement of Paul's grounding in basic science foundations is perhaps even more important today, when some journals

only want to publish the diamonds, and those diamonds sometimes turn out to be glass.

Rich also remembers attending a seminar with Paul in 1972 and noticing Paul was not paying attention to the speaker. After the seminar, Paul approached Rich in an atypically excited state. "Such an animated demeanor was unknown to the members of his laboratory, for Paul was always calm and well grounded," he said. Paul apparently had spent the last hour thinking about old unexplained data, and Rich recalls that he asked, "What would you say if I told you it doesn't take energy to make ATP but to get ATP off the catalytic

site?" Rich remembers this as the first crack in understanding ATP synthase.

Jill Myers was a graduate student with Paul from 1978 to 1983 and a co-author of the 1982 JBC paper that first proposed rotational catalysis. The last paragraph of this paper began with "A final speculative comment may be warranted" and finished with "A relative rotational movement of beta-subunits and a control subunit core could merit consideration." Jill remembers arguing that protein rotation was a concept that was simply too improbable for the august JBC. "Little did we know," she said, "it would end up earning him the Nobel Prize."

Stephen Dahms, a postdoctoral fellow from 1969 to 1972, remembers Paul's always-positive outlook and love of life, describing him as a "preeminently sociable person who developed personal relationships with his research children and colleagues, and yet remained modest."

Bruce Weber, a postdoctoral fellow from 1968 to 1970, remembers "Paul's joyous engagement with biochemistry and with tennis (he always beat me)."

In writing this article, it was wonderful to hear several of my colleagues remark that when they face a difficult situation themselves, the answer often comes when they ask, "How would Paul Boyer handle this?"

Video

In an interview about his 2018 Rose Award, Steven Clarke talks about seeing Paul Boyer's Rose Award plaque in Boyer's UCLA office. See the video at asbmb.org/asbmbtoday.

Steven G. Clarke (clarke@chem.ucla.edu) is a distinguished professor of chemistry and biochemistry and a member of the Molecular Biology Institute at UCLA. He is the 2018 recipient of the ASBMB's Rose Award.

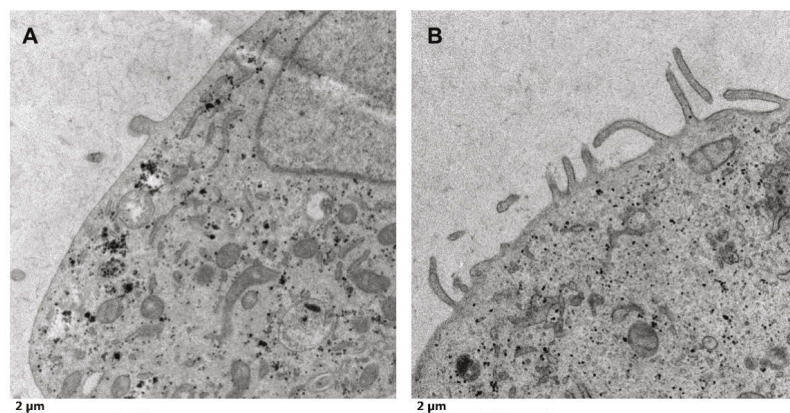
Plasma membrane lipids mediate key interactions in assembly of filoviruses

By Robert V. Stahelin

Filoviruses, which include Ebola and Marburg, are lipid-enveloped viruses containing a negative-sense RNA genome encoding seven genes. While no Food and Drug Administration-approved drugs and vaccines exist for filoviruses, a recombinant Ebola vaccine, effective in animal models, appeared to help contain and limit the spread of a recent Ebola outbreak in the Democratic Republic of Congo.

One of the seven genes in Ebola and Marburg encodes the matrix protein known as VP40. VP40 is a peripheral protein that associates with the inner leaflet of the plasma membrane to regulate assembly of new virus particles. Strikingly, VP40 is able to form viruslike particles, or VLPs, from mammalian cells in the absence of other viral proteins. These particles are nearly indistinguishable from authentic virus and have provided researchers working outside of the highest biosafety-level labs with a system to investigate viral assembly and budding as well as the role of host lipids in these processes.

In research published in 2013, the X-ray structure of Ebola VP40, or eVP40, revealed a dimer mediated by a N-terminal domain alpha-helical interface (1). Mutation of the eVP40 dimer interface abrogated the ability of eVP40 to form VLPs and localize to the plasma membrane inner leaflet. The researchers discovered that eVP40 membrane binding regulated eVP40 oligomerization, as incubation



COURTESY OF MONICA HUSBY

Transmission electron microscopy of cells expressing the Marburg matrix protein demonstrates viruslike particle formation from the cell plasma membrane. A: Mock transfected cells display few protrusions from the plasma membrane. B: Cells transfected with a Marburg matrix protein expression plasmid display remarkable viruslike particle formation from the plasma membrane of the cell after 24 hours.

of eVP40 with a membrane mimetic (dextran sulfate) led to formation of an eVP40 hexamer. Mutations in eVP40 that reduced hexamer formation abolished VLP formation.

The same study found that eVP40 is a transformer protein with the ability to form an octameric ring structure that can bind RNA. The essential role of the eVP40 octamer in Ebola replication has not been resolved fully, but the octamer has not yet been observed at the plasma membrane inner leaflet or in VLPs or virions. Instead, recent research shows that the octamer plays a role in regulating viral transcription and is enriched in the host cell nucleus when compared to the eVP40 dimer (2). And while the role and significance of

nuclear localization of eVP40 is still unknown, the eVP40 octamer binds plasma membrane lipids an order of magnitude less than the eVP40 dimer, which partially may explain its different cellular localization and role in viral replication.

We now know the role of plasma membrane lipids in Ebola virus assembly. Nearly two decades ago, experiments demonstrated that eVP40 bound vesicles containing phosphatidylserine, or PS; however, little information was available on lipid binding selectivity and the role of lipid binding in VLP formation. Now we know that eVP40 binds PS using two cationic loop regions in its C-terminal domain (2). PS binding by eVP40 is selective when compared

to phosphatidylinositol, phosphatidylglycerol and phosphatidic acid. In support of the PS binding selectivity, several amino acids in the C-terminal domain contribute to PS recognition, including lysine, asparagine and serine residues. Swapping of native lysine for arginine (i.e., positive charge for positive charge) was not sufficient to restore PS selectivity.

Research published in 2015 showed that PS binding by eVP40 also was critical to eVP40 localization at the plasma membrane inner leaflet and VLP formation (3). In addition, eVP40 requires a significant pool of PS at the plasma membrane inner leaflet for efficient assembly and budding. A mutant cell line partially deficient in PS synthesis was critical in proposing this hypothesis, as VP40 assembly and budding was reduced significantly in mutant cells (with about a 30 percent reduction in PS levels) but restored upon adding PS back to these cells. PS binding also triggered conformational changes in eVP40 structure critical to appearance of VP40 hexamers and larger oligomers at the plasma membrane inner leaflet.

PS induces partial insertion of the eVP40 C-terminal domain into the hydrocarbon region of the plasma membrane, according to a 2013 research paper, which may aid in stabilizing the eVP40 oligomers that form and altering membrane structure important for viral budding.

PS is not the only important plasma membrane lipid in EBOV assembly. A 2016 study found that phosphatidylinositol 4,5-bisphosphate, or PI(4,5)P₂, modulates interactions of eVP40 oligomers with the membrane interface in vitro and in cell culture (4). In contrast to PS depletion, which significantly reduced eVP40 hexamer formation

from dimers, PI(4,5)P₂ depletion greatly reduced large eVP40 assemblies (those larger than hexamers and dodecamers) but didn't significantly reduce eVP40 hexamers. Thus, PS and PI(4,5)P₂ play contrasting roles in eVP40 assembly, with PS mediating the initial plasma membrane association and conformational change to form hexamers. Subsequently, PI(4,5)P₂ stabilizes membrane interactions required to sustain large eVP40 oligomers to maintain viral budding.

Marburg VP40 has significantly different lipid binding properties from eVP40. A 2015 study showed that the mVP40 X-ray structure is conserved in overall structure with that of eVP40, harboring an N-terminal alpha-helical dimer interface and overall structural similarity between both the N- and C-terminal domains. However, the sequence similarity of the C-terminal domain in mVP40 was only 15 percent when compared to the eVP40 C-terminal domain. This difference in sequence is observed as amino acid changes in regions where VP40 associates with membranes. Marburg VP40 has a higher cationic charge density on its surface and does not have many of the key residues found interacting with PS in eVP40. Another study found that mVP40 behaves as an anionic charge sensor binding anionic lipids with promiscuity based upon the anionic charge density of the membrane interface. Neutralization of the plasma membrane interface in cell culture led to the rapid displacement of mVP40 from the plasma membrane, further supporting the anionic charge sensor hypothesis.

Host cell plasma membrane lipids are significant for more than filovirus assembly and budding. Research published in 2011 showed that budding. Ebola virus uses host PS to attach and

enter cells through a process known as apoptotic mimicry. However, how PS levels on the outer membrane of the viral lipid envelope increased remains unclear. The plasma membrane of human cells is normally asymmetric, with PS concentrated in the inner leaflet. A clear connection to the role of PS in viral entry was made from the inner to outer plasma membrane leaflet when eVP40 is sufficient to induce PS exposure on the outer leaflet of the plasma membrane at sites of viral budding. A recent study found that a host scramblase, Xkr8, also contributes significantly to this process by helping the viral particles achieve a loss in plasma membrane PS asymmetry so that PS is available to interact with host cell receptors to mediate attachment and facilitate entry.

A challenge of studying lipids in filovirus replication has been the available viral systems to work with. Working with live virus requires the highest biosafety-level facilities, and the process of virus neutralization affects lipid measurements, limiting the studies performed on virus-induced lipid metabolic changes. However, lower biosafety-level systems are available that allow for a more complete representation of the viral life cycle. For instance, a 2014 study found that a tetracistronic minigenome system allows for all seven Ebola virus proteins to be expressed in human cells, allowing budding and viral entry to be studied in more complete fashion. Implementation of such assay systems or generation of new assay systems should allow for mechanistic investigation of lipid metabolic changes in cells infected by filoviruses, perhaps unveiling new drug targets or biomarkers of disease in the viral life cycle.

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Robert V. Stahelin (rstaheli@purdue.edu) is the Retter professor of pharmacy and a professor of medicinal chemistry and molecular pharmacology at Purdue University.

Shedding light on the protein AKAP350, a shadowy organizational hub in cells

By Sasha Mushegian

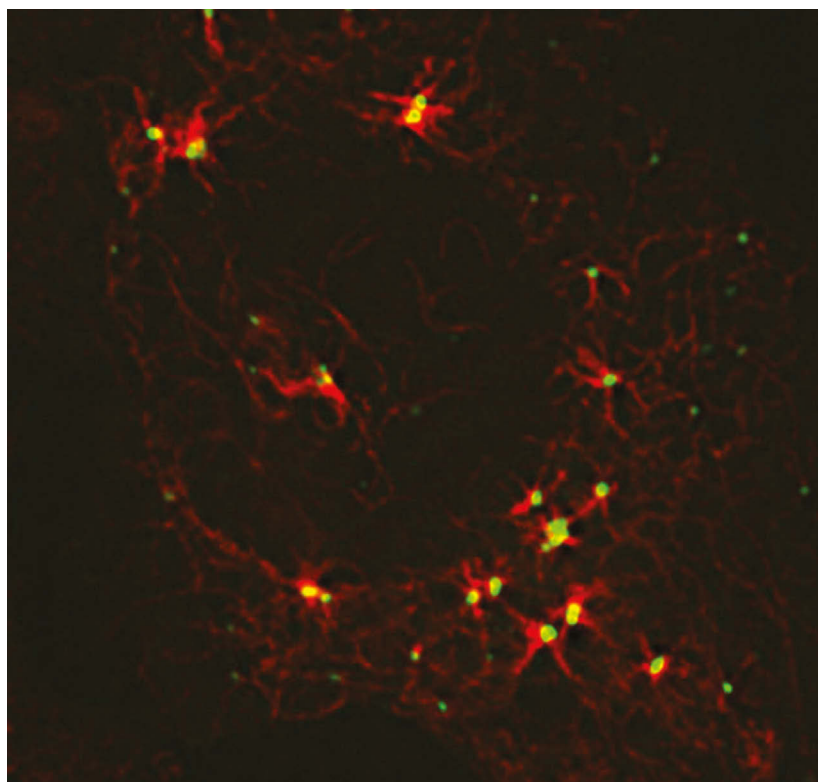
On a cellular level, we are all hanging on by delicate threads. All cells are crisscrossed by a network of strands called microtubules, which act as railroad tracks that move cargo around the cell, as winch cables that separate chromosomes during cell division and as scaffolding components that give a cell its shape.

Because of its essential role in the cell cycle, microtubule assembly is the target of essential anti-cancer chemotherapies (paclitaxel, for example), which stop out-of-control cell division by destabilizing microtubules. Now, researchers have shed light on the role that a large, enigmatic protein plays in assembling microtubules, paving the way for better treatments. The results of the research were published in the **Journal of Biological Chemistry**.

In 1999, James Goldenring's research team at Vanderbilt University showed that protein kinase A-anchoring protein 350, or AKAP350, is a component of the centrosome, a center of microtubule organization in human cells. The team later showed that microtubules did not form efficiently without AKAP350. But the way in which AKAP350 regulated microtubule formation was difficult to understand, largely because of the technical challenges posed by AKAP350's heft.

"Since this protein is so huge, it's very difficult to study it," said Elena Kolobova, the research scientist in Goldenring's laboratory who led the new study. "A few years ago, we finally came to develop synthetic constructs of (AKAP350), which allowed us to go to the next level of evaluation and function."

Using a combination of detailed



COURTESY OF JAMES GOLDENRING/VANDERBILT UNIVERSITY

A large protein coordinates cellular components required for microtubule assembly.

biochemical analyses and super-resolution microscopy, the team finally was able to gain some understanding of the complex roles that AKAP350 plays in regulating microtubules in cells. AKAP350 formed a physical bridge spanning components of the centrosome. And AKAP350 appeared to recruit multiple proteins involved in building microtubules, coordinating their function in one spot.

"I like to call this thing Deep Space Nine. Everybody comes to hang out at AKAP350," Goldenring said. "I think we've only scratched the surface of the structural organization that this protein is probably providing."

Mutations in AKAP350 have been

associated with cardiac arrhythmias, so it will be of interest to see whether the protein's role in microtubule assembly contributes to proper heart function as well.

"I think (AKAP350) is a fundamental regulator of cell function," Goldenring said. "So we need to know a lot more about this protein before we can even begin looking at what it might mean for disease."

DOI: 10.1074/jbc.M117.806018



Sasha Mushegian (amushegian@asbmb.org) is scientific communicator for the Journal of Biological Chemistry. Follow her on Twitter @sash_mu.

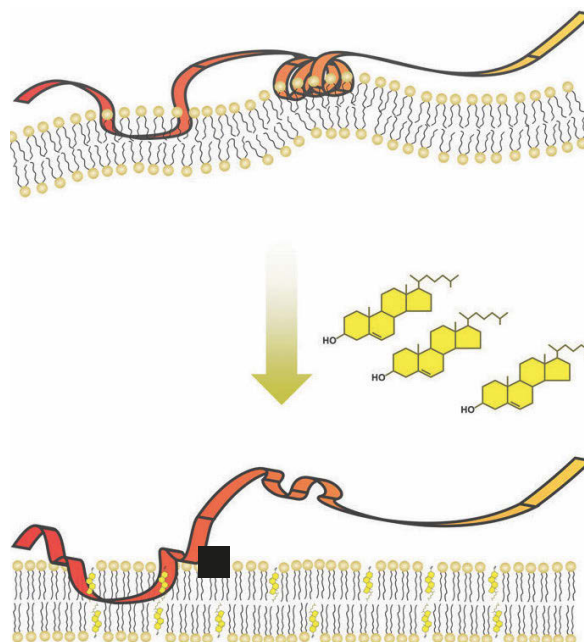
A spring-loaded sensor for cholesterol in cells

By Sasha Mushegian

Although too much cholesterol is bad for your health, some cholesterol is essential. Most of the cholesterol that the human body needs is manufactured in its own cells in a synthesis process consisting of more than 20 steps. Research from the University of New South Wales in Sydney, Australia, published in the **Journal of Biological Chemistry**, explains how an enzyme responsible for one of these steps acts as a kind of thermostat that responds to and adjusts levels of cholesterol in the cell. This insight could lead to new strategies for combating high cholesterol.

Toward the middle of the assembly line of cholesterol production, an enzyme called squalene monooxygenase, or SM, carries out a slow chemical reaction that sets the pace of cholesterol production. In 2011, Andrew Brown's laboratory at UNSW discovered that when cholesterol in the cell was high, SM was destroyed and less cholesterol was produced. The new research explains how this process of sensing and destruction happens.

SM is embedded in the membrane of the cell's endoplasmic reticulum, or ER, which is composed of fatty molecules, including cholesterol. As cholesterol in the cell increases, more and more of it is incorporated into the ER membrane.



COURTESY OF ANDREW J. BROWN/UNIVERSITY OF NEW SOUTH WALES

Researchers at the University of New South Wales have discovered that a spring-shaped protein structure senses cholesterol in cells.

SM contains a series of 12 amino acids that serve as a “destruction code” that tells the cell's garbage disposal machinery to degrade the SM protein. Brown's team showed that under typical conditions, the destruction code is hidden by being tucked away inside the ER membrane as part of a spring-shaped structure. Using experiments in cell cultures and with isolated proteins and membranes, they also showed that this spring structure could embed only in membranes that contained a low percentage of cholesterol. When the amount of cholesterol making up the membrane increased, the spring

popped out, exposing the destruction code.

Ngee Kiat Chua, a graduate student, led the new study. “When cholesterol levels are low, this destruction code is hidden in the membrane like a spring-loaded trap,” Chua said. “However, too much cholesterol (in the membrane) springs the trap, unmasking the destruction code.”

When this occurs, the cell proceeds to destroy the SM.

The researchers speculate that, because the synthesis step carried out by SM is crucial to determining the amount of cholesterol a cell produces, drugs targeting SM could be used to decrease cholesterol as an alternative to the oft-prescribed statins, which target an enzyme earlier in the cholesterol synthesis assembly line. But they also wonder whether the type of cholesterol-responsive spring they discovered might be used by other proteins involved in cholesterol metabolism to sense and adjust cholesterol levels.

“It's perhaps stretching the bow a little too far to make a connection from our little cholesterol spring mechanism to metabolic disorders,” Brown said. “But we've found a fundamental cholesterol-sensing mechanism, and that's where this work has advanced the field.”

DOI: 10.1074/jbc.M117.794230

“When cholesterol levels are low, this destruction code is hidden in the membrane like a spring-loaded trap ... however, too much cholesterol (in the membrane) springs the trap, unmasking the destruction code.”



Sasha Mushegian (amushegian@asmb.org) is scientific communicator for the Journal of Biological Chemistry. Follow her on Twitter @sash_mu.

Just drops of viper venom pack a deadly punch

By Laurel Oldach

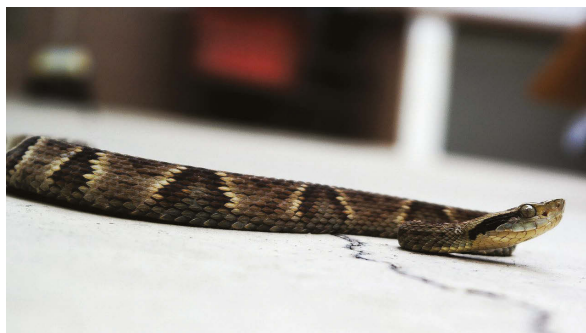
A bite from a lancehead viper can be fatal. Species in the family, among the most dangerous snakes in Central and South America, have venom that can disrupt blood clotting and cause hemorrhage, strokes and kidney failure.

Researchers at Brazil's largest producer of anti-venoms have done a structural analysis of glycans modifying venom proteins in several species of lancehead. The report offers insight into the solubility and stability of toxic proteins from venom and into how venoms from different species vary. Scientists are working to map glycan structures back onto the proteins they modify.

Solange Serrano, a researcher at the Laboratory of Applied Toxicology at the Instituto Butantan in Sao Paulo, studies the protein toxins in lancehead venom. In a recent article in **Molecular & Cellular Proteomics**, scientists from Serrano's laboratory, in collaboration with researchers at the University of New Hampshire, report on the sweet side of snake venom toxins.

The researchers looked at glycans, a group of sugar molecules attached in a complex chain, often with many branches, that can be attached to proteins. According to Serrano, most proteins in lancehead venom are modified with glycans, which can affect the proteins' folding, stability and binding. But little is known about glycan structure in the venom.

Serrano's graduate student Debora Andrade-Silva visited the laboratory of glycomics expert Vernon Reinhold in New Hampshire to learn techniques for structural characterization



COURTESY OF WIKIMEDIA USER LEANDRO AVELAR

Researchers studying venom from *Bothrops jararaca* (pictured) and related vipers have done a structural analysis of glycoproteins in the venom that may give insight into toxic proteins' solubility and stability.

of glycans. While there, Andrade-Silva and colleagues characterized the structure of 60 glycan chains in eight lancehead, or *Bothrops*, species' venoms. The researchers isolated the glycans and analyzed them by mass spectrometry, breaking down each complex molecule into smaller, simpler ions. By piecing together the spectra of many such ions, they could tell which sugars were present and how they were linked into treelike glycan structures.

Lancehead venom contains nearly 100 milligrams of protein per milliliter of liquid. At this concentration, protein solutions tend to become viscous or form gels. Analyzing the structures of glycans attached to the proteins, the researchers found that a disproportionate number were tipped with sialic acid, a sugar with a negative charge.

"Glycans containing sialic acid may help in venom solubility and increase toxin half-life," Serrano said.

Sialic acid on a toxic enzyme may also bind to host proteins called siglecs, pulling the enzyme closer to target cells for greater effect; this has been observed in other types of venom.

While Serrano's group researches

venom composition, the applications are close to home. Another department of the Instituto Butantan produces most of the anti-venom available in Brazil. Serrano said she hopes that basic research into venom toxins will help researchers develop improved treatments for envenomation.

"The antivenoms do a reasonable job, but they are not so good at neutralizing the local effects of snakebite," Serrano said.

These effects, including swelling, hemorrhage and necrosis, can be so severe that doctors must sometimes amputate bitten limbs. Better understanding of how venom differs between snake species could improve the efficacy of anti-venom treatment.

Andrade-Silva and Serrano are working to map the structures from the glycan inventory back onto the proteins they modify. Because some venom proteins have been repurposed as medicines, knowing more about how glycosylation helps each protein fold, hold its shape and attach to binding partners may have applications in biotechnology.

DOI: 10.1074/mcp.RA118.000748

Video

See video of South American lancehead vipers at asbmb.org/asbmbtoday.



Laurel Oldach (oldach@asbmb.org) is a science communicator for the Journal of Lipid Research and Molecular & Cellular Proteomics and a staff writer for ASBMB Today. Follow her on

Twitter at @LaurelOld.

Medical detectives, linked by a PubMed search

Japanese and Israeli researchers team up to find answers for a child with an ultra-rare disease

By Laurel Oldach

The baby looked healthy at first. But within two hours of birth, he was having severe seizures.

Hospital staff at the Rambam Medical Center in Haifa, Israel, were doing a routine check when they realized that the baby was unwell. They transferred him to the neonatal intensive care unit right away and began doing tests, hoping to make a diagnosis. But every test came back negative.

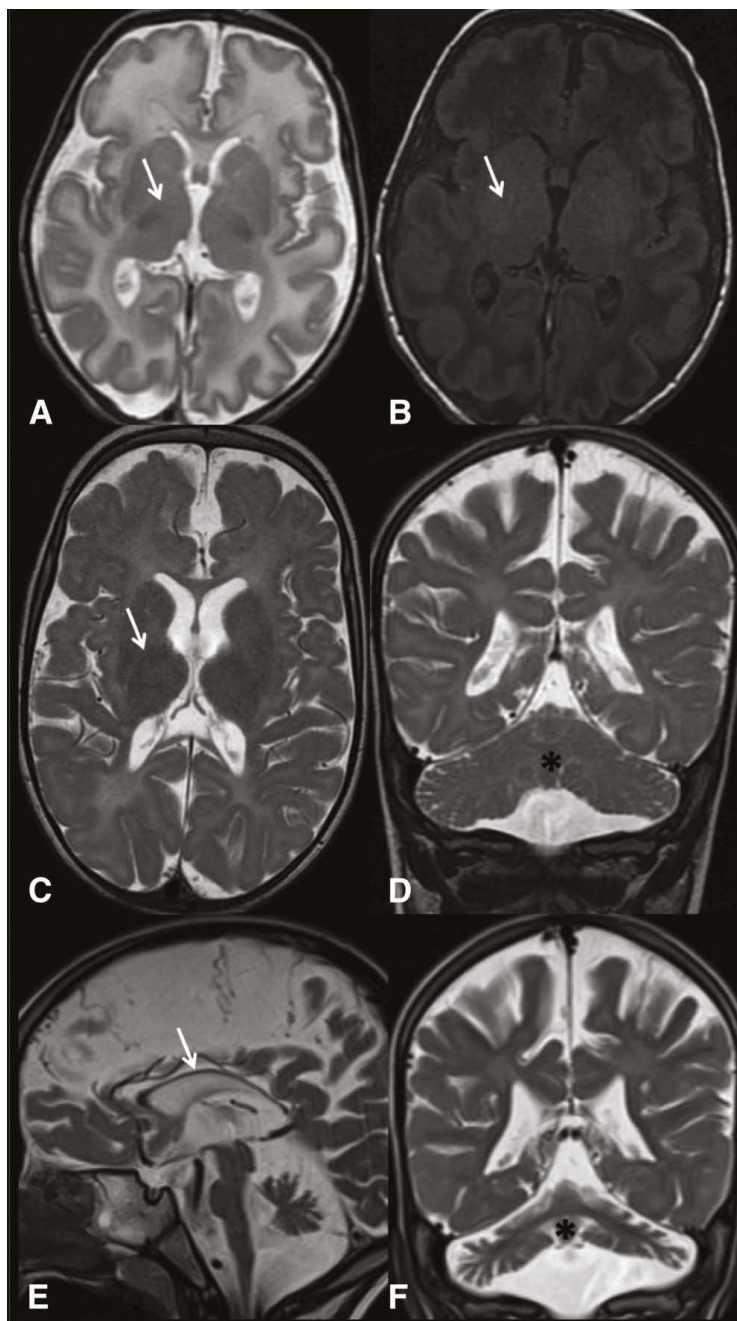
The question was simple: What ails this baby?

The answer would take years to figure out. Researchers from Rambam Medical Center, Japan's Riken Brain Science Institute and other institutions in both countries announced their solution to the medical mystery in an article in the June issue of the **Journal of Lipid Research**.

A mysterious genetic ailment

Hanna Mandel, a metabolic clinician, was head of the team that assessed the infant in the NICU back in 2011. Seizures in newborns usually are caused by oxygen deprivation during birth. But this baby was born by Caesarean section, and his skin color and breathing had looked perfectly healthy. More than a dozen routine tests came back normal. The child had no infection, no problem with known metabolites, no clues in his urine or cerebrospinal fluid. After a battery of routine tests and an extra metabolic workup, Mandel said, they found nothing that could explain the child's illness.

So the doctors sent the child, by this time three weeks old, for brain scans. The images showed a lack of



COURTESY OF YASUHIRO HORIBATA ET AL

Magnetic resonance imaging scans of an Israeli child's brain at 3 weeks (top), 1 year (middle) and 4 years of age (bottom) show limited myelin in places where it would be expected (marked with arrows). The child's doctors worked with a geneticist to find the genetic cause for his developmental disorder.

myelin, the essential fatty coating around nerves. Myelin works like the plastic insulation around an electrical wire. If the insulation isn't there, the wires — in this case, neurons — cannot carry an electrical signal as far or as fast. This deficiency may have affected the boy's development.

As he grew older, the child's development lagged; he never began to move on his own. Follow-up scans showed that his myelin still was not developing and other parts of his brain were beginning to atrophy.

When the child was 4 years old, Orly Elpeleg, a specialist in rare genetic diseases at Hadassah–Hebrew University Medical Center in Jerusalem, led a team that sequenced and analyzed much of the boy's genome, looking for homozygous mutations that he might have inherited from both of his parents, who are cousins.

Elpeleg found 13 sites in the boy's genome where he had inherited rare coding variants from both parents. By looking at his healthy family members' genes, the team could rule out many of these sites as causing the child's problems. The mutation the researchers found responsible was a single-nucleotide change in a gene called ethanolamine phosphotransferase 1, or EPT1. The mRNA of the gene was much shorter in the boy than in a healthy control. At the time, no one ever had diagnosed a patient with an EPT1 mutation.

When the geneticist found the mutation, Mandel went straight to PubMed, a database housing medical and biological research. She was looking, she said, "for someone who would be interested to study the pathogenicity of the EPT1 mutation."

She found the world experts on the gene in question.

Bringing together an international team

Several years earlier, Yasuhiro Horibata had been a graduate student in the laboratory of Yoshio Hirabayashi, who studies lipid physiology

As he grew older, the child's development lagged; he never began to move on his own. Follow-up scans showed that his myelin still was not developing and other parts of his brain were beginning to atrophy.

at the prestigious RIKEN Brain Science Institute in Japan.

The two had discovered that the EPT1 gene codes for an enzyme that puts the finishing touches on the lipid phosphatidylethanolamine, or PE for short. PE makes up about a fifth of all the phospholipids in the brain. They published their findings in a 2007 paper in the *Journal of Lipid Research*.

Mandel found that paper and wrote to Hirabayashi. Soon she, Hirabayashi and Horibata, who was by then a professor at Dokkyo University, hatched a collaboration by email, and the Israeli team shipped a sample of the child's tissue to Japan.

The Japanese team measured enzyme activity and confirmed that it was very low compared with a healthy control, because the incorrectly shortened protein was destroyed immediately by the cell's quality-control systems. They looked for changes in the child's skin cells, measuring all the lipids the cells produced. The lack of EPT1 only slightly reduced the amount of PE in his tissue. This was unexpected, since PE was the main known product of EPT1 activity.

However, the shortage of EPT1 dramatically reduced the amount of another molecule, plasmalogen, a lipid product made from PE and enriched in myelin. It seemed that the cells were using other enzymes to compensate for PE production but not enough to rescue the plasmalogen synthesis. The researchers concluded that even though its PE-manufacturing work is duplicated by another enzyme, EPT1 is important for making myelin in the normal brain. That work is described in the team's new *JLR* paper.

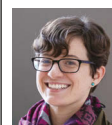
Hope for the future

The researchers solved the genetic piece of the boy's puzzling disease. Last year a British team reported on a patient with similar symptoms and a similar mutation, making the Israeli boy only the second in the medical literature with an EPT1 disorder.

However, as for many people living with rare genetic diseases, his treatment options are limited. He is paraplegic and unable to see or hear. His seizures have worsened.

Mandel emphasizes the positive aspects of the child's life. "He lives in a beautiful Arab village in Northern Israel, in a beautiful house with his parents and sister," she said. "During the day, he is going to a rehabilitation center near his home village, where he gets all the paramedical support one could think of."

Meanwhile, the doctors have offered his parents genetic counseling based on their research. "The couple is aiming for preimplantation genetic diagnosis for future pregnancies," Mandel said. The procedure, which involves screening embryos made by in vitro fertilization for specific genetic diseases before implanting them, could help ensure that any future children the couple may have escape the effects of EPT1 deficiency. DOI: 10.1194/jlr.P081620



Laurel Oldach (oldach@asmbm.org) is a science communicator for the *Journal of Lipid Research and Molecular & Cellular Proteomics* and a staff writer for *ASBMB Today*. Follow her on

Twitter at @LaurelOld.

From the journals

By John Arnst, Angela Hopp, Sasha Mushegian & Laurel Oldach

We offer a selection of recent papers on a variety of topics from the **Journal of Biological Chemistry**, the **Journal of Lipid Research**, and **Molecular & Cellular Proteomics**.

Why do kidney disease and heart failure correlate?

People with chronic kidney disease are at unusually high risk of also developing cardiovascular disease; in fact, a patient with non-dialysis kidney disease is more likely to die of heart failure than to develop end-stage kidney failure. However, traditional atherosclerosis risk factors contribute less strongly to cardiovascular disease in chronic kidney disease patients than in subjects with intact kidney function. Researchers still are trying to figure out how chronic kidney disease is linked to cardiovascular disease and how best to prevent it. In a recent study in the **Journal of Lipid Research**, Kathrin Untersteller and colleagues at Saarland University Medical Center in Germany and the Medical University of Graz in Austria undertook a detailed longitudinal study of patients with chronic kidney disease who were not on dialysis.

Altered kidney function is known to change the protein content of high-density lipoproteins, or HDL, which are inversely correlated with heart disease in the general population. Untersteller and colleagues hypothesized that the level of HDL (known as “good cholesterol”) or its protein makeup in a patient’s serum at enrollment could predict the risk of cardiovascular disease in the next five years. The researchers concluded that, although some characteristics of HDL correlated weakly with future heart disease risk, no characteristic could be used independently to predict risk

after controlling for other risk factors. The study underscores the complexity of untangling causality in clinical studies.

DOI: 10.1194/jlr.P085076

A role in the blood for a milk protein

The enzyme plasmin carries out important functions in blood, including breaking down fibrin clots and activating growth factors. Plasmin is produced by activating the precursor protein plasminogen, so uncontrolled plasminogen activation — caused, for example, by bacterial pathogens — contributes to clotting disorders and other disease states. In a study published in the **Journal of Biological Chemistry**, Alexander Zwirzitz and colleagues at the Medical University of Vienna found that lactoferrin, an immunomodulatory iron-binding glycoprotein from human milk, specifically inhibits plasminogen activation by directly binding plasminogens on cell surfaces. Because circulating lactoferrin increases during pregnancy, this newly discovered function may help explain why pregnancy comes with an increased risk of thromboembolism.

DOI: 10.1074/jbc.RA118.003145

Linking cancer’s sweet tooth and distaste for fiber

Cancer cells are metabolically quirky. For energy, they rely on aerobic glycolysis, a relatively inefficient way of getting energy out of glucose, instead of shuttling glycolysis products into the mitochondria to finish breaking them down. Besides this widespread preference of most cancers, known as the Warburg effect, colorectal cancer cells have an extra

metabolic quirk called the butyrate paradox. Whereas healthy cells in the colon depend on butyrate, a short-chain fatty acid made by bacteria in the digestive system, for a majority of their energy, cancerous cells are less able to proliferate when butyrate is available.

Researchers at China Pharmaceutical University in Nanjing reported on their studies of the metabolic changes in colorectal cancer cells in a recent paper in **Molecular & Cellular Proteomics**. The work zeroed in on the cells’ distaste for butyrate and preference for glycolysis. Qingran Li and colleagues used a metabolomics screen and found that cancer cells, after treatment with butyrate, tend to activate mitochondrial oxidation and stop using glycolysis products to generate new nucleotides and amino acids. The researchers showed that butyrate pushes this metabolic remodeling by binding to pyruvate kinase isoform M2, or PKM2, and activating it. Active PKM2 generates pyruvate, the starting point of the Krebs cycle. This research adds evidence to the existing hypothesis that turning up PKM2 may suppress tumor growth.

DOI: 10.1074/mcp.RA118.000752

Alzheimer’s protease curates neuron surfaces

The brains of people with Alzheimer’s disease contain many protein aggregates outside of cells, known as plaques. These mainly are made of the peptide amyloid-beta, which is released from the plasma membrane when the protease BACE1 cleaves its membrane-anchored precursor protein. Because amyloid-beta cannot be produced without BACE1,

Series brings history of lipid science to life

Since 2013, the **Journal of Lipid Research** has been running a series of thematic reviews about what organizer Alfred H. Merrill Jr. originally dubbed the “Living History of Lipids.”

In his introduction to the series, Merrill described his motivation for starting the collection this way: “Much of what we know about lipids, and might be inclined to assume was easy to discover, arose from incredibly hard work, cleverly designed experiments, astonishing coincidences, and, sometimes, colossal accidents. This series of thematic reviews is intended to give glimpses into these stories. The authors will try to present the events and personalities as living histories where, when possible, readers will have a sense of stepping back in time.”

Thus far, the series has covered the lipid hypothesis of atherosclerosis, eight decades of bile acid chemistry, the discovery of essential fatty acids, what ApoE knockout and -in mice have taught us about atherogenesis, and early studies of arachidonic acid.

The latest installment, the sixth in the series, by Jean E. Vance of the University of Alberta, was published this spring. It is about the discovery, chemistry and biochemistry of two ubiquitous phosphoglycerolipids — phosphatidylserine and phosphatidylethanolamine.

PS and PE, as they’re known for short, captured Vance’s attention back when she was a postdoctoral researcher at the University of California, San Diego, working in the lab of Daniel Steinberg. (Steinberg, by the way, wrote the first installment of the “Living History” series.)



“My interest in what I felt were the rather neglected phospholipids, PS and PE, arose from some of my preliminary data suggesting that phospholipids could be compartmentalized into distinct pools in cells, perhaps due to specific inter-organelle lipid trafficking events,” Vance recalled. “(M)y research evolved into studying the biosynthesis, cell biology and functions of PS and PE in mammalian cells. Consequently, a major focus of my research was to understand the mechanism by which PS is transported from its site of synthesis in an ER domain — mitochondria-associated membranes, or MAM — to mitochondria for decarboxylation to PE.”

— Angela Hopp

DOI: 10.1194/jlr.E044164

numerous BACE1 inhibitors have been tested or are in clinical trials as Alzheimer’s therapy.

In a recent article in **Molecular & Cellular Proteomics**, Julia Herber and colleagues at the German Center for Neurodegenerative Diseases described how they used a targeted surface glycoproteomics method to observe the effects of BACE1 inhibition. By labeling glycosylated membrane proteins, the researchers showed that BACE1 inhibition increases the abundance of unprocessed amyloid precursor protein but also increases other BACE1 substrates and even nonsubstrate proteins. This suggests that the inhibitor may exert unan-

anticipated side effects by remodeling neuronal surface proteomes.

In another blow to BACE1 inhibition, major drug companies Merck and Pfizer killed BACE1 inhibitor trials this year because the drugs showed no benefit. But other companies, including Eli Lilly and Novartis, still have inhibitors in testing in the clinic. DOI: 10.1074/mcp.RA118.000608

Regulating endosomal pH

Numerous disorders, including neurodegenerative diseases, are associated with defective pH regulation in the endolysosomal pathway. Hari Prasad and Rajini Rao from the

Johns Hopkins University School of Medicine performed a meta-analysis of factors affecting the regulation of an endosomal ion exchanger. They found, conserved across yeast, flies and mammals, that these exchangers (and therefore endosomal pH) were regulated transcriptionally by inhibition of a histone deacetylase, or HDAC, in response to nutrient limitation. Pharmacologically increasing expression of the HDAC corrected endosomal pH and improved clearance of amyloid proteins in a cell model of Alzheimer’s disease. Their study was published in the **Journal of Biological Chemistry**.

DOI: 10.1074/jbc.RA118.002025

A pathogen grabs back

Some pathogens seem impressively bold when evading the immune system, engaging with the immune system's weapons directly to disarm them. An interdisciplinary team at the Helmholtz Centre for Infection Research published a study in the **Journal of Biological Chemistry** that describes how a bacterial protein grabs on to host antibodies, possibly to avoid being attacked by them.

Andrea Scrima's research team was interested in a group of virulence factors called invasins, which assist pathogens of the genus *Yersinia* (including the plague bacterium *Yersinia pestis*) in invading the host. In the new study, they focused on invasin D from the zoonotic pathogen *Yersinia pseudotuberculosis*.

"Not much was known about this protein except for its DNA sequence. Nothing was known about its particular function," Scrima said.

The team solved the crystal structure of the protein, investigated when it's expressed during infection and looked for its interaction partners. They found that invasin D bound the immunoglobulin A and G antibodies.

But rather than this interaction being the result of the host attacking the bacterium, it was actually the bacterial protein that was intercepting the antibody — a bit like grabbing someone by the wrist to avoid being grabbed by their hand.

The study required collaboration among groups with diverse expertise, which Scrima credits for the insight into this unusual form of immune evasion.

"This, in my opinion, is a very good example of a great and interesting interdisciplinary collaboration that shows that the whole is more than the sum of its parts," Scrima said.

— *Sasha Mushagian*

DOI: 10.1074/jbc.RA117.001068



COURTESY OF ANDREA SCRIMA

A newly published crystal structure of invasin D is part of a study of how the pathogen *Yersinia pseudotuberculosis* invades its host.

An enzyme's strange residues

Lysosomal phospholipase A2, or LPA2, is an unusual enzyme. In addition to interacting with a wide range of substrates, LPA2 can act as either an acyltransferase or a phospholipase. It also plays a role in host defense mechanisms, and, in contrast to many neutrally active phospholipases, is most active in highly acidic pH.

To figure out why LPA2 has such strange properties, researchers at the University of Michigan honed in on Asp13, a recently identified acidic residue on the enzyme. Their paper in the **Journal of Lipid Research** describes how, when they substituted Asp13 for a variety of amino acids,

the researchers found that LPA2 became most active at neutral pH and was less able to interact with the mono- and double-unsaturated acyl chains that it previously had favored. DOI: 10.1194/jlr.M084012

Six degrees of dopamine receptor mutation

Dopamine disturbances are thought to play a role in multiple psychiatric disorders. Freja Herborg and colleagues at the University of Copenhagen systematically compared the effects of six rare mutations, identified in patients with diverse neuropsychiatric conditions, on the function of the dopamine active transporter, or DAT. They found that all six of the

variants had unique structural and functional changes but that disruptions in ion conductance were a common theme that might underlie disruption of dopamine transport in neuropsychiatric disease. The study was published in the **Journal of Biological Chemistry**.

DOI: 10.1074/jbc.RA118.001753

Pore forming, proteome remodeling

It's a tale nearly as old as genetic information: One set of cells would like to continue its daily business of protein synthesis and replication, while another would like to sabotage those mechanisms for its own gain. When the pathogen *Listeria monocy-*

RNR gets some R and R

Researchers at the Massachusetts Institute of Technology have discovered how an enzyme fundamental for DNA synthesis turns on and off, prompting ideas for how to develop new antibiotics and other drugs.

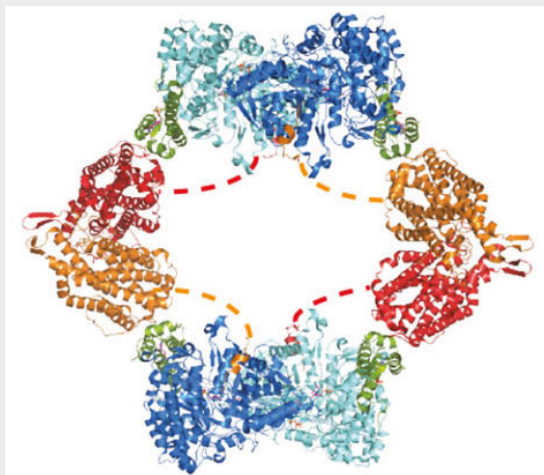
Ribonucleotide reductases, or RNRs, are thought to be among the oldest enzymes in evolutionary history because they are responsible for turning the building blocks of RNA into the building blocks of DNA. Catherine Drennan, a professor of biology and chemistry at MIT, studies how this enzyme works in humans and bacteria.

In a new paper in the **Journal of Biological Chemistry**, Drennan's team investigated why an RNR from *Escherichia coli* forms a donut-shaped structure when it's inhibited. Introducing mutations that disrupted the formation of the ring caused the enzyme to stay turned on, resulting in overproduction of deoxyribonucleotides and increased mutation rates.

"We looked at the *E. coli* in vivo data published by Schaaper and coworkers at (the National Institute of Environmental Health Science) in light of our in vitro results and we went, 'Wow. Not being able to turn off is a huge problem,'" Drennan said.

Human RNRs have been targets in studies of cancer drugs, but Drennan is excited about the possibility of targeting the formation of these ring structures in bacterial RNRs as a new antibiotic strategy.

"I'm very concerned about bacterial antibiotic resistance because I have a 10-year-old daughter, and so



COURTESY OF DRENNAN LAB/MIT

Ribonucleotide reductase forms a distinctive ring-shaped structure when inhibited.

"I've spent the last 10 years of my life being on different antibiotics," Drennan said. "I think that this is a really interesting difference between bacterial and human (RNRs): they all form rings, but they form different kinds of rings. And it seems like there's much more opportunity for specificity there, for designing small molecules that can target a bacterial RNR that would have no cross-reactivity with humans."

— *Sasha Mushegian*

DOI: 10.1074/jbc.RA118.002569

togenes, of foodborne infamy, finagles its way inside epithelial cells in the human intestines, the bacterium deploys the pore-forming toxin Listerialysin O, or LLO, which interferes with the proteins synthesized by the infected cell. This results in cell death by creating holes in cell membranes.

In a paper in **Molecular & Cellular Proteomics**, researchers at the Pasteur Institute in Paris describe a proteomics analysis of human epithelial cells treated with LLO, in which they found that the toxin acts exclusively by altering host proteins through post-translational modifications involving ubiquitin rather than affecting transcriptional activity of underlying genes. They also found that a similar toxin, Perfringolysin O,

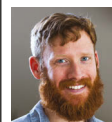
acts through proteome remodeling.

DOI: 10.1074/mcp.RA118.000767

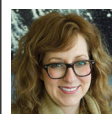
G protein gadgets

G protein-coupled receptors mediate many key signaling processes, but their activity is difficult to study in live cells. Nevin Lambert's lab at the University of Georgia developed miniaturized G proteins fused to reporter probes as tools to monitor GPCR activation directly, precisely and sensitively. These constructs can be adapted to diverse assay formats and be used with standard lab equipment, making them useful for interrogating many signaling pathways and drug targets. The work was published in the **Journal of Biological Chemistry**.

DOI: 10.1074/jbc.RA118.001975



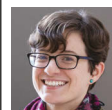
John Arnst (jarnst@asbmb.org) is ASBMB Today's science writer. Follow him on Twitter @arnstjohn.



Angela Hopp is executive editor of ASBMB Today and communications director for the ASBMB. Follow her on Twitter @angelahopp.



Sasha Mushegian (amushegian@asbmb.org) is scientific communicator for the Journal of Biological Chemistry. Follow her on Twitter @sash_mu.



Laurel Oldach (loldach@asbmb.org) is a science communicator for the Journal of Lipid Research and Molecular & Cellular Proteomics and a staff writer for ASBMB Today. Follow her on Twitter at @LaurelOld.

Jerry Hart changes residency, assumes presidency

The new ASBMB president has left the department he helped shape at Johns Hopkins and taken up a new position as eminent scholar at the University of Georgia

By John Arnst

To call Gerald “Jerry” W. Hart a leader in the field of glycobiology would be an understatement.

In 1983, Hart and a colleague, Carmen-Rosa Torres, discovered that the glycan O-linked N-acetylglucosamine, or O-GlcNAc (pronounced “ogel-nac”), is responsible for adding carbohydrates to molecules within the nucleus and cytoplasm of cells, a form of glycosylation that experts previously thought was impossible in those locations. In the past three decades, research has shown that O-glcNAc is crucial for a wide range of physiological processes, including regulation of tau protein fibers in Alzheimer’s disease.

Hart helped launch the journal *Glycobiology* in 1989 and served as its editor-in-chief for 12 years. A decade later, he helped write the textbook *Essentials of Glycobiology*, now in its third edition.

A longtime American Society for Biochemistry and Molecular Biology member, Hart has served as an associate editor for the journal *Molecular & Cellular Proteomics* since 2008 and the *Journal of Biological*



MEGHA SUBRAMANIAN/ASBMB

Prior to joining the Johns Hopkins faculty, Jerry Hart was a postdoctoral fellow at the university in the lab of William J. Lennarz. Hart received his Ph.D. from Kansas State University in 1977 and his bachelor’s degree from Washburn University in 1971.

Chemistry since 2012.

Hart joined the faculty at Johns Hopkins University in 1979. In 1993, he briefly moved to the University of Alabama at Birmingham to serve as chair of the department of biochemistry and molecular genetics before rejoining the Hopkins faculty as director of the department of biological chemistry in 1997.



MEGHA SUBRAMANIAN/ASBMB

Jerry Hart's research associates Partha Banerjee and Stéphan Hardivillé joined his lab as postdocs.

“A lot of people have the fantasy of going back in the lab when they’re this late in their career. Whether I still have the ability or not, I’ll find out, but it’s like riding a bicycle.”

Hart recently spoke with John Arnst, ASBMB Today’s science writer, about his relocation and upcoming research plans. Their conversation has been edited for length and clarity.

What were your motivations for the move to the University of Georgia, and what kind of projects will you be taking with you?

It’s a great opportunity that they’ve given me to go there and primarily focus on research; I won’t have any

administrative duties. I’ve been a department chair for 26 years, so my fantasy is that I might get back in the lab and have some fun doing research again for the rest of my career, however long that lasts.

I’ll do a little teaching of graduate students and maybe even undergraduate students, but mostly I’ll be doing research, which will be a lot of fun.

A lot of people have the fantasy of going back in the lab when they’re this late in their career. Whether I still have the ability or not, I’ll find out, but it’s like riding a bicycle. The only



MEGHA SUBRAMANIAN/ASBMB

Jerry Hart stands in his lab at John Hopkins University. Since the discovery of O-GlcNAc in 1983, glycobiologists have discovered that the glycan also plays an important role in oncogene and tumor suppressor proteins.

limitation, of course, is that when you get older it's more difficult to see a small thing like a microliter.

People might not be aware that the Complex Carbohydrate Research Center at the University of Georgia is the best place in the world to do glycobiology. There is no place on the planet that is even close to what they've created there, in terms of both people and equipment and resources. I've been on their advisory board since 1987, and, basically, it's about 18 to 19 full-time faculty and about 200 scientists all doing work on glycans both in plants and animals, and it's one of the most collaborative places I've been.

This was out of the clear blue sky. I wasn't expecting this, especially this late in my career, but it's a great opportunity.

What is it like to move your lab?

It's pure hell.

No. 1, I used to know where every single thing was in my lab, and once I moved I knew where nothing was. Moving a lab is a lot of work, even with a moving company. And, of course, now I'm moving a house and a lab.

I am looking forward to a warmer climate, though.

Are you bringing any lab members?

Maybe. It's currently unknown. I'm trying not to bring any members with me, because I made my lab really small in the last year or so — but that wasn't because I was planning this. One or two may go temporarily to

President's Message

Read Jerry Hart's first President's Message on page 2.



ASBMB

Jerry Hart listens to speaker at the 2018 ASBMB annual meeting in San Diego where he was presented with the Herbert Tabor Research Award.

finish up and things like that, but it's up to them.

What glycobiology research are you excited to be tackling now?

What's come out in the last three decades of working on O-GlcNAc is that it's involved in practically everything. And so one of the most difficult decisions is what to do next, right?

The most interesting area for me right now is how O-GlcNAc regulates transcription. It majorly regulates gene expression in response to nutrients; how does that work, and how does it regulate the interaction of transcription factors?

O-GlcNAc is also critically important for practically everything the brain does, particularly at the synapses of learning and memory and neurodegenerative diseases, so those are two main areas that we're really going to focus on.

Prolonged increase in O-GlcNAc is also a fundamental mechanism of glucose toxicity in diabetes. There are just so many different avenues.

One of the reasons I've had a lot of students over the years is that when they come to my lab they can pretty much work on anything they want in

terms of the biology. I've had students walk in and say they want to work in protein translation. I didn't know anything about protein translation, but now I do, because I had a graduate student that spent five years of their life working on how O-GlcNAc regulates protein translation. So it makes it really fun; I'm always learning new stuff.

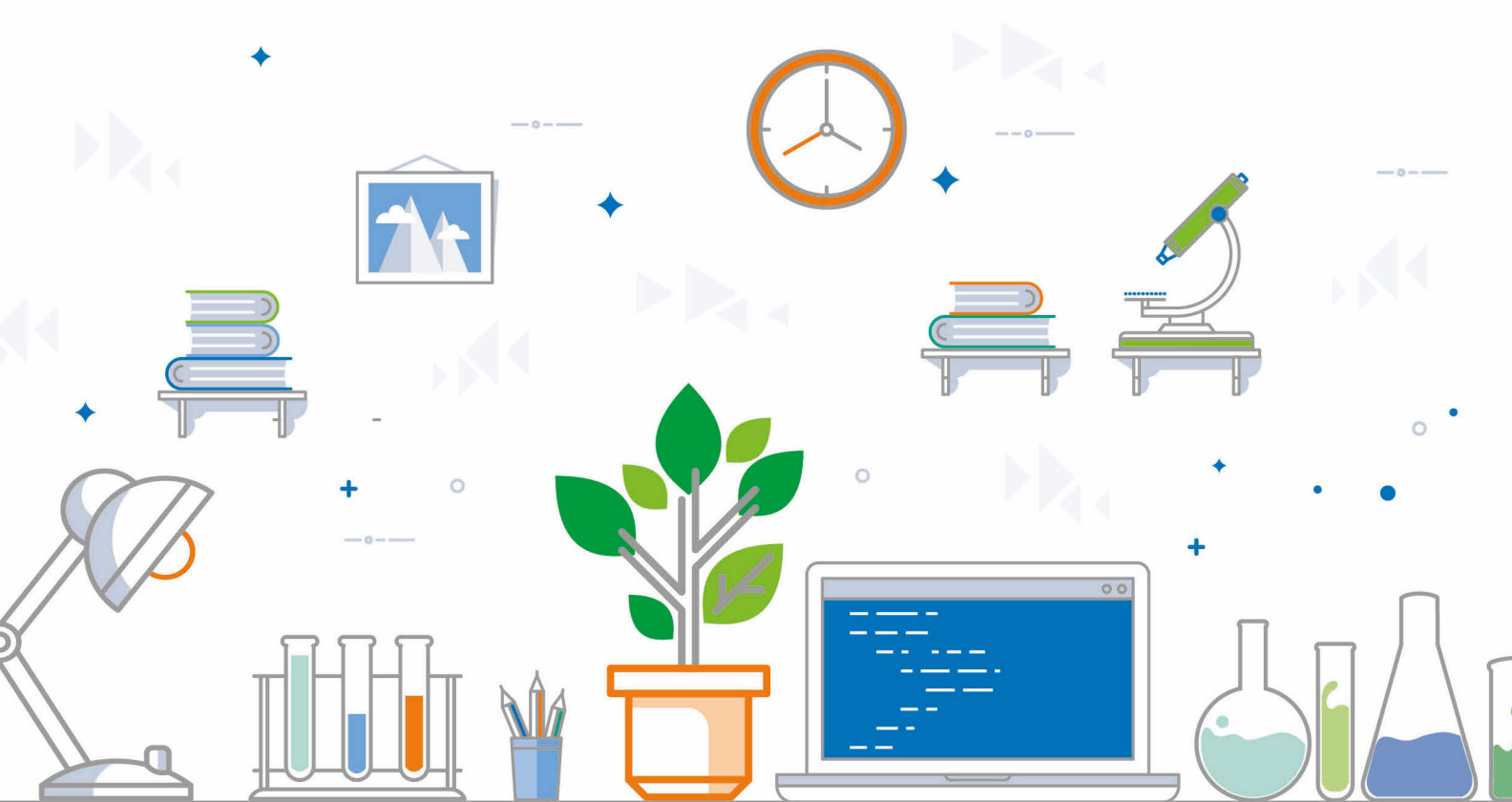
I'm not an expert in almost everything we're working in, but that's OK. Sometimes we're accused of not being focused, but we're pretty focused on a monosaccharide — you don't get more focused than that.

Video

In an interview from the American Society for Biochemistry and Molecular Biology's 2018 annual meeting, Jerry Hart talks about winning the 2018 Herbert Tabor Research Award and becoming president of the ASBMB. Watch at asbmb.org/asbmbtoday.



John Arnst (jarnst@asbmb.org) is ASBMB Today's science writer. Follow him on Twitter @arnstjohn.



ASBMB professional-development resources

Jobs board

asbmb.org/jobboard

The ASBMB jobs board has listings from academia, government and industry. Looking for your next hire? Members can post jobs for free.

Grant-writing training

asbmb.org/grantwriting

This Washington, D.C.-based summer workshop yields impressive results; 75% of participants end up with successful grants within two years.

Communications training

asbmb.org/commcourse

Can't travel for training? Take the ASBMB's "The Art of Science Communication" online course to gain the skills, knowledge and mindset necessary to become a great presenter.

Small meetings

asbmb.org/specialsymposia

Small meetings are offered throughout the year on a wide range of scientific topics. Interested in organizing a meeting? Members can work with the ASBMB to plan and organize a special symposium.

Careers blog

asbmb.org/careersblog

Every week, our jobs blog presents insights into the current job market.

Webinars

asbmb.org/webinars

We offer live webinars and recordings of past webinars on topics including getting funding, salary negotiation, research careers in industry and more.

Video tutorials

asbmb.org/careers/tutorials

Our video series has tips on networking, dressing professionally, building a personal brand and more.

asbmb.org/careers

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THE CAREERS ISSUE



National labs offer options for science careers

By Laurel Oldach

In a world that asks scientific trainees whether they plan to seek a job in academia or industry, not many consider a research career independent of either sector. In a national laboratory, for instance.

The national laboratory system employs more than 20,000 scientists and engineers in 17 laboratories across the country. The system, primarily funded by the Department of Defense and the Department of Energy, grew from the Manhattan Project and the early days of the Cold War, when concentrating the nation's nuclear expertise was a high priority. While several laboratories continue to focus on maintaining the country's nuclear weapons stockpile, the system's mission has evolved since the 1940s.

Nowadays, researchers at national laboratories conduct basic research in microbiology, genomics, crystallography and other biochemical fields in addition to physics, materials science and engineering. They also provide equipment and support at scientific core facilities to over 30,000 visiting scientists per year.

ASBMB Today writer Laurel Oldach spoke to Tom Metz and Mollie Rappé, Ph.D. scientists who work at national laboratories, about how they landed where they are and what working in the national laboratory system is like. The interviews have been edited for style, length and clarity.

Tom Metz: 100 percent research, all the time

Tom Metz, the metabolomics team lead of a research group at Pacific Northwest National Laboratory in eastern Washington, has a prolific publication record. The 100-plus journal articles on his CV include algorithm development, methods in multi-omics, viral pathogenesis and his first love, chronic disease.

"That's one of the things that I like about working here," Metz said. "Every year is a little bit different in terms of the projects that you get to work on. It's very intellectually stimulating."

Metz talked about how he came to lead the metabolomics team within the integrative -omics group at PNNL, a career path in research that may be unfamiliar to many scientists.

Let's start with the basics. What do national labs do?

There are 17 national laboratories

around the country, and they were set up to help with national priorities: energy, defense, things like that. Different laboratories do different things. Our group here at the Pacific Northwest National Laboratory does basic research on biomedical and environmental themes. For example, we study organisms that generate a lot of a particular material, whether it's a lipid or fatty acid, that can be used for bio-fuel production or even commodity chemical production. We have a lot of studies now looking at the microbiome in human and mouse models of disease, trying to understand mechanisms and identify biomarkers; we have a number of projects looking at diabetes and cancer.

The capabilities that have been developed here for molecular measurement can pretty much be applied to anything that contains the

molecules we specialize in. We have a really diverse research portfolio. Typically, we will pair up with external collaborators that have interesting biological questions, and then we work together to answer those driving science questions.

What is it like to work as a lead scientist at the PNNL? How does it compare to being, say, a professor at a university?

It's 100 percent research, all the time. We do not train students as a primary objective. Of course, we have students come through here in different capacities. We have post-bacs, post-master's and postdoctoral research associates who will spend anywhere from one to four years here working on a project. But that training isn't our primary goal.



COURTESY OF PACIFIC NORTHWEST NATIONAL LABORATORY

Tom Metz is the metabolomics team lead of a research group at Pacific Northwest National Laboratory. He says his work provides endless possibilities, with different projects every year.

How did you first get interested in science?

My mom was a nurse in surgery, and I was fascinated by the stories she would tell when she would come back from different cases. I first thought I wanted to do disease research; at the time, I thought I needed a medical degree to do that. I applied to medical school and didn't get in. My organic chemistry professor talked me into going back to the same school to start a bachelor's in chemistry.

One thing led to another, and I ended up in graduate school. I still wanted to do disease research, and I ended up going to University of South Carolina for my Ph.D. with John Baynes. He was studying diabetes, focusing on proposed chemical mechanisms for why certain individu-

als with diabetes develop diabetic complications. That was really cool to me, because it coupled chemistry with disease research.

After I finished my Ph.D., I asked him, if I wanted to do a postdoctoral appointment in mass spectrometry, where should I go? He suggested Jack Henion at Cornell or Dick Smith at the PNNL. That year, Jack Henion had just retired, and he was starting up a new company. I felt, with a startup company, there were probably not a whole lot of opportunities for research.

Then I came out here (to Richland, Washington) and interviewed at the PNNL. I met Dick Smith and a lot of the people in the group at the time and got to see all of the great instrument development that was going

on. They gave me what I still call the "shock-and-awe tour" of all the instrument labs. I felt like a kid in a candy store, and I knew that this was where I wanted to do my postdoc appointment.

A few months into that appointment, two calls for proposals came out looking for advanced proteomics and metabolomics technologies applied to diabetes. Having just done a Ph.D. in that area, I wrote those grants. I couldn't be the PI on paper because I was a postdoc, but they were both funded. Because I was pretty good at writing grants, Dick suggested that I stay here as a staff member.

It seems like you still get plenty of opportunities to dig into mechanisms of diseases like diabetes.

Sure. It really depends on what we can get funding to do. It almost seems like the possibilities are endless, because we have such a solid reputation and track record in instrument development and technology development — not only hardware but also software — and application of both of those to systems biology studies. So we really have a lot of good opportunities to continue doing that.

Any advice for students and trainees who might be interested in a research career similar to yours?

I think they should think about what they really want to do and find the right opportunities for their career objectives or their scientific passions. Often, I think, there's a little bit of a mismatch in what people end up doing, say, for a postdoctoral appointment and what they would really like to do.

Mollie Rappé: On the lookout for scientific stories

Mollie Rappé spent three months as a science writing intern at the American Society for Biochemistry and Molecular Biology in 2015 while earning her Ph.D. in biophysics. After graduating, she took a job as a science writer at Sandia National Laboratories in Albuquerque, New Mexico. ASBMB Today caught up with Rappé to talk about her pursuit of a career in science communication.

“As a science writer, I get to go in and talk to the researchers about their work. Whether they’ve been working on ways to decontaminate anthrax for the past 15 years or a new meta material that can do cool new things for the last 18 months, I get to learn all about it,” she said.

Since we spoke, Rappé has accepted a new job as a science writer at Brown University. “I’m looking forward to getting back to my biophysical roots,” she wrote in an email.

How did you first realize you were interested in science?

I’ve been interested in science pretty much my whole life. My mom likes to tell stories about how “rock” was my fourth word and how I used to go around when we were on walks and stuff, picking up pretty pebbles and putting them in my diapers. As I got older, my interest moved from rocks to bugs to biology in general, so I went into biochemistry in college and biophysics for grad school.

What did you work on in grad school?

At Johns Hopkins I studied ribosome biogenesis, how the factory of the cell puts itself together, specifically the bacterial 30S ribosome. There were some rRNA mutations that I made to attempt to perturb assembly, and it pretty much destroyed assembly. The mutant ribosomes were



COURTESY OF MOLLIE RAPPE

Mollie Rappé, shown here when she was in graduate school, originally planned on a research career but is now a science writer at a national laboratory in New Mexico.

fatal if they were homogeneous in the bacteria, so I had to do some work-arounds to get a mixed population of normal, functional ribosomes and these mutant ribosomes. Then, how do you purify the mutant ribosomes to see what stage of assembly they were actually paused at? That was pretty much six years of work.

You interned at ASBMB Today as a graduate student. Were you writing on the side throughout grad school, or was the internship your major writing experience?

I had written fiction on my own since elementary school, but it wasn’t until my fourth year of graduate school that I realized that I didn’t like doing research. I didn’t like the constant failure of experiments and spending a week figuring out, “Oh, the reason why it failed is because a lab mate destroyed an enzyme” — that sort of thing.

The American Association for the Advancement of Science has a test to compare what you’re good at and what you enjoy doing with “alternative careers,” and that’s when I discovered that science writing was

actually a real career, and that opened up my eyes. I found the internship with the ASBMB and persuaded my Ph.D. adviser to let me take a leave of absence to do the internship. I’m just glad the ASBMB was flexible, because it took a while to convince her.

We talk a lot these days about ‘alternative careers’ for people with Ph.D.s Did you experience any friction when you decided to leave the bench after grad school?

Most of my thesis committee were quite disappointed. I got a lot of talking-to from other women scientists about how dare I “lean out” and leave the bench, so yeah, there was a lot of friction. I think by that point my Ph.D. adviser had basically written me off. If it weren’t for one of my committee members stepping up and basically saying, “Guys, why don’t you get your heads out of your butts?” then my thesis defense probably would have been a lot more painful.

That sounds really difficult.

It’s ridiculous. It’s like, can’t you look at the statistics? Just because you chose one path doesn’t mean that it’s the one true path. But, at least in my experience, to most of the professors I come across, becoming a professor at a research institution is the one true path and anything off of that — at best, it’s second-best. A lot of them told me that it was a waste that I was leaving.

How did you become aware of the national lab system? How did you find the job at Sandia?

During my thesis work, I had gone to Brookhaven National Lab every quarter to do experiments at the



COURTESY OF RANDY MONTOYA/SANDIA NATIONAL LABORATORIES

To report on a story about a new medical device that combined microneedle and microfluidic technologies to measure subcutaneous electrolytes, Mollie Rappé signed herself up for a clinical trial.

synchrotron there, and my father had some involvement with the National Renewable Energy Laboratory. So I knew of them.

After I finished my internship at the ASBMB and went back to write up my thesis, I applied to anything and everything in the general area of science communication. From being a barely paid social media intern for the Planetary Society in California to writing for a chemical goods company, to universities, to national labs, I applied everywhere. I love it at Sandia, and I'm really glad that they took a risk on someone who only had three months of science writing experience.

Wait, can I pause you and ask about how you use a synchrotron for ribosome assembly assays?

This is not a common use for a synchrotron. X-ray crystallography is the primary use. But you can use X-rays that were generated by the synchrotron to irradiate frozen bacterial cells. The water frozen in ice — a special kind of ice — forms hydroxy radicals, which are highly reactive and cut everything up. The hydroxy radicals from this bright X-ray have a very

short lifetime, so they really only cut the part of the ribosome that is solvent exposed. By doing some primer extension and back-calculation, we see where these cleavages occurred. Then you can compare wild-type ribosomes to mutant ribosomes to see the places that are different and thus, presumably, unfolded — whether it's a protein that's not there or an entire domain of the ribosome just sort of flopping around because certain key helices haven't been formed yet.

There's one footprinting beam line at Brookhaven National Lab and another at Lawrence Berkeley National Lab; those are really the only two.

You seem to write about lots of different types of science at Sandia. How do you find leads?

I have several different ways I find stories. We have laboratory-directed research and development funds, which are funded as part of program overhead, and then the scientists there write proposals — say, "I want to develop a microfluidic system that can hook up to microneedles and detect electrolyte levels." That may someday

be used for the military, but it's basic science. Proposals like that one are a really good source of stories for me.

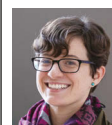
Of course, we are on the lookout for scientific papers that are coming out. We talk to managers to ask what sort of cool research is going on and what's about to be published to get on top of things and write about that.

What's your favorite thing about your work?

Getting to talk to the researchers about their cool stuff. Working on the microneedles story, which went from basic science supported by laboratory-directed research and development to now being in clinical trials supported by the U.S. Defense Threat Reduction Agency, I actually volunteered for the clinical trial. So they stuck the microneedles in me, and I wrote the news release from a first-person perspective. I could actually say, "Yeah, these are painless microneedles. When they go in, you feel something kind of like pulling off a Band-Aid, but once they're in there you don't feel anything." It was cool.

Any advice for people who are in the lab now and might be interested in doing something similar to what you do?

Out of all of the people that I've met at science writing conferences and scientific conferences who've made this switch, I haven't met anyone who regrets it. If you're in the lab and you love what you do and you love incremental learning about a very narrow area, then of course stay in. But there are other options, and you shouldn't let naysayers get to you.



Laurel Oldach (oldach@asbmb.org) is a science communicator for the Journal of Lipid Research and Molecular & Cellular Proteomics and a staff writer for ASBMB Today. Follow her on

Twitter @LaurelOld.

An entrepreneur fights disease on the ground

By Laurel Oldach

Imagine a small rural community most of a day's walk from the nearest clinic. A community health worker comes through town, vaccinating local children, giving prenatal vitamins to expectant mothers, and offering tests for infections like HIV and malaria. With a type of diagnostic device that resembles a home pregnancy test, the worker, often a volunteer, can do a blood test quickly, far from the lab.

Such tests are simple and should be easy to use, but they have pitfalls. A recent study found that single-use vials of buffer packaged with some tests can leak, and substituting water or saline may give a false-positive result. Paula Fernandes, who trains health care workers around the world, recently saw someone apply a blood sample to the wrong end of a diagnostic device.

Rapid diagnostic tests “are said, and believed, by many in the public health sector to be easy-to-use and reliable,” Fernandes said. “And yes, if used and stored and managed correctly, they are reliable. But there are so many areas where quality is degraded.”

Fernandes started her company, Global Scientific Solutions for Health, to solve quality problems in the clinical lab. She and her team consult with ministries of health and train lab workers and health care providers around the world to make sure diagnoses are reliable and patients get the care they need.



COURTESY OF GLOBAL SCIENTIFIC SOLUTIONS FOR HEALTH
Paula Fernandes and a training course participant look at tools for laboratory supply chain management.

An unusual path to a Ph.D.

Fernandes’ passion for science began early. “When I was 8, I decided I was going to be a microbiologist,” she said.

Her father, who ran a small business in England installing refrigerators, took her with him to work during summer holidays. One year, he brought her to a lab that needed a new cold room. “My eyeballs must have been so big walking into this lab,” Fernandes said. “Someone took me and showed me — I don’t know, a wheat germ or something under the microscope. I was like, ‘Wow. There is a whole hidden world that I never knew anything about, and it’s incredible.’”

For her birthday that year, her family gave her a microscope, and she dissected everything she could find. But there was one obstacle to becoming a

microbiologist. “I really hated school. The only thing I liked about school was biology.”

Fernandes dropped out at age 15, later returning to take exams for the general certificate of secondary education, or GCSE. In the United Kingdom, these tests usually are taken at the end of 10th grade. At the time, they marked the end of compulsory education; some students went on for two more years of schooling followed by exams known as A-levels. But Fernandes was impatient to get out of high school and into the lab.

While preparing for the GCSEs, “I started hand-writing letters to laboratories all over the southeast of England,” she said. “I can’t remember how many letters I wrote, but I know my hand hurt.”

She sent dozens of inquiries for entry-level work, received two replies

and landed a job in the microbiology lab at a general hospital in northwest London.

The work was poorly paid, and one of her least favorite tasks was spending hours autoclaving blood cultures used to diagnose infections and sluicing them down drains. But Fernandes was thrilled to be in a real lab with real bench work going on nearby. She was especially fascinated that her co-workers sniffed agar plates to detect certain microbes.

“I was a bit of a busybody when it came to science. I was always at the bench asking questions,” she said. Her fascination was clear to her co-workers. “People started teaching me stuff. I had a good nose: I was able to sniff out *Haemophilus influenzae* on a plate of *Pseudomonas*.”

Sensing potential, her manager sent her for a certification course in medical laboratory science.

Around that time, an aunt was diagnosed with an advanced case of tuberculosis. Fernandes was shocked when the infection, which she diagnosed in the lab but thought of in strictly historical terms, eventually killed her aunt.

“I was there with the entire family around her bedside when she died,” she said. “It was a case of basically turning off the life support ... I remember thinking to myself, ‘How can a disease like tuberculosis kill my aunt right in front of my eyes when she’s not even 40?’ She had other problems that made her more susceptible — but (until late in the infection, her TB) wasn’t diagnosed! It wasn’t picked up! How could it not have been diagnosed? I couldn’t understand this. That had a huge impact on me.”

Meanwhile, her professors in the medical lab science program encouraged Fernandes to continue her education. Because she hadn’t taken the A-level exams, applying



COURTESY OF PAULA FERNANDES

Paula Fernandes demonstrates fingerstick blood sample collection to military laboratory workers in Angola.

to university was a tricky proposition. The professors in her program at Paddington College petitioned the national university entrance board for an exception, enabling her to go on for a bachelor’s in biotechnology. She excelled, and she later was accepted into graduate school at Cambridge University.

“I went from this rough, rebellious kid to somebody who was doing a Ph.D. in genetics at Cambridge,” Fernandes said. “And Cambridge was funny, because I don’t think they had anyone like me ... There’s this whole background that I was missing, but I also felt like people were kind of interested in me because of that.” Fernandes wrote her dissertation on mycobacterial genetics and planned for an academic career researching tuberculosis.

Diagnosing diseases in humans

In 2001, Fernandes moved to the U.S. for a postdoctoral fellowship in Baltimore. After a few years

and a change in labs, it became clear that she didn’t want to be a research professor.

“I felt that there was too much distance between proteins that I was working on and my old life diagnosing diseases in humans, which seemed far more exciting to me,” she said.

She returned to the clinical laboratory just as molecular diagnostics were becoming available commercially, prompting a change in how clinical labs worked. After a year at a clinical pathology laboratory back in England, Fernandes returned to the U.S. for personal reasons. She interviewed for a job helping to launch laboratories as part of the President’s Emergency Plan for AIDS Relief. She knew the job was in Africa, but the hiring manager didn’t tell her exactly where, and she didn’t think to ask. That didn’t put her off.

“I was like, ‘Oh, I want to go to Africa and help set up labs there,’” she said. “I had just done that at a lab in the U.K., and I thought it was really interesting.”

Country X turned out to be Nige-

Advice for aspiring entrepreneurs

Paula Fernandes offers these recommendations for scientists interested in starting their own businesses:

- **Ask questions.**

Go to networking events and meet people. “I think it’s really important just to get some exposure just on the language, on the philosophy. Speak to entrepreneurs and find out their path, because it’s always fascinating.”

- **Be adaptable.**

Fernandes transitioned “from being a scientist who’s focused on a very specific technical problem like quality diagnostics to hiring, managing people and having to handle things like IT ... You think you’re a microbiologist? Well, now you’re putting the trash out, making the tea, you’re the HR person, you’re the IT person, you’re the bookkeeper — OK, we have a bookkeeper and accountant, but still — and you’re the contracts manager.” She faced a steep learning curve figuring out how to handle everything.

- **Take advantage of training opportunities.**

For younger scientists interested in starting a business, Fernandes recommends starting to practice and learn about the path as early as possible. As a graduate student at Cambridge, she entered a competition called the Biotech Young Entrepreneurs’ Scheme. “I think that was the seed that really made me want to start my own company.”

- **Do what you know ... and love.**

After competing in BiotechYES, Fernandes spent time looking at possible ventures. But then, “It suddenly occurred to me, why am I trying to start a business in something other than what I already do? ... I’m right here, I know what it is I’m doing right now, I know what I could do to improve it ... and it’s the one thing on earth I’m most passionate about.”

ria. After a few years helping to set up diagnostic and toxicity monitoring labs there, Fernandes became a program manager at the Association of Public Health Laboratories, based in Maryland, and enrolled in an MBA program. As she moved up in the ranks and away from the field, she said, “I realized that the lab was never at the forefront of everyone’s mind doing public health. Yet it was the lab that determined whether there was a public health issue or not.”

That realization motivated Fernandes to found her company, Global Scientific Solutions for Health, in 2008. “For me, there was just too big a gap between the policy and the practice,” she said. “I started GSSHealth because I really wanted to focus on the field and focus on bridging that gap.”

She describes the company’s work as “putting policy into practice”: implementing the decisions of health policy makers in developing countries that don’t have unlimited funds to throw at public health problems.

“The starting point is always global health policy and international health regulations,” Fernandes said. “Let’s

say, for example, ‘If you have HIV, you need to have a viral load test.’ That would be a policy statement ... Then it’s a question of actually making it happen.”

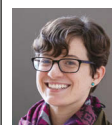
This viral load testing policy is a real one, recommended by the World Health Organization and its partners in 2013. However, with logistical and technical concerns, enacting the policy worldwide is a Herculean effort. If no clinical labs are available, if lab workers lack the tools or training to conduct a viral load test, or if reagents or equipment maintenance don’t arrive reliably, then “give each patient with HIV a viral load test” becomes an impossible instruction.

Fixing these problems in collaboration with local health care providers, health ministries and nongovernmental organizations is where Fernandes and her team come in. They offer training to lab technicians, trainers, auditors, community health workers and others in the healthcare system, working to strengthen existing systems rather than duplicating them. The team focuses in particular on regions far from national reference labs in countries’ capitals.

“The places that are most vulnerable to public health events and biosecurity events (are) places on borders between countries,” Fernandes said, citing the 2014 Ebola outbreak in West Africa and work GSSHealth and its partners have done on implementing interventions to reduce antimalarial resistance at the border between Thailand and Cambodia. “There’s a lot of travel back and forth; there’s a lot of mixing of populations and diseases. These are very important areas.”

The company has 10 employees at its office in the heart of Baltimore as well as subject matter experts in Africa and Southeast Asia.

“We’re really mission-driven here,” Fernandes said. “Passion is infectious. We may have a small team, but every person here is just fantastic, and you’re nothing without that.”



Laurel Oldach (loldach@asbmb.org) is a science communicator for the Journal of Lipid Research and Molecular & Cellular Proteomics and a staff writer for ASBMB Today. Follow her on

Twitter @LaurelOld.

Negotiating for scientists

By *Adriana Bankston*

Debra Behrens is a Ph.D. counselor at the University of California, Berkeley, where she addresses the career concerns of graduate students, postdocs and international scholars in the sciences. She specializes in career change, negotiation, dual-career issues, cross-cultural interview skills and international job search strategies.

After completing a Ph.D. at the University of California, Santa Barbara, Behrens taught in the graduate counseling program at California State University.

Behrens presented a session on negotiation strategies for scientists at the 2018 American Society for Biochemistry and Molecular Biology Annual Meeting in San Diego.

To start the session and get a feeling about participants' perceptions, Behrens asked the audience what words came to mind when they thought about negotiating the salary for a dream job. The responses spanned a continuum from "stressed" to "confident." This was a nice ice breaker into a topic that many of us probably don't think about very often. We may only become aware of our reactions when faced with a real-life situation, so this exercise helped identify our feelings about a hypothetical negotiation.

After the session, I talked further with Behrens about the topic of negotiation. The following is an edited summary of the session and our conversation.

Why is negotiation important?

Negotiation is not only for job offers. We all engage in negotiation in our daily lives on both personal



COURTESY OF DEBRA BEHRENS

Debra Behrens, a Ph.D. counselor at the University of California, Berkeley, says negotiation is not just a skill for getting what we want in job offers but for use in our daily lives.

and professional matters ranging from high stakes to smaller issues. Being an effective negotiator allows you to develop, maintain and improve relationships. Life is a series of negotiations, so learning how to negotiate effectively can be useful in a variety of ways.

What is negotiable and what is not?

In a job offer, items that are negotiable are often resources, such as lab equipment and office space, and conditions related to work-life balance, such as the ability to work remotely and the amount of time off or vacation you can ask for. Other negotiables relate to job title or assignment, salary, benefits and perks of the job. Even before getting to the on-the-job issues, you can negotiate your start date and moving expenses.

Non-negotiables are items such as insurance benefits and retirement as well as anything governed by employment law or an organization's structure.

What factors should one think about when negotiating salary?

Preparation is a key element, and a surprising number of candidates don't prepare adequately for negotiation. You should know the market value of the position and look for salary ranges in comparable organizations, and you should factor in the region or local area of the job and the type of organization you are negotiating with (academic, nonprofit, industry, etc.).

When negotiating a salary for your dream job, remember that you are in a good position because the employer wants to bring you on board and you want to accept the offer. You share the same goal. You're simply trying to arrive at agreement on the terms and conditions. Some candidates worry that an employer might retract the offer if they ask for more money, but they should move forward and consider that shared goal.

How can you use negotiation to your advantage?

You should begin thinking of negotiation as early as the job interview. Use that discussion to gather information pertinent to asking for more money and benefits. What you learn in the interview can inform how you present your case. For instance, if you learn that the company is expanding its science, technology, engineering and mathematics partnerships with local school districts, you might leverage your background in science outreach and your teaching-assistant training.

Or, if you have specialized skills or a unique combination of experience and knowledge, it also might be possible to leverage this background in

negotiating the job offer. The key is to demonstrate the value of your expertise or experience to the employer.

The start date also sometimes can be leveraged in the negotiation. In some situations, the employer urgently needs to fill the position by a certain date, and the candidate might be able to leverage this to their advantage.

Negotiation is an interaction, so think of it in terms of creating a win-win situation as opposed to an adversarial one. Think about options during the negotiating process, and ask reasonable questions that generate options or show possibilities (for example, you could say, “I know you can’t pay for x, but how about y instead?”). Help your prospective employer think creatively and focus on the substantive outcome that will benefit both parties.

How can you alleviate negotiation-related concerns?

Think in terms of why it’s important to negotiate. View the negotiation process as an interactive dialogue rather than a static exchange. Be willing to ask exploratory questions such as “Would it be feasible to ...?” or “Under what circumstances might you consider ...?” When you ask for a salary or benefits, you are defining what you need in order to be effective on the job. That mindset can help focus the conversation with the employer on your needs. If you have the resources you need to be successful on the job, you will be better able to meet the employer’s needs. Remember that everyone feels some anxiety about negotiating, and with practice your skills will improve.

What’s your advice for what not to do?

Don’t underestimate the power of a positive attitude. Thank the employer for the offer and express your enthusiasm for the position.

Negotiation mistakes include being unable to demonstrate what you bring to the table and being unprepared to counter arguments. Also, don’t limit your focus to salary, but rather consider the overall compensation package. Don’t be afraid to advocate for yourself and ask for what you want and need in the job. Remain honest during the negotiation process, and be truthful about your current or previous salary.

Why is negotiating more difficult for women?

Many people are hesitant to negotiate. This is often their first important discussion in a job, so it naturally will come with some anxiety. Most women negotiate less often than men.

One study showed that salaries of men who recently graduated from Carnegie Mellon were 7.6 percent, or almost \$4,000, higher on average than those of female MBAs from the same program. Only 7 percent of women attempted to negotiate, whereas 57 percent of their male counterparts asked for more money. This may be due to the fact that women simply accept their employer’s salary offer. Other possible factors are sociocultural issues or the fear of appearing to be concerned only with money or being perceived as too aggressive.

What are broader considerations for negotiation?

Negotiation is different in every job search. One candidate might value flexible work hours or the option of telecommuting while another might be interested in support for professional development or moving expenses. You should bring up perks or negotiables that are important to you. That helps the employer understand what you value most. By organizing your priorities, you can allocate enough time to discuss those at the top of the list.

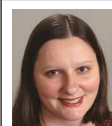
Before a negotiation meeting,

you should devote adequate time to preparation. You need to identify the deal breakers and the areas you are willing to be flexible on, and you should consider quality-of-life factors in terms of what will make you happy and productive on the job.

Do you have a story of successful negotiation?

I knew a candidate who was negotiating for an academic position and was able to leverage a competing offer from another employer during the process. Not only was she successful in negotiating her desired salary, budget and relocation expenses, but the negotiation also yielded a lecturer position for her spouse, who also was seeking an academic job. The couple had discussed their priorities and decided that living apart would not be an option if they received job offers in different locations. They had a commuter marriage in the early years of their relationship and were not willing to make that sacrifice again.

The candidate demonstrated her value by emphasizing her relevant experience in teaching and mentoring. She also benefited from the lucky timing of the competing offer and being candid with the employer about her deal breaker. Another key factor was that she mentioned early in the negotiation process that she was part of a dual-career couple and also was seeking a position for her spouse. Candidates who hesitate to make a request can lose out, because later in the process the resources and opportunities may no longer be available. If you need something, don’t hesitate to negotiate.

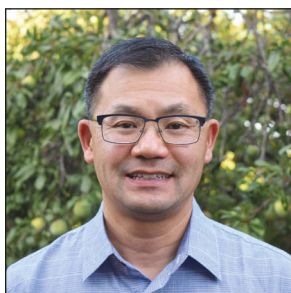


Adriana Bankston (abankston81@gmail.com) is associate director of fundraising and strategic initiatives at Future of Research, a nonprofit organization with a mission to champion, engage and empower early-career scientists with evidence-based resources to improve the scientific research endeavor. She can be reached via LinkedIn or on Twitter @AdrianaBankston.

Five tips for career success

By Danielle Snowflack

Almost 200 graduate students and postdoctoral researchers gathered April 21 for a career-development event at the annual meeting of the American Society for Biochemistry and Molecular Biology where they learned about a diverse array of scientific careers, participated in skill-building workshops and networked with peers and speakers. The entire event was full of useful information; below are five tips for career success that resonated with me.



TO

1 Your career path is less like a ladder and more like a jungle gym.

—Robert To, associate director of quality control conformance, Bayer HealthCare

We're all programmed to see our career path as a series of linear steps up to a final goal — undergraduate, graduate, postdoc, forever job — but this rarely happens. You may move sideways in your career or even take a step or two back before moving up the ladder again. Don't be afraid to take a risk when opportunities present themselves if they will help you build your unique career.



PURCELL

2 Create a skills toolbox and use it.

—Nicole Purcell, associate professor of pharmacology, University of California, San Diego

The skills you develop as a trainee help you stand out in the job market. When you're in the lab, talk to your colleagues about their experiments. Challenge yourself to learn new techniques both in and out of your field. Work on developing critical thinking skills, which will help you however your career evolves. And acquire skills outside the lab. Explore entrepreneurship, science writing and communication, policy, outreach, education, even art — whatever resonates with you. This will help build you into a well-rounded candidate.



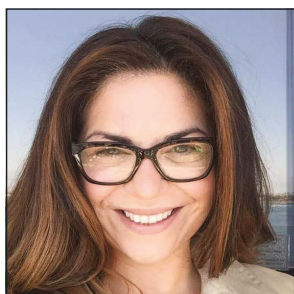
GREER

3 Communication skills are critical to success. Less jargon, more passion.

—Susanna Greer, director of clinical research and immunology, American Cancer Society

Science is a language most people don't speak fluently. When communicating with diverse audiences, think of yourself as a translator. Eliminate jargon and create analogies to make your research accessible. Work on making your science story relevant to the audience, which may mean that you don't share every piece of data you have collected. Most importantly, practice.

Training courses like the ASBMB's Art of Science Communication are available to help you develop these skills. Learn more at asbmb.org.



MACALUSO

4 Work on believing that you belong in the room.

— *Andrea Macaluso, director of outreach and partnerships, SpringerNature*

Imposter syndrome is a reality for many people in the sciences, especially those from underrepresented groups. In professional interactions, be confident and remember that your skills and knowledge got you where you are today. Don't be intimidated by people who question what you know, and don't let negative experiences diminish your self-confidence.



NGUYEN

5 Luck is what happens when preparation meets opportunity. You don't need to see the entire staircase to take the next step.

— *Deborah Nguyen, vice president of research, Cellular Approaches*

With these words from the Roman philosopher Seneca and Martin Luther King Jr. in mind, explore your options, network and talk to people in fields that interest you. Don't know where to start? Start with videos under the heading "Career Paths" at asbmb.org and the career section of the ASBMB Today website. Once you find a job that interests you, identify people in the field and ask for informational interviews. For the price of a cup of coffee, you can get started on the path to career success.



Danielle Snowflack (dsnowflack@asbmb.org) is the director of education, professional development and outreach for the ASBMB. Follow her on Twitter @drsnowflack.

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'I recognize myself in some of my students'

Teaching biology at a community college

By Aubrey A. Smith

The modern community college is a far cry from what it used to be or from what the public perceives it to be. As a member of the faculty at Montgomery College, I teach some underprepared students who need to enroll in developmental courses, but I also encounter persistent, gritty, talented and enthusiastic students who are willing to learn.

I was raised in Port-au-Prince when Haiti was the Pearl of the Caribbean in spite of the infamous Jean-Claude Duvalier dictatorship. After elementary school, I left Haiti to live with relatives in a suburb of Montreal. In North America, I was finally able to see animal and plant species that I had only heard of or read about in books. I had my first ecology course, where students were encouraged to be observant and to write reports about their city's fauna and flora.

I was fascinated by my first human biology and chemistry courses. As a junior in secondary school, I hung on my chemistry teacher's every word as he described his master's thesis on subatomic particles. For a while, I could not hold a conversation without mentioning the charm quark and the strange quark. I even wrote a poem, "La danse de l'univers," in which I invoked leptons, bosons and gluons; I thought it was a masterpiece, but my French teacher found it incomprehensible. By the time I was a senior, I had developed a strong interest in chemistry. I joined my school's Quiz Bowl team. One of the coaches,

now a politician and member of the National Assembly of Quebec, had a degree in molecular biology. Hearing him describe his research projects and his life in the lab, I decided it would be pretty cool to be a biochemist.

After graduation, I enrolled in a two-year program in pure and applied sciences. I attended university for only one semester before moving to New York City, where I learned English by immersion and eventually earned a B.S. in chemistry. As an undergraduate, I worked on a research project investigating chemically modified insulin derivatives. My PI was an organic chemist who wanted to study the interactions between insulin and its receptor. In the lab, I learned a variety of techniques and gained confidence in my ability to conduct research and present my work at regional and national conferences. I also mentored high school students who joined the lab in the summer.

A call to teach

As a graduate student, I quickly realized that I loved teaching. I truly enjoyed interacting with students in my role as a teaching assistant. I also learned from some of the classroom professors who were able to engage an entire lecture hall. I was pursuing a Ph.D. in biochemistry because I wanted to be at the bench, but I liked being a TA in undergraduate chemistry courses. When I had the opportunity to design, schedule and

teach a summer biochemistry course for incoming pharmacy students, that solidified my desire to be a teaching professor.

While in grad school, I was diagnosed with end-stage renal disease, and I had to undergo four-hour hemodialysis treatments three times a week. This did not derail my doctoral studies, but it made me question the compatibility of my medical condition with a research-intensive academic career. After earning my doctorate, I worked in the private sector as a support scientist in the field of biological and chemical hazard prediction. After a successful kidney transplant, I entered the job market and interviewed at primarily undergraduate institutions.

In 2007, I joined the biology department at the Rockville campus of Montgomery College, a multicampus community college in the Maryland suburbs of Washington, D.C. The college serves a diverse student body, and it is home to the nation's largest engineering transfer program. It is also the only community college with a hospital on campus.

I teach a nonmajors biology course, microbiology and an introductory biology course for students who wish to pursue careers in science, technology, engineering, math, or medicine and allied health professions.

The duties and responsibilities of a community college professor aren't that different from those of professors at primarily graduate institutions that

award bachelor's degrees. We serve on committees, design curricula, update our teaching practices, keep abreast of new developments in our fields, write grant proposals — and sometimes lament our students' lack of preparation for midterms.

A few years ago, my colleagues conceived a way for our STEM students to benefit from in-house research experiences. This was a part of our efforts to improve the recruitment and retention of students in STEM majors and to make early exposure to undergraduate research a priority. Thankfully, Montgomery College has made significant investments in STEM by building and planning state-of-the-art facilities in all three campuses.

Our students' research experience is framed within a course that includes lab work, seminars, journal club presentations and poster presentations at the Montgomery College STEM Undergraduate Research Conference. The college hosted the inaugural Maryland Collegiate STEM conference, an event that has featured the work of undergraduate researchers from community colleges across the state for the past four years.

Reaping rewards

I recognize myself in some of my classroom and research students. Like them, I attended college part-time and worked full-time or attended college full-time while working part-time, playing on the men's volleyball team and taking a very long subway ride to and from school. It is rewarding to see students discover their passion and talent for science in much the same way that working in a lab, generating data, independently purifying proteins and presenting my work at conferences gave me the confidence to think beyond an undergraduate degree in chemistry.

When I first walked in to my current dentist's office, we recognized each other as former teacher and stu-



COURTESY OF FATIMAH AL KHAYYAT

Aubrey Smith advises Keunta Wilson, a pre-nursing student, on a microscope's iris diaphragm and how to optimize illumination during the lab portion of a principles of biology class at Montgomery College in Maryland where Smith is an associate professor of biology.

dent. I had been his TA in a biochemistry course when he was in dental school. It turns out that, before that, he had been an undecided student at the Rockville campus of Montgomery College, and he drove an ice cream truck to finance his education. I told him that many more at the college were following his footsteps.

Not long ago, I had a conversation with a student in my nonmajors course. She was doing very well, and I asked about her program of study. She told me she hadn't declared a major and enumerated a number of interests ranging from interior design to early childhood education. I suggested that she should enroll in the introductory course for STEM majors. She did, performed admirably and became a biological sciences student. She excelled in her other STEM courses, worked with me on an original phenotypic complementation research project and received an internship at the J. Craig Venter Institute. She ultimately transferred to a renowned university and received a full scholarship.

Such uplifting accounts are not uncommon, though other stories can be heartbreaking. Thankfully, the faculty and counselors refer our students to appropriate resources when they find themselves in difficult situations.

If you are a teacher at heart and value a decent work-life balance, you certainly will enjoy working at a community college. While not a guarantee of future full-time employment, teaching as an adjunct while in graduate school is crucial. Furthermore, you should enroll in professional development classes that address topics such as active learning techniques, open educational resources and how to engage with underprepared students. You also will not have to give up research, and you likely will be happy to mentor eager and ambitious undergraduates.



Aubrey A. Smith (aubrey.smith@montgomerycollege.edu) is an associate professor in the department of biology at the Rockville campus of Montgomery College. Follow him on Twitter @aubsta.

An ASBMB course brought me closer to my SciComm career

By Katharina Hennig

My interest in science goes back to my early years in school, when biology was the most fascinating subject — at least to me. With a weird obsession, I could look through a microscope for hours to observe strange-looking insects or the fine structure of my own hair. So it came as no surprise that I decided a few years later to start on an academic career path by enrolling in a university to study biotechnology. This choice ultimately led me to my current position as a Ph.D. student.

My project involves studying how cells within the human body move. The topic is fascinating, considering that immune response, wound healing and diseases all are based on cellular movement. For decades, scientists all over the world have been trying to understand this fundamental process in order to develop novel therapeutic and diagnostic strategies to fight cancer and other diseases.

This thought gave purpose to my research project and kept me motivated over the last four years. My experiences extend beyond anything I could have imagined before starting my Ph.D., but I always have felt something was missing, something besides doing experiments, analyzing data and presenting my work at conferences.

What was missing became obvious to me with time: As I got deeper and deeper into the world of science, it became increasingly difficult to explain the purpose of my work to my friends and family. But how could that be? How could I do such meaningful work but lack the ability



PHOTOS COURTESY OF ANDRES BERLESE

Katharina Hennig welcomes two participants to the Rencontres des Jeunes Physiciens in Grenoble, France, and gives them instructions about their poster presentations. Hennig organized the 2017 conference for temporary university staff.

to explain it to others? I eventually realized the importance of making science accessible to a broader audience. So I decided that I wanted to communicate science to everyone — not just to specialists in the field but also to nonexperts and (dare I even say) the world.

About a year ago, I started looking for a career path outside my comfort zone of academia, and I found a field that immediately caught my interest: science communication, a profession for passionate scientists who want to share science with the general public in order to start a dialogue, raise awareness and engage people. After exhaustive online research, I became convinced that this might be the right track for me. With one more year as a Ph.D. student ahead, I decided to get involved.

I started off easy by signing in on

Twitter. Twitter's scientific community is huge. Researchers from all fields share their latest articles, promote their research and create an online network. This was not just helpful for me as a Ph.D. student; it also taught me what science communication (or SciComm, as the cool kids call it) was really about.

We scientists can share our passion in endless ways: explaining our research to friends and family in a casual environment, presenting our work in front of a nonscientific audience, blogging our stories online, or posting videos on YouTube. As I feel uncomfortable in front of a camera or crowd, my first choice of medium was the written word. Countless science magazines and blogs publish articles by science communicators, if their stories are newsworthy, well written and fit a journal-specific genre.

After a few attempts to pitch my stories to editors (not always successful), I realized that there is more to science communication than just randomly writing down my experiences. I needed help developing a successful and interesting online identity as a writer, and I found the guidance I was looking for in the American Society for Biochemistry and Molecular Biology online course “The Art of Science Communication.”

The eight-week course is taught by professional science communicators and outreach experts and involves about three to five hours of work per week. The training consists of three parts: watching explanatory videos online, participating in interactive discussion sessions on Skype and working on a final presentation at home. We started with a general overview of science communication, which led to more specific instructions on how to structure a talk effectively, what content to cover and how to improve communication skills.

Throughout the course, I became more aware of how to communicate science successfully. Gaining credibility and knowing the target audience are especially crucial to becoming a successful communicator. Step-by-step, week-by-week, we participants were guided through creating our own short presentation aimed at engaging a broad audience. The main obstacles in doing so were our scientific selves. We were used to using technical terms to describe every little detail. But once we understood that scientific jargon is the enemy of SciComm, our presentations transformed into exciting and educating talks suitable for both researchers and nonexperts.

As the grand finale of the course, we created videos of our thoroughly prepared presentations. After practicing my talk, it was time to record myself in front of a camera. I felt awkward at first, but it was great training. PowerPoint slides were not allowed, so I used gestures and



Katharina Hennig greets participants, introduces sponsors and shares goals at the 2017 Rencontres des Jeunes Physiciens in Grenoble, France.

random household items to visualize the biological processes I was explaining. For example, from a physical point of view, cells can behave as an elastic object. So I used a rubber band to demonstrate that cells usually elongate before suddenly initiating movement. Other participants drew simple sketches, used props or came up with other creative ideas to spice up their final talks.

In the end, I most probably will keep that short video to myself. But the lessons I have learned will help me to share my passion for science. I now feel a lot more confident explaining my Ph.D. project to my friends and family. In addition, I received valuable tips and tricks that helped me grow in

my role as a science communicator — a career path that I, now more than ever before, consider to be the right choice for me.

The ASBMB training gave me strength and confidence (as well as a certificate) to apply for jobs outside my academic comfort zone, which ultimately brought me one step closer to my dream: making a living out of my passion for communicating science to the world.

Katharina Hennig (katha.hennig@googlemail.com) is a Ph.D. student in the Laboratory of Interdisciplinary Physics in Grenoble, France. She is working in the field of mechanobiology, trying to unravel how physical properties of the surrounding environment control the movement of cells. Follow her on Twitter @Katha16777.

A straight and twisting career path

My journey from the bench to the classroom to the ASBMB

By Quira Zeidan

When I was 8 years old, my mom gave me an encyclopedia of nature in four volumes titled Plants, Animals, Microorganisms, and Rocks and Minerals. After reading these books over and over, I began asking to go out into the field (the zoo, parks, the beach) to collect specimens and samples. I classified rocks according to their composition and texture, dissected pollination organs from flowers, and examined the anatomical differences between emu and rhea — applying my own version of the scientific method to my daytrips and excursions.

Many of my close relatives worked in biology, engineering and medicine, and I grew up hearing them talk about science. My mother was an endocrinologist and animal rights advocate; her hobby was to rescue and rehabilitate injured stray dogs and cats to place later for adoption. I considered going to veterinary or medical school, but that interest ended the day my mother stopped by the roadside to offer medical assistance at the scene of a fatal car crash. I was only a teenager, so she told me to stay in the car and not look, but I peeked through the window for a few seconds and saw chaos: people crying, injured and bloody; paramedics and



PHOTOS COURTESY OF QUIRA ZEIDAN

Budding scientist Quira Zeidan collects rock in a river near her childhood home in Venezuela.

ambulances; and bodies being laid on the road. I was frozen and terrified. I then realized that remaining emotionally balanced in the face of sickness and death required a stoicism and psychological strength that I did not have.

After high school, I enrolled in an undergraduate biology program in my native Venezuela, intending to become a marine biologist, but I soon was captivated by the curriculum's required class on molecules and cells. I was fascinated by the vast universe we cannot see with our bare eyes: thousands of microbes with sophis-

ticated functions and forms, single-celled organisms that have been around for millions of years, proteins that acquire new functions with slight changes in their three-dimensional shape and especially the organized intracellular complexity of the cell, where tiny molecules work together to maintain life and allow movement.

I earned a B.S. in cell biology and started as a research scientist at the Institute of Tropical Medicine in Caracas. My research focused on characterizing the subcellular and biochemical alterations associated with heart and liver damage during chemotherapy with doxorubicin, a potent but toxic drug commonly used in the treatment of blood and solid tumors. I then was offered a research internship in a collaborator's laboratory at the Johns Hopkins University School of Medicine to study the molecular mechanisms of protein synthesis reprogramming in mammalian cells exposed to heat stress.

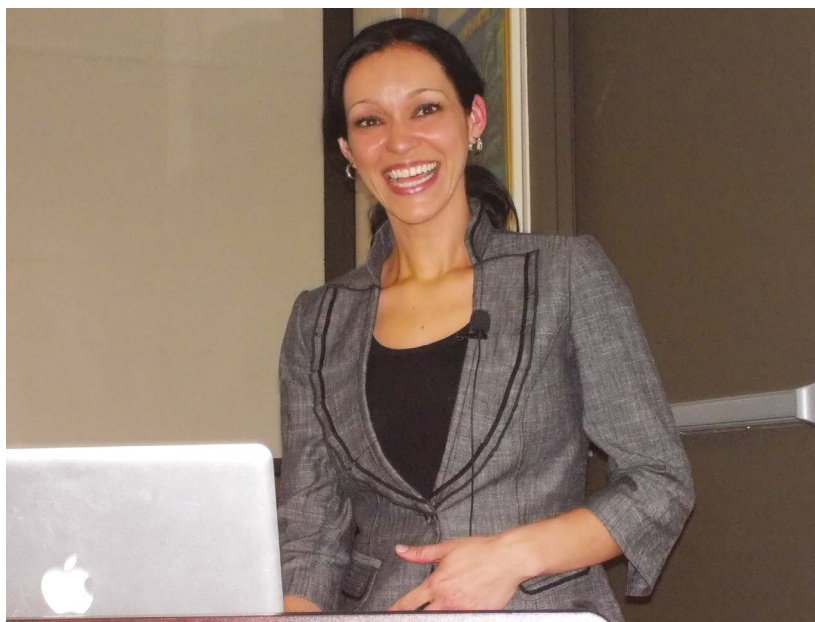
During this internship, I studied to become fluent in English and took all the standardized tests required to apply for graduate school in the U.S. I was accepted in the biological chemistry program at Hopkins and promptly began my thesis project investigating the chemical modification of ribosomes by sugar and its

effects on translation and protein homeostasis.

While at Hopkins, I also became a mom, and suddenly the need for work-life balance took priority in my life. I earned a Ph.D. in biochemistry and went on to do a postdoctoral fellowship at the National Institutes of Health, studying the mechanisms of translation initiation regulation in yeast.

I continued on the traditional path to becoming an independent scientist, but I realized that I had changed as a person. My long hours alone in the laboratory repeating experiments now felt monotonous and isolating; I craved sociability and diverse activities. I had worked as a teaching assistant as an undergraduate and graduate student, and I enjoyed thinking about teaching methods and strategies I could use and the interactions with my students and other teachers. One day, I realized that I was spending more time reading about science education and less time thinking about technical issues in the lab. Teaching felt like a career that would allow me to remain connected to science while satisfying my need for human interaction.

I was working in the lab full-time as a postdoctoral fellow, but I also took evidence-based teaching and learning online courses, volunteered as journal club leader and poster judge, and mentored college students in summer enrichment programs. I completed pedagogy classes at a community college as part of an alternative teaching certification program for high school biology and chemistry teachers. I took a position as an adjunct professor of chemistry and anatomy and physiology for nursing students, and I participated in professional development activities for teachers. I learned how to manage a classroom, how to develop effective lesson plans, how to create meaningful assessments, how to deliver information in multiple ways, and how to generate a safe and inclusive



Quira Zeidan presents her Ph.D. thesis in 2012 at Johns Hopkins University.

environment for the exchange of science knowledge.

Because teaching was so rewarding, I started to do informal science outreach activities. I visited my son's elementary school classroom on Career Day to demonstrate kid-friendly biology experiments, and I organized visits to a local anatomy museum for my students' relatives and friends. I also volunteered at my institution's education office to plan professional development activities for fellow postdocs and graduate students. All my nonlab activities pointed toward a career path as a science educator and communicator.

At the end of my postdoctoral project, I knew I had dedicated enough time to the lab, and I was eager to explore opportunities in other science-related fields. I was still teaching as an adjunct, and I considered teaching as a full-time career, but I was also open to working in associations and nonprofits — unfamiliar environments where I could apply my skills and learn new ones.

I found a perfect match in the position of education and public outreach coordinator at the American Society for Biochemistry and

Molecular Biology. In this job, I use my teaching, communication and scientific abilities, while also learning about a new kind of scientific organization. I manage science education and outreach projects, supporting ongoing programs and helping develop new resources and materials. I represent the society at professional conferences and review grant applications. I engage with the public, society members and other ASBMB departments. I am discovering that bench research and classroom teaching are not the only ways to contribute to scientific advancement.

By following the straight-line plan I conceived as a student and by making unexpected turns that resonated with my passions and emotional growth, I created the combination of experiences that led me here. In supporting the science community through the society's efforts, I continue to grow and find fulfillment as a science professional leading a productive, balanced and accomplished life.

Quira Zeidan (qzeidan@asbmb.org) is an education and public outreach coordinator at the ASBMB. Follow her on Twitter @quirazeidan.

Could a necktie have made the difference?

By Eleftherios P. Diamandis

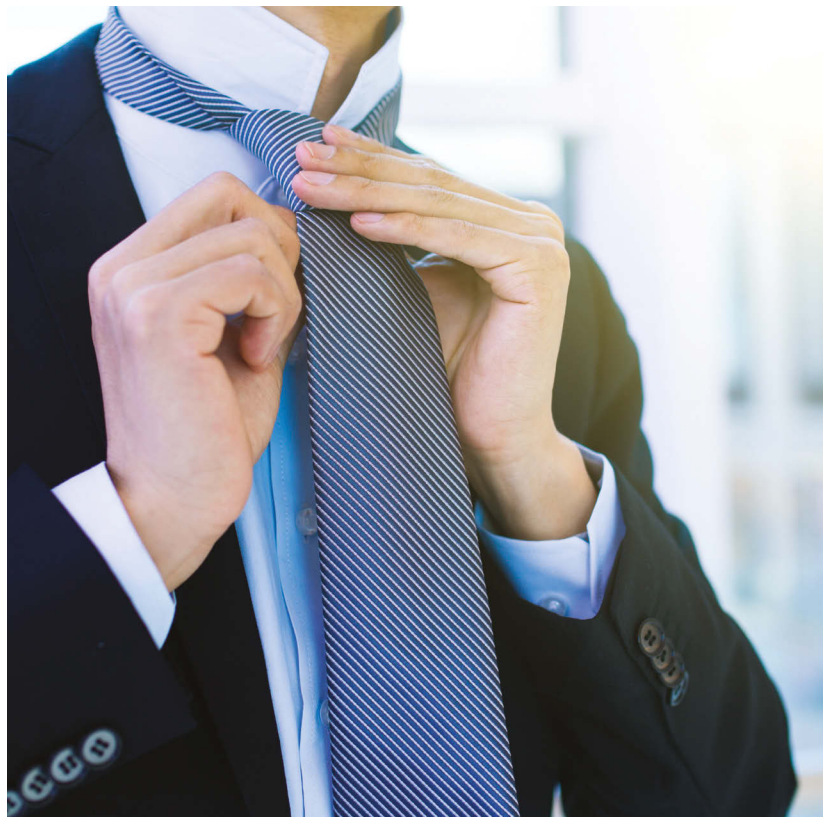
Many years ago, I interviewed for a chair position at a major cancer center in New York City. My credentials were spot-on, I was at the right stage in my career, and I was very keen on moving to the Big Apple. When asked why I wanted to move, my response was cryptic: “I want to play for the New York Yankees.”

Negotiations transpired, and I quickly became one of two final candidates. I was convinced that I was the right person for the job, and I was even rumored to be the front-runner.

In total, I had three interviews on top of presenting at a formal research seminar. The last interview, which was the final stage of the hiring process, was attended by the entire selection committee and included the institute’s president and Nobel laureate, the chief of medicine, and a dozen others with similar titles and positions. For this interview, I was asked to give a presentation followed by a discussion.

While preparing for this final step, I considered two options: (a) to present my natural self, which would include my signature flamboyant and humorous style, or (b) to be the serious, phlegmatic and calculated candidate who would tell the committee exactly what it wanted to hear.

To help me decide, I asked my immediate advisers which of the two approaches to use. My then-25-year-old daughter, a Ph.D. graduate student, advised me to go with the first option, i.e., skip the tie (I hate those) and give a funny but informa-



tive talk covering all the areas I would be ranked on (such as my vision for the department). My wife, a Ph.D. scientist, suggested the exact opposite — wear a tie, present top content and don’t tell any jokes.

After weighing my options, I decided to listen to my daughter and give a tieless, sportily attired and information-loaded but amusing presentation. I was certain the committee would appreciate my confidence in taking a risky approach, especially under such stressful circumstances. I secretly hoped they would equate my tactic with that of a Yankee player

pitching at a winning 3-2 game against the Boston Red Sox in the bottom of the ninth inning, with the bases loaded, two out and at full count. After all, it takes guts to throw a strike, but it could win you the World Series.

As part of my presentation, I created two cartoon characters (referred to here as Peter and Paul) representing the institute’s president and chief of medicine. In the cartoon, Peter and Paul chatted about me and asked questions about the needs of the institute, my credentials, expectations for the job and the like — one asking

while the other answered based on information in my CV. At the end, I summed up with a video clip: Music from Star Wars played while a bright star rose from the institute's grounds and landed on top of the Empire State Building, representing the projected meteoric rise of the department under my leadership. Triumphant indeed.

To monitor how I was doing, I carefully evaluated the faces of the two real characters during my talk. When presented with the cartoons, instead of cracking a smile as I had imagined, the Nobel laureate bit his lip. When the star landed on top of the Empire State Building, the chief of medicine scratched his head. Worst of all, when the presentation was over, the Nobelist walked out of the room without asking a single question. And during the question period, the 12 chiefs were more silent than the 12 apostles during the Last Supper.

A few days later, I was notified that I was off their candidates list. I later learned, to my surprise, that the other candidate also was not hired. Instead, they appointed an internal interim chief who stayed on for years.

I will never know if a tie and a conservative presentation would have landed me the job, but a few remarks are relevant here. First, a tie will not get you a job, but the absence of it may be costly, depending on the audience and its expectations — so better to wear one than not.

Second, tasteful jokes are usually well-received at conferences and other presentations (as I know from many years of lecturing), but “sense of humor” is a relative term and varies greatly among people; in critical interviews, trying to be funny is a big risk. It may be safe to keep some carefully selected jokes for dinner with the committee members but never for the final round. After all, there may

be few, or just one, big “final round” in your entire career.

And lastly, returning to the baseball metaphor — a heroic win with the last strikeout might go into the books, but a game lost to a grand slam can be costly.

What would I do if I could do it again?

I'd throw a curve ball.

Not sure what to wear?

Check out the ASBMB video, Dressing professionally for women and men, on the careers page at asbmb.org



Eleftherios P. Diamandis (eleftherios.diamandis@sinaihealthsystem.ca) is the chair in prostate cancer biomarkers and head of clinical biochemistry, Mount Sinai Hospital, and head of the division of clinical biochemistry in the department of laboratory medicine and pathobiology, University of Toronto.

FINAL CALL FOR ESSAYS

WHEN SCIENCE MEETS SICKNESS

Deadline: Sept. 15

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A network helps launch a career

Gustavo Silva is an assistant professor of biology at Duke University, where he runs a research laboratory focused on understanding how cells cope with stress, which is the underlying cause of many human diseases. His team combines molecular biology, biochemistry, proteomics and computational approaches to investigate how ubiquitin, a highly conserved eukaryotic protein, modifies ribosomes, controls protein synthesis and increases cell tolerance to oxidative stress.

In this month's Research Spotlight, Silva discusses how he navigated his scientific career and the challenges of building a supportive professional network. The text has been edited for length, style and clarity.

What experiences enabled you to reach your position?

Any success I have had can be traced back to the foundation laid by my mother. She has always been my strongest supporter and has believed in and encouraged me every step of the way. My mother overcame numerous challenges to provide me with a good education and the opportunity to go to college and graduate school.

Also essential to my scientific trajectory was Jamaine Davis, an assistant professor at Meharry Medical College, who mentored me during my transition to a postdoc position. Under his guidance, I learned what was necessary to become a successful and independent scientist. I began to understand my value as a scientist and as an individual, I started building up my support community, and I made use of many opportunities to advance my science and my career (including participation in the American Society for Biochemistry and Molecular Biology Interactive Mentoring Activities for Grantsmanship Enhancement



COURTESY OF GUSTAVO SILVA

Gustavo Silva, of Duke University, says he learned to treat networking like exercise.

workshop). After years of preparation, I felt motivated to apply for an independent position. As a new faculty member at Duke University, I am still learning how to navigate this new environment, but I have already identified colleagues and administrators who are invested in my success and are providing the resources, mentorship and support to make it happen.

How did you first become interested in science?

Growing up, I was very curious — one of those kids who was always asking, “But why?” I enjoyed learning and understanding everything about the world and about life in general. Unfortunately, biology was taught as a rote subject, requiring heavy memorization, instead of offering the opportunity to understand principles and ways of thinking. My high school teacher told me I would find answers to my questions when I went to college, and that is what I did. As a freshman, I took a genetics class that covered scientific methodology and the history of modern genetics. I was fascinated by how knowledge evolved and was generated through hypothesis testing and the collective work of the scientific community. At that time,

I did not know much about a career in sciences, so I decided to intern in the research laboratory of Luis Netto. There I discovered that the career appealed to me because of its intellectual challenges and creative freedom.

Did you ever fail at something? How did you get back on track?

By the end of my Ph.D., I realized that I had not networked nearly enough to establish meaningful connections, to have people vouch for me as sponsors or even to submit strong reference letters on my behalf. I was very shy when I attended conferences and did not interact with people outside my lab or my department. I always thought I was disturbing people; therefore, I lost numerous chances to develop my network.

Looking back, I understand that networking is not easy if you do not have the right supporting community in place. It becomes even harder when you feel that you do not belong in a certain environment as a minority, because of your race, gender, socioeconomic status, sexual orientation or an intersection of these.

After I landed my postdoctoral position, I swore to myself that I would not make the same mistakes again and I would start preparing as soon as possible for my next appointment. I made plans, actively sought mentors, asked for feedback and took incremental steps to overcome my challenges. I am still working at my networking skills, and I stress their importance to my students and postdocs because I understand the power of professional connections to provide access to opportunities. I now treat networking like exercise: The more you do, the easier it gets and the stronger you feel.

What advice would you give to young persons from underrepresented backgrounds?

First: Build a supportive network. People will likely teach you how to do science, but a career in science requires far more than that. You need to find mentors (plural) who have your best interest at heart, who can guide you on your career path, and who can help you navigate the challenges of being from an underrepresented group in a mostly white and male environment. There is a huge hidden curriculum — a group of unwritten rules — and if you are not part of the internal circle or did not gain this cultural capital from family or your institution, it makes everything harder. The earlier we learn the rules and expectations of the career, the smoother our progress will be.

Second: Learn how to develop strategic plans and maintain balance. A career in science is multifaceted and requires a lot of organization. There is science to do, projects to manage, skills to learn, classes to teach, people to mentor, etc. The earlier we learn how to balance our time, assess the risks and rewards of each activity, build up our portfolio and organize our lives, again, the smoother our progress will be.

Third: Find your voice. After my Ph.D., I decided not to allow fear to prevent me from doing what I thought was right. After that, opportunities started to open up and my career started to take off. We need to ask for what we want and need, we need to reach out to people, we need to ask for feedback, we need to watch and learn from people who inspire us, we need to network, and we need to be brave. But first, we need to feel comfortable doing that. This is a big challenge when you are not used to doing it, but it is something to try a bit every day. No one will advocate better for yourself than you.

What are your hobbies?

All my hobbies have a learning component. I love playing soccer (and sports in general) but also learning about the tactics, history and evolution of the game. The same applies to combat sports and learning about all the different martial arts. I love listening to and learning about music, and I am developing a taste for experimental cooking and mixology. I also like to read biographies and books on social sciences and race relations.

What was the last book you read?

“Coal to Cream: A Black Man’s Journey Beyond Color to an Affirmation of Race” by Eugene Robinson. The book highlights the experiences of a black American journalist, his perception of racism, his discovery of colorism and his new understanding of his own racial identity. All of that was revealed during his journey as a media correspondent in Brazil.

I also just read “You’re Hired! Now What? A Guide for New Science Faculty” by Mohamed Noor, and I am going through “At the Helm: Leading Your Laboratory” by Kathy Barker. Both provide incredible guidelines for establishing your own research laboratory and further developing your mentoring and organizational skills.

Do you have any heroes, heroines or role models?

The women in my family, particularly my mom and my grandmother, were more than heroines. With super-human strength, resilience and drive, they overcame countless challenges when all the odds were stacked against them to give me the opportunity to choose my own path. The freedom to work in what you love is a privilege that I do not take for granted, given the struggle that was necessary to get me where I am.

Another role model I have is the civil rights leader Stokely Carmichael

(Kwame Ture). He dedicated his life to the liberation and empowerment of black people in the U.S. and abroad, contributing to the organization of grass-roots movements through community engagement. His lessons and methodological approaches resonate deeply with me and serve as inspiration for political engagement and lifelong dedication to causes.

What keeps you working hard?

I have two important motivators. The first is excitement for the unknown and discovery. Every day is different from the day before and will be different from the day after. There is always room to grow, to be creative, to learn. The second is the possibility of making structural changes in education as I advance in my career. As academics, we are in a unique position to promote and champion change. I hope to contribute by inspiring and providing mentoring opportunities for the next generation of diverse scientists who will change the face of the field. Science should be inclusive, transformative and serve all members of our community. To do that, we must break the vicious cycle that maintains science as a privilege of the few and provide high-quality education, access to opportunity and fair treatment to all.

About the Research Spotlight

This feature highlights biomolecular and biomedical scientists from diverse backgrounds to inspire up-and-coming scientists to pursue careers in the molecular life sciences. Eligible candidates include Ph.D. students, postdoctoral fellows, faculty and researchers. Nominate a colleague by sending an email to education@asbmb.org.

LGBTQ individuals are less represented in science — and that’s a problem

By *Jacob M. Carter*

Another Pride Month has come and gone, offering the same lesson it does every year — inclusion and diversity are important. Outside of the valid argument that we should respect and be kind to all different kinds of people, inclusion and diversity are important because every person brings a unique perspective to problem solving. Research has demonstrated the value of such diversity, yet lesbian, gay, bisexual, queer or transgender individuals in science, technology, engineering and mathematics continue to face barriers to professional advancement. This needs to change if we hope to have a diverse workforce ready to tackle the world’s toughest problems.

I remember the first time I realized as a gay man that I had no idea how well-represented the LGBTQ community was in the STEM workforce. I was at one of the nightly poster sessions at the 2012 annual meeting of the Ecological Society of America. I remember a new topic area of posters that year — ecologists investigating the representation of women and racial minorities in the field. They had lots of data show-



U.S. AIR FORCE

Members of the U.S. Air Force participate in a 2016 Pride Month 5-K run in Illinois.

ing women and people of color are underrepresented not only in ecology but in STEM overall, and they were beginning to ask the question, “Why are these groups underrepresented in STEM fields?” While we must do more work to answer this question and address these disparities, I found myself standing among these many posters wondering, “Where are data on LGBTQ individuals in STEM? Am I, as a gay man, underrepresented in STEM?” I would find that the data didn’t exist.

While the National Science Foundation compiles detailed statistics

about women, underrepresented minorities and the prevalence of various disabilities among researchers and STEM students in the U.S., it does not ask about LGBTQ identification. Nor are there many large-scale, systematic, independent studies that address the representation of LGBTQ individuals in the STEM workforce or question what the social environment is like in STEM workplaces for these individuals.

We know that many LGBTQ scientists still fear coming out to their colleagues. This is likely because publishing, receiving tenure and get-

ting grant funding all heavily depend on the judgment of colleagues, who might be influenced by their own explicit or implicit biases. Studies conducted over the past few years suggest such biases play a role in women and people of color receiving STEM awards and grants; there is no reason to think that the LGBTQ individuals in the STEM community would be exempt from similar biases. The American Physical Society produced a report showing that one in three LGBTQ physicists considered leaving their department or workplace in the last year, which correlated strongly with personally experiencing harassment and/or witnessing it.

LGBTQ students also experience hostile environments in STEM programs. In a study conducted at a major university in the western U.S., researchers found that engineering students identifying as LGB did not have as many opportunities to succeed as their heterosexual peers due to the additional emotional and academic effort these students exhausted to internalize their sexuality. Another study of computer majors identifying as LGBTQ at a university found that these students did not feel like they belonged in the field and were, therefore, less likely to continue in the major. And it's possible that such issues, in addition to dealing with the hardships of identifying as LGBTQ, keep LGBTQ students from being retained in the STEM workforce.

Those challenges to success may be affecting who enters and who stays in STEM fields. This year, a study published in *Science Advances* reported that LGBQ individuals are less represented in STEM than their heterosexual counterparts (the study did not report on transgender students). This study used a longitudinal, national data set of 4,162 STEM-aspiring college students across 78 institutions to determine whether status as a sexual minority predicted a lower likelihood

of retention in a STEM major. The study found that, by the fourth year of college, 71.1 percent of heterosexual students were retained in STEM, whereas 63.8 percent of the sexual minority students were retained — an approximate 7 percent difference between the groups. This difference increased to 10 percent when the author controlled for other factors that support retention in STEM. This study and others have shown that one factor that improves retention of students is participation in undergraduate research; yet even though LGBQ students in this study had higher rates of participation in undergraduate research relative to their heterosexual peers, they were still less likely to remain in STEM.

I experienced such issues as a gay graduate student. For example, one professor was concerned about their kids seeing a gay couple at their Christmas party. “Do you think they’ll display lots of affection to each other?” this professor asked a friend of mine. Once we got word of this, my partner and I respectfully decided not to attend the party. Whenever this professor and I had to be in the same room together for meetings, it was not pleasant for me. This made me question how other professors in my department felt toward gay people. That one incident turned what I thought was a very supportive environment into one I questioned as hostile.

But some research shows promise. A study published in 2015 in the *Journal of Homosexuality* suggests that LGBTQ scientists feel more accepted in their fields compared with their peers in other professions. That is great news, since we know that when individuals can express their identities openly they are happier, healthier and more productive workers and can serve as role models to the next generation of young scientists. Still, more than 40 percent of those LGBTQ STEM workers surveyed

were not out to all their colleagues. There is still work to do to make sure that LGBTQ students and faculty in STEM professions feel comfortable. And while the recent study in *Science Advances* was a great start to exploring decreased retention of students in STEM, there is more data to be collected and more research needed in this area.

Diversity can increase the efficacy and innovation of teams. For example, in a study of 4,277 companies in Spain, companies with more women were more likely to introduce radical new innovations into the market. In another study looking at profitability across 20,000 firms in 91 countries, companies with more female executives were shown to be more profitable. While these studies were correlational, there also have been laboratory studies to show that diverse teams have increased performance.

Many critical questions in STEM require innovation and a variety of perspectives to put forth adequate solutions or hypotheses. The underrepresentation of minority groups in STEM is thus a problem. We know that women, racial minorities and people with disabilities are underrepresented in the STEM workforce, because the National Science Foundation and others have collected data on this issue. One minority group that has been overlooked, however, is individuals who identify as LGBTQ.

The world now faces some of its most challenging issues: climate change, cybersecurity and antibiotic resistance, to name a few. It is therefore critical that we ensure a diverse STEM workforce to bring to the table different perspectives and drive creativity and innovations in solutions to these issues.



Jacob M. Carter (jcarter@ucsusa.org) is a research scientist for the Center for Science and Democracy at the Union of Concerned Scientists. Follow him at blog.ucsusa.org and on Twitter @UCSJacob.

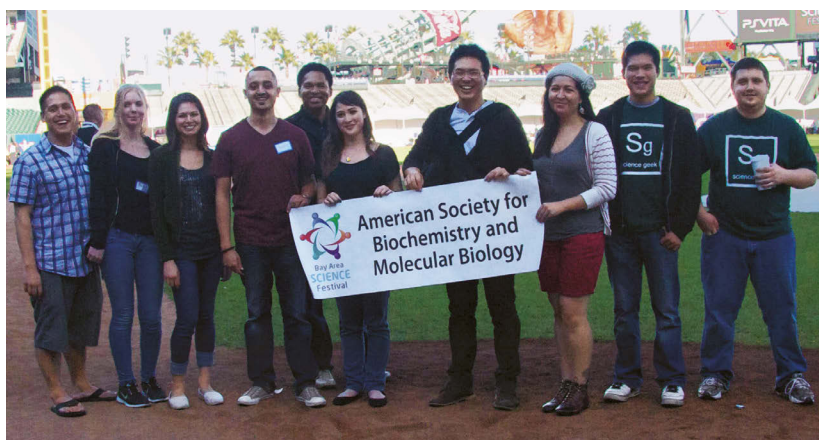
Why a grad student should join a scientific society

By Shea E. Feeney

Scientific societies — I’m sure you’ve heard of them. They’re the standard for how scientists band together. Scientific societies serve an important purpose, whether it be to exchange ideas among members or to rally together to advocate as a unified voice for government support. But are you a member of one? Being a part of a scientific society as a graduate student communicates a specific message.

Let’s take me, for example. I’m a graduate student member of the American Society for Biochemistry and Molecular Biology. When I was an undergraduate at San Francisco State University, I helped found an ASBMB Student Chapter and was involved in K-12 outreach in my community. As a Ph.D. student at the University of California, Davis, I became a member of the ASBMB Educational and Professional Development Committee; I serve on the graduate and postdoc subcommittee, which focuses on enhancing the ASBMB’s service on issues related to training and career development for these groups. I identify as an American scientist in the field of biochemistry and molecular biology who has chosen to be affiliated with a community of like scientists at various career stages.

Society membership shows an interest and willingness to be involved in your scientific community. You do not want to communicate an unintended message by not joining any scientific society as a graduate student. Inaction here does you no favors. And as I hope to prove to you with this article, a plethora of benefits



PHOTOS COURTESY OF SHEA FEENEY

Shea Feeney, second from left, and other members of the ASBMB Student Chapter she helped found at San Francisco State University pose at the Bay Area Science Festival at AT&T Park.

are available if you get involved in a scientific society. If you are a graduate student (or know a graduate student), please read this (or give this to them) for a list of reasons that should serve as a catalyst to get you past that activation barrier, if you will.

Be a scientist within a community of scientists

As mentioned above, by joining a society, you are communicating to your field (and on your CV) what kind of scientist you identify as and what community of scientists you are affiliated with. And by joining a community of scientists in a field you care about, you can enhance the power of their collective voice.

Network, network, network

Now that you have identified your community, you should leverage this

by building your network. By being a part of a scientific society, you already have built a link, but you also have opportunities to meet people face-to-face at the annual meeting and smaller conferences held throughout the year. Being a part of a society enables you to grow a large network — which is good, because you never know when you may need to turn to someone for more in-depth advice and have them become a mentor, which brings us to ...

Find new mentors

Take advantage of a mentorship program or leverage your network to gain a new mentor from your scientific society. Your PI is, hopefully, not the end of the line when you seek advice. Building out your mentorship can be particularly helpful if you want to pursue a career path outside the traditional tenure-track

faculty position. For instance, I have been expanding my own network by being involved with the ASBMB, and I have asked several of my new contacts informally to do informational interviews. This has helped me to gain new insights into and advice about nontraditional career paths.

Develop professionally

Resources for career and professional development are priceless for graduate students. The ASBMB has many resources — from an entire course about the art of science communication to career development webinars on a range of topics from building your CV to the future of the biomedical research workforce. If you want to work on building your skill set (and now is always the time to do so), you need this kind of resource to sharpen your competitive edge. Please don't fall into the trap of thinking you can delay working on your professional development until you start looking for a job while the rest of your peers are starting now. Working on skills such as communication will help you at any stage. I speak from my direct experience with using the ASBMB's professional development resources and can vouch that they have been incredibly helpful and gave me new insight into different career paths, from careers in science writing to science policy, so I feel more informed about the options available. Moreover, I believe these resources help give a strong foundation for skill sets needed for any career path (for example, science communication and building a strong CV are important for most careers in science).

Get involved beyond the bench

As a member of a scientific society, you can become involved in activities beyond your bench work. Perhaps you'd find it rewarding to advocate



Feeney and other members of the San Francisco State University ASBMB Student Chapter showed children how to make DNA double helices out of licorice and marshmallows during the Bay Area Science Festival.

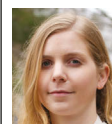
for the science in your field. The ASBMB offers a policy fellowship that brings graduate students to Capitol Hill (if you are interested in science policy, I encourage you look up the ASBMB's Capitol Hill Day or the ASBMB policy blotter). Societies also offer opportunities to get involved as a graduate student in committees or in specific student leadership positions. This is the pathway I took by joining the Education and Professional Development Committee as a Ph.D. student. After being involved in a Student Chapter for undergraduates, I wanted to continue with the ASBMB and do some form of outreach. Improving and increasing access to science education is particularly meaningful to me, and being on this committee gives me experience beyond my bench work in the lab in an area that is personally important and professionally relevant.

Get more perks

Although you pay nominal dues to join the ASBMB as a graduate student, you can recoup this cost through all the intangible benefits listed above and also the tangible benefits of direct discounts on conferences and opportunities to apply for travel awards and fellowships. The 2019 ASBMB annual meeting will

be held in balmy Orlando, April 6-10. Registration is discounted for graduate student members, and travel awards are available — so do remember to apply. The ASBMB also offers members free online subscriptions to its journals, including the *Journal of Biological Chemistry*, and the monthly magazine *ASBMB Today* (the awesome magazine you are reading right now, which welcomes personal essays from all ASBMB members, including grad students).

These have been the direct benefits of my own membership with the ASBMB. I strongly believe that any Ph.D. student can leverage these same advantages and more. It really boils down to a simple cost-benefit analysis. If you are interested in all that the ASBMB has to offer, I hope you will rest your weary lab-trotting feet for a few minutes and sign up on their website to join a community of more than 11,000 ASBMB scientists.



Shea E. Feeney (sefeeney@ucdavis.edu) received her B.S. with a double major in biochemistry and cellular and molecular biology from San Francisco State University. She is now a Ph.D. student at the University of California, Davis, with a major in biochemistry, molecular, cellular and developmental biology and a designated emphasis in biotechnology.

Colorblindness as ideology

How good intentions derail diversity in STEM education

By *Kecia M. Thomas*

Like many African-Americans who attended college in the late 1980s and even the early '90s, I was often the only black student in my lab or seminar. One afternoon, I attended a large class in another department with others in my program cohort and again found myself the lone black student. The junior faculty member teaching the class shared a story from his own graduate school days about the time he mistook his new black major professor for someone not on the faculty. In fact, he said he repeatedly challenged this MP to tell him when the “real” professor would return.

My instructor thought his story was humorous, and it appeared everyone else in the class did too. I did not. His effort to connect with students through this story did not make me feel relaxed. In fact, it did the opposite; I felt put on alert. How could this professor actually see me if he felt at home sharing a story about his own racialized expectations of who faculty are? Not only was I left once again navigating my token experience, but now I had the additional burden of managing my professor’s implicit expectation of what faculty and doctoral students look like. Clearly, I did not fit the mold.

Colorblindness is a popular diversity model or ideology that on the surface reflects pro-diversity intentions but in practice suppresses diversity and elevates sameness. For decades, society has espoused the virtues of colorblindness as a method to avoid discriminating based upon race. In reality, colorblindness may be self-preservation. It allows us to pretend



that if we do not see race, then we cannot act based upon race. “I don’t see color” and “We’re all one race, the human race” are common expressions of colorblindness. However, we cannot help but see differences; it’s unavoidable. Pretending that those differences are not there does not eliminate discrimination. Colorblindness erases the plausibility of race as a cause for mistreatment, thus making it more difficult to avoid or resolve racial bias in the future. For people of color, colorblind messages like “We’re all the same” may send a message of cultural insensitivity to their lived experiences as underrepresented minorities, or URMs, especially in fields such as science, technology,

engineering and mathematics where there is severe underrepresentation.

As I look at doctoral programs today, it appears little has changed since I was a student. I appreciate white faculty members’ attempts to connect with their students and their efforts to diversify academic disciplines. However, well-meaning behaviors do not always translate into effective diversity practice. Well-funded programs born of good intentions sometimes reflect colorblindness, ultimately signaling an identity threat to people of color that may result in ineffective cross-racial mentoring and weak student retention.

Closing the gap

Despite the time and money invested in programs to recruit, retain and graduate women and URM students in STEM fields, the demographic reality of these professions has not shown a significant payoff. A 2011 U.S. Department of Commerce report shows that the representation of women in STEM has rested at 24 percent since 2000; only 4.8 percent of today's scientists identify as black or African-American, according to the National Science Foundation. Our studies suggest that underrepresented grad students are largely dissatisfied with their graduate school experience and NIH researchers have found they often do not consider an academic career path attractive. These students' lack of satisfaction seems to show up in their relatively low levels of confidence for success in STEM academic paths and perhaps even in their reluctance to pursue STEM careers, despite faculty support. This further limits the opportunity for future URM students to encounter role models like themselves in college and graduate school.

Many STEM programs have attempted to close their diversity gap through efforts to expose more URM students to these disciplines earlier in their academic careers. Other efforts have focused on closing academic achievement gaps in critical areas, such as math. Although well-intentioned, both strategies perpetuate a model of URM students as having a lack or deficiency. As an organizational scholar, I feel compelled to ask, What if STEM disciplines sought to identify and remedy their own internal deficiencies that create barriers to participation by URM students?

Research suggests that, regardless of their disciplines, faculty rarely are trained to mentor any student and that, given that faculty mentors of URM students are frequently

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white and male, they often lack multicultural competence and have not reflected upon or explored the relevance of race (their own and others') in their daily lives as their URM students do. These faculty are likely to embrace models of diversity that appear inclusive on the surface but derail diversity in their implementation. At this ideological level, STEM education programs may focus on intervening in students' preparation in order to become more diverse programs rather than understanding the program issues that deter student entry and engagement.

One strategy for closing the diversity gap in STEM may be found in examining faculty and URM students' interpersonal relationships at both the undergraduate and graduate school levels. These students often find themselves as pioneers and tokens in programs that are desperate for their success. Well-meaning faculty and even peers go out of their way to support racial minority students and colleagues, yet these students still experience marginalization and exclusion. So what goes wrong?

Models of diversity

Diversity science may show how good intentions and well-meaning behaviors derail critical mentor-protégé relationships, especially when URM students have majority-group mentors. Many of these mentors, regardless of their age, have been socialized to embrace and emulate colorblindness. Colorblind models

of diversity downplay differences, especially with regard to race, which is already a taboo subject. Sentiments such as "We're all one race, the human race" illustrate this model.

In contrast, multicultural models seek to make diversity visible in order to facilitate an appreciation of differences rather than a silencing of them. Multicultural ideologies see acknowledgement of students' diversities as an opportunity for growth and learning. Colorblind ideologies consistently are preferred by majority group members, according to a University of Nebraska study, whereas people of color often prefer multicultural models of diversity.

Colorblindness may signal identity threat to people of color rather than identity safety. One field study of hospital professionals found that, at the department level, white colorblindness was related to decreases in minority worker engagement and the reverse was true for minority workers who worked with more multiculturally oriented whites.

Another experiment suggests that whites' diversity ideologies have performance consequences for minorities; when URM research participants were paired with white participants, whites' exposure to the two diversity models mattered. When whites were exposed to a colorblind model before their interaction with a URM partner, URM performance on a cognitive ability task decreased. Furthermore, analysis of the video of their interaction found that whites exposed to colorblindness behaved in more dis-

crimination ways toward their URM partners. Leaders' diversity ideologies also appear to have an effect, such that URM members felt accepted in groups led by multicultural leaders but distanced themselves from their peers and experienced relationship conflict when group leaders were colorblind.

Minorities' expectations that colorblindness may place them at risk for bias or discrimination appear to be supported by research in and outside of education. One organizational field study demonstrated that when an organization's rhetoric reinforced colorblindness, minority workers had low expectations of organizational diversity, expected heightened risk for bias and lowered expectations of their own performance; for black women in particular, this led to decreased performance. Individuals high in colorblindness appear less able to detect signs of bias such as microaggressions, those chronic ambiguous slights that often reinforce URM students' marginality and stereotypes. One example is when faculty comment to URM students, "Actually, that's a good idea ..." The use of "actually" suggests that good ideas are not expected from that URM student, especially when the same type of feedback is not provided to majority-group students when their ideas are good. Majority students simply are expected to have good ideas.

Research on STEM education in K-12 settings suggests that colorblindness may be a predictor of faculty interactions and effectiveness with diverse students. A 2015 study by German researchers found that colorblind teachers were less willing to adapt their instruction to culturally diverse students. Perhaps most alarming are the findings of a case study suggesting that colorblind STEM teachers interact with URM students from a deficiency perspective that positions the students as inherently inferior, less prepared and less interested in STEM rather than

attending to how the history of exclusion in education and inhospitable climates for learning may disadvantage URM students. I agree with the authors, who fear that the framework from which these colorblind teachers interact with their URM students may derail these students' STEM-related confidence, interest and career aspirations.

Looking forward

STEM organizations should continue to pursue their past access and education strategies but also take ownership of their diversity ideologies and the negative, identity-threatening messages they might be sending, however well-intended. Our science communities must assess their readiness for diversity and be willing to invest in efforts to educate the STEM community about how issues like race, identity and culture interact with access, development, training and perseverance in the sciences.

Professional development for faculty and graduate students (future faculty) should include attention to mentoring, particularly in diverse dyads. Trust and relationship building within a same-race pair is likely a different process compared with the relationship between a mentor and student from different backgrounds. A focus on the importance of a multicultural and inclusive framework is necessary to reduce the risk of sending colorblind messages to the very students we hope to develop into the next generation of scientists. Challenging common sayings like "You have to be chained to the bench" or "You have to be a slave to the bench" may be a first step.

The science community also should

Challenging common sayings like "You have to be chained to the bench" or "You have to be a slave to the bench" may be a first step.

consider the variety of career paths that underrepresented students might desire relative to their white peers and accept that not everyone desires a publish-or-perish tenure-track position at a research-intensive institution. Likewise, we must acknowledge that these other career paths have value for minority communities, for STEM and for society as well.

In my experience coaching a small group of black postdocs, I learned that their reasons for earning a Ph.D. in STEM differ vastly from the motivations I usually hear from my STEM colleagues. These young black Ph.D.s say they are primarily driven by their desire to be of value and to be visible role models in their community. This conflicts with the images of young scientists sleeping in their labs and occasionally looking out at an ivory tower in the distance. For my black postdocs, the STEM subject matter of their research is a vehicle to elevate the aspirations of their community's youth and to prove to them that black kids have a vast array of opportunities available to them. Their research is important to them, but for many it is not their sole or primary motivator.

Becoming more-inclusive scientists and STEM professionals requires that we acknowledge and appreciate the diversity of our students. We must take to heart their motivations and the feedback they provide to us in person or through climate assessments and exit surveys that will allow us to support them more effectively.



Kecia M. Thomas (kthomas@uga.edu) is an industrial-organizational psychologist and senior associate dean of the Franklin College of Arts and Sciences at the University of Georgia.

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