Vol. 20 / No. 4 / April 2021

ASBMBTODAY

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

SCIENCE & ART

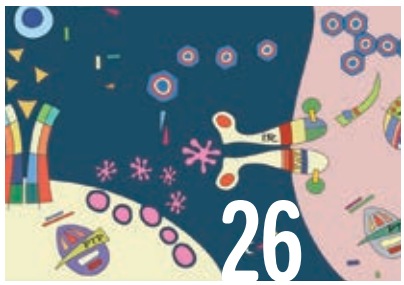

ASBMB
PUBLICATIONS
ASBMB Journals are now open access.
Journal of Biological Chemistry
Molecular & Cellular Proteomics
Journal of Lipid Research
The American Society for Biochemistry and Molecular Biology's three journals are open access beginning in January.
asbmb.org/journals-news/open-access
JBC
JOURNAL OF BIOLOGICAL CHEMISTRY
JLR
JOURNAL OF LIPID RESEARCH
MCP
MOLECULAR & CELLULAR PROTEOMICS

CONTENTS

NEWS

SCIENCE & ART

On the cover: Erica Tandori created this clay sculpture of a human dendritic cell.



PERSPECTIVES

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

ASBMB
American Society for Biochemistry and Molecular Biology
www.asbmb.org/asbmbtoday
PRINT ISSN 2372-0409

Hidden talents

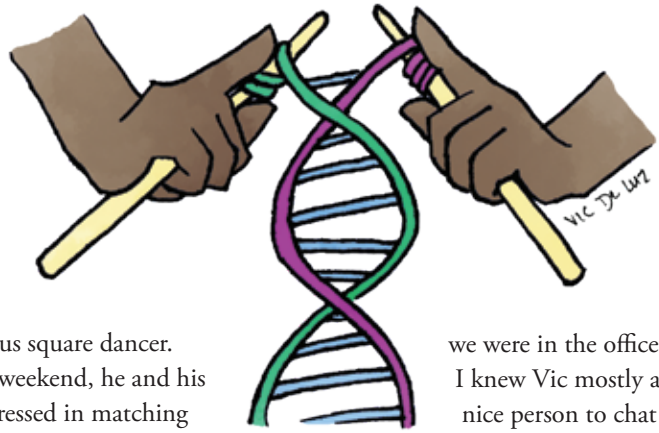
By Comfort Dorn

It gives me great pleasure to learn about the unexpected talents of my co-workers.

Years ago, I worked with an editor, a nondescript, slightly goofy, by-the-numbers kind of guy. I didn't think much about his life outside the office until I learned that he was a serious square dancer. Every weekend, he and his wife dressed in matching outfits (brightly colored vest for him, lots of petticoats for her) and drove to an Elks lodge or similar venue to do-si-do and promenade with a bunch of similarly inclined couples. It completely changed my image of him.

Now that we're mostly working from home, we don't have as many of those social gabfest moments when we can learn which of our esteemed associates are gourmet cooks, equestrians, mountaineers, novelists or chess masters. And that's a real shame. It's such fun to imagine the person who, in my experience, mainly stares at a computer screen, out feeding the poultry in a backyard chicken coop or teaching a Zumba class.

That's why I was so delighted to see this drawing of hands knitting a strand of DNA to represent gene synthesis.



Vic De Luz has worked in the American Society for Biochemistry and Molecular Biology's publications department for more than two years, most recently as executive assistant. Back when we were in the office, I knew Vic mostly as a nice person to chat with while waiting for coffee to brew. Our work didn't intersect very often, so I was completely taken aback when I saw this artwork for the Journal of Biological Chemistry's Methods Madness campaign. It's witty and fun, and it brings our first-ever science and art issue of ASBMB Today right back to the heart of the society.

Turn to page 48 to see more of Vic's Method Madness drawings. They are a terrific bonus in an issue that's been a joy to edit.

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

Maquat and Steitz win Wolf Prize in medicine

Joan Steitz at Yale University and **Lynne Maquat** at the University of Rochester have won the 2021 Wolf Prize in medicine for their work on RNA biology.

Steitz, a Howard Hughes Medical Institute investigator, has studied RNA for decades and has made many fundamental contributions to the field.

STEITZ

She found that ribosomes use complementary base pairing to begin translation of messenger RNA. She uncovered the pivotal role that small noncoding RNAs have in the splicing of precursors to messenger RNAs and the biogenesis of ribosomal RNA. She also revealed the mechanisms regulating RNA stability in eukaryotes.

The American Society for Biochemistry and Molecular Biology recognized Steitz's pioneering gene-expression work with its 2015 Herbert Tabor Research Award.

MAQUAT

Maquat was recognized for her studies of the quality-control mechanism that targets flawed messenger RNAs, which, if left unchecked, can lead to abnormal protein production in, for example, cancer and cystic fibrosis.

In an announcement, the foundation said her work on nonsense-mediated mRNA decay "provides valuable information to help physicians implement 'personalized' or 'precision' medicine by treating the disease mutation that is specific to each individual patient."

In 2018, Maquat won the Federation of American Societies for Experimental Biology Excellence in Science Award and gave her award lecture at the ASBMB annual meeting.

Steitz and Maquat will share the $100,000 purse that comes with the Wolf Prize with Adrian Krainer at Cold Spring Harbor Laboratory, who specializes in RNA splicing and whose work led to the development of the first FDA-approved drug for spinal muscular atrophy, a deadly genetic neurodegenerative disease.

Of the trio's collective work, the foundation said, "They have made ground-breaking discoveries in RNA regulatory mechanisms demonstrating that RNA is not a passive template between DNA and protein, but rather plays a dominant role in regulating and diversifying gene expression."

Many ASBMB members have won the medicine prize over the years. In 2020, Jennifer Doudna and Emmanuelle Charpentier, whose work led to the discovery of the gene-editing tool CRISPR–Cas9, won. Lewis Cantley and C. Ronald Kahn won in 2016. Jeffrey Ravetch won in 2015. Nahum Sonenberg won in 2014.

Booker named deputy editor of new ACS journal

Squire Booker, Evan Pugh professor of chemistry and of biochemistry and molecular biology at the Pennsylvania State University, has been named deputy editor of ACS Bio & Med Chem Au, an open-access journal of the American Chemical Society.

The journal is one of nine, collectively known as ACS Au, recently launched by the ACS to be compliant with open-access requirements. Each focuses on a different field and is led by a deputy editor from that field, according to an ACS press release. ACS Bio & Med Chem Au publishes "experimental and theoretical studies on the chemical, physical, mechanistic, and/or structural basis of biological or cell function in all domains of life."

Booker holds the Eberly family distinguished chair in science at Penn State and is a Howard Hughes Medical Institute investigator. His lab studies novel mechanisms and pathways for the biosynthesis of natural products and cellular metabolites, with a particular focus on enzymes that use S-adenosylmethionine and iron–sulfur clusters to catalyze reactions via radical mechanisms.

BOOKER

Booker is a member of the American Society for Biochemistry and Molecular Biology Finance Committee, former member of the society's Council and former chair of the Minority Affairs Committee. He organized the 2016 ASBMB annual meeting, helped to inaugurate the society's Ruth Kirschstein Diversity in Science Award, and established and organized the ASBMB Interactive Mentoring Activities for Grantsmanship Enhancement grant-writing workshop, known as IMAGE.

UC DAVIS

Eric Conn served on the UC Davis faculty for 43 years and was world-renowned for his contributions to the understanding of plant metabolism.

Biochemistry games memorialize Conn

A competition between students at the University of California, Davis, and at University College Dublin, Ireland, has been launched in memory of plant biochemist **Eric Conn**, a UC Davis professor of molecular and cellular biology and a member of the American Society for Biochemistry and Molecular Biology from 1952 until his death in 2017.

Sixty UC Davis undergraduates participated in the preliminary round, called the Eric Conn Biochemistry Quizzes, held on Zoom. Between 10 and 15 of them will be selected to compete in the finals, depending on responses from UC Dublin.

The first-round Conn Quizzes included questions about fundamental biochemistry, and the final games will focus on protein structures, including two proteins related to the SARS-CoV-2 virus that causes COVID-19, according to organizer Walter Leal, a UC Davis distinguished professor.

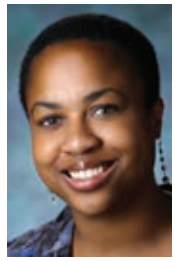
Eric Conn served on the UC Davis faculty for 43 years and was world-renowned for his contributions to the understanding of plant metabolism. He organized the university's introductory course in biochemistry in 1959 and taught it until he retired in 1993.

A member of the National Academy of Sciences, Conn received the UC Davis Academic Senate's highest honor, the Faculty Research Lecturer Award, in 1977 and was the third recipient of the UC Davis Prize for Teaching and Scholarly Achievement. "He strongly believed that a university professor should excel in both research and teaching," Leal told the Davis Enterprise.

UC Davis and UC Dublin are both global research universities, with 39,000 and 33,000 students, respectively.

Bumpus featured in virtual Black history museum

Namandje Bumpus, chair of the Johns Hopkins School of Medicine pharmacology department, is featured in The Legacy Project, a virtual museum created by Microsoft that aims to "shine a bright light on the amazing accomplishments that African Americans have not only made in the past, but are continuing to make right now."



BUMPUS

Bumpus, whose research focuses on drug metabolism by the cytochromes P450 family of enzymes, made history in 2020 when she was named chair of her department; she is the first African American woman to lead a department at the Hopkins school of medicine.

Bumpus is the only living scientist and higher-education academic included in the virtual gallery; she appears alongside scientists from history such as physicist Carolyn Beatrice Parker and people with notable achievements in other fields, such as astronaut Victor Glover Jr. and writer Roxane Gay.

Wente will be Wake Forest's next president

Susan Wente, a high-level administrator and cell biologist at Vanderbilt University, will become president of Wake Forest University in July. Her appointment was announced in late January by the university's board of trustees.

WENTE

Wente joined Vanderbilt in 2002

as chair of the cell and developmental biology department, where her lab studies nucleocytoplasmic trafficking. In the years since, she has ascended through the ranks. She was made associate vice chancellor for research at the medical center and the senior associate dean for biomedical sciences in 2009. She became the first woman provost in 2014.

She served as interim chancellor of Vanderbilt from mid-2019 to mid-2020, during which time she was responsible for leading the university's COVID-19 response and plan for returning to campus as safely as possible. (All students were welcomed back in the fall.)

Jeff Balser, dean of the School of Medicine and Vanderbilt University Medical Center's president and chief executive officer, said in a statement, "Susan's wisdom and unerring judgment are at the center of the deep and innovative partnership that exists between the university and medical center, a partnership that is unique in academic medicine and has positioned Vanderbilt to lead and thrive. She has been a trusted colleague and friend over many years, and I sincerely congratulate Wake Forest on her historic appointment."

Wente will be Wake Forest's first woman president. The private research university is located in Winston–Salem, North Carolina, with more than 8,000 students. Wake Forest has a medical school, with plans to open a second in the coming years in Charlotte.

Wente earned her bachelor's degree in biochemistry from the University of Iowa and Ph.D. in biochemistry from the University of California, Berkeley. She completed a postdoctoral fellowship at the Rockefeller University before accepting her first faculty position in 1993 at Washington University's School of Medicine.

She has received many honors throughout her career. She is an elected fellow of the American Association for the Advancement of Science. She was named a fellow of the American Society for Cell Biology in 2019 and won the organization's Women in Cell Biology Senior Career Award in 2011. In 2008, she won the John H. Exton Award for Research Leading to Innovative Biological Concepts. (That award is named after a former associate editor for the Journal of Biological Chemistry, an ASBMB publication.)

Bassler shares Ehrlich–Darmstaedter prize

The German Federal Ministry of Health and a coalition of other funders announced in January that the 2021 Paul Ehrlich and Ludwig Darmstaedter Prize would be shared by **Bonnie Bassler** and her former postdoctoral mentor, Michael Silverman. The prize recognizes their discoveries concerning bacterial quorum sensing, collective behavior that causes microbes to change their phenotypes depending on how many neighboring bacteria are around.

BASSLER

Bassler, a microbiologist, was a postdoc in Silverman's lab at the Agouron Institute in La Jolla, California, in the early 1990s. Prior to her time there, Silverman had discovered the components underlying the first known system of communication between bacterial cells, and that work explained how the bioluminescent bacterium Vibrio fischeri, found as a symbiont in eukaryotic hosts, can activate expression of genes required to produce light only when many conspecific bacteria are present: The bacteria both produce and detect the concentration of a small-molecule signal. In a 2015 autobiographical essay, Bassler wrote that as a grad student, after hearing Silverman talk about this work in a seminar, "I rushed to the podium immediately afterward and begged to become his postdoc."

During her postdoc, Bassler discovered new, unrelated small-molecule production and sensing systems in other bacteria, demonstrating that the phenomenon — which would come to be known as quorum sensing — is widespread. After four years in Silverman's lab, she became an assistant professor at Princeton University in 1994, where she continued to explore novel quorum-sensing molecules and signaling pathways. Quorum sensing, her lab and others have shown, is crucial for the control of bacterial virulence and biofilm formation. Some quorum-sensing molecules can be used for communication across bacterial species, using what she describes as a universal communication signal. She has shown there are also opportunities for eavesdropping, including by viruses and eukaryotes, demonstrating that quorum-sensing–mediated communication spans domains.

Bassler is now a full professor and chair of the molecular biology department at Princeton. She became a Howard Hughes Medical Institute investigator in 2005. Among her honors are a 2002 MacArthur Foundation fellowship, colloquially known as a genius award; election to the American Association for the Advancement of Science, the National Academy of Sciences, the American Academy of Arts and Sciences, and the Royal Society; and numerous research prizes. She is active in science outreach, describing bacterial communication in lively lectures, TED talks and videos.

The annual Ehrlich–Darmstaedter prize has been awarded by the Paul

Ehrlich Foundation since 1952. It recognizes international researchers who have made important contributions to immunology, microbiology, hematology, chemotherapy or cancer research.

Schnell named department chair

Mathematical physiologist **Santiago Schnell** has been named chair of the University of Michigan Medical School Department of Molecular and Integrative Physiology effective March 1 after serving as the department's interim chair since August 2017.

Schnell holds an undergraduate degree from Universidad Simon Bolivar and a D.Phil. from the University of Oxford, where he also completed a Wellcome Trust senior research fellowship. He joined the Michigan faculty in 2008 and was promoted to professor in 2015. He is also a professor of computational medicine and bioinformatics and a William K. Brehm investigator at the Brehm Center for Diabetes Research. In 2017, he was named the John A. Jacquez collegiate professor of physiology.

SCHNELL

Research in the Schnell lab focuses on two broad areas: biometrology (the development of standard methods to obtain high-quality measurements in biomedical sciences) and mathematical biology (the development of mathematical models of complex physiological systems). His work substantially has altered the view of measuring and modeling enzyme-catalyzed reactions within cells, where the environment is heterogeneous and characterized by high macromolecular content.

Schnell is a fellow of the Royal Society of Chemistry, American Association for the Advancement of Science, Society of Mathematical Biology and Latin American Academy of Sciences. He was recognized in 2019 as an emerging leader in health and medicine by the National Academy of Medicine. He is editor-in-chief of the journal Mathematical Biosciences.

IN MEMORIAM

Kurt Ebner

UNIVERSITY OF KANSAS MEDICAL CENTER

Kurt Ebner, who chaired the biochemistry and molecular biology department at the University of Kansas Medical Center for two decades, died Jan. 29 in Overland Park, Kansas. He was 89.

Born March 30, 1931, Ebner grew up in Canada and received bachelor's and master's degrees from the University of British Columbia. He earned a Ph.D. from the University of Illinois in 1960, working in Bruce Linder Larson's lab. He studied at the National Institute for Research in Dairying in England with Herbert Gutfreund on a National Research Council postdoctoral fellowship and was then a postdoc at the University of Minnesota with Paul Boyer, who shared the 1997 Nobel Prize in chemistry.

Ebner joined the Oklahoma State University faculty in 1962 as an assistant professor, becoming a professor in 1969 and regent professor in 1971. He then joined the faculty of the University of Kansas Medical Center, where from 1974 to 1994 he chaired the biochemistry and molecular biology department. He retired and was named professor emeritus in 1998.

Ebner's research focused on enzymology and the structure and function of the hormone prolactin. He received the National Institutes of Health Career Development Award in 1963 and the Borden Award from the American Chemical Society in 1969. He was a diplomat of the National Board of Medical Examiners and represented biochemistry chairs on the American Association of Medical Colleges Council of Academic Societies. In 2011, former students and colleagues formed the Kurt E. Ebner Discovery Lectureship at the University of Kansas Medical Center in his honor.

In his youth, Ebner played amateur baseball and captained a volleyball team that won the British Columbia high school championship. After retirement, he played golf in senior leagues. He and his wife traveled extensively and enjoyed camping in the mountains. He was deemed the official photographer of functions sponsored by the Friends of Music and the Arts at his church.

He is survived by his wife of more than 60 years, Dorothy, as well as four children and nine grandchildren.

Robert L. Post (1920 – 2021)

By Jack H. Kaplan, Paul J. DeWeer & Joseph F. Hoffman

Robert Lickely Post (Robin to all who knew him) passed away on Jan. 26 following a long illness. The fields of physiology and membrane biology lost a pioneer who laid much of the groundwork for our understanding of the way cells maintain their ionic composition through the action of a family of proteins called ion pumps.

Robin Post was born Nov. 4, 1920, in Philadelphia. Following his undergraduate education at Harvard College, he earned an M.D. in 1945 from Harvard Medical School, and after an internship in Hartford, Connecticut, he joined the faculty of the University of Pennsylvania as an instructor in physiology. In 1948, he joined the faculty of Vanderbilt University Medical School in the department of physiology, where he rose through the academic ranks and became a professor of physiology in 1966. He remained at Vanderbilt until his retirement in 1991. At that point he returned, with his wife Elizabeth (who was also a professor at Vanderbilt and predeceased him in 2015), to Philadelphia. They lived in the Quadrangle retirement community in suburban Philadelphia and were active members of the Haverford Friends Meeting. Post was also a visiting professor in the physiology department at Penn.

Post first reported on the movements of sodium and potassium ions across the plasma membrane of human red blood cells in 1955 at a meeting of the American Physiological Society. He spent the remainder of his career investigating how the protein responsible for maintaining the cellular composition of these ions in almost all animal cells, called the Na/K-ATPase, carries out this active transport. To this day, one rarely encounters a publication on the Na/K-ATPase that does not mention one of his many groundbreaking studies.

In 1957, Jens Christian Skou published his observation that when adenosine triphosphate, or ATP, is exposed to crab nerve tissue, it is cleaved rapidly only when sodium and potassium, or Na and K, ions are simultaneously present. For this "first discovery of an ion-transporting enzyme, Na^+,K^+-ATPase," Skou was awarded the 1997 Nobel Prize in chemistry. (He shared the prize with John E. Walker and Paul D. Boyer, who were honored for elucidating ATP synthesis). The research community already knew that the ionic gradients across the membranes of muscle and nerve (where they underlie electrical activity) and of red blood cells — low Na and high K inside, high Na and low K outside — are regenerated continually, yet the mechanism remained unknown.

COURTESY OF JOSEPH F. HOFFMAN

Robert "Robin" Lickely Post died Jan. 26 after a long illness. In a tribute, colleagues at the University of Pennsylvania wrote, "He was a patient and logical thinker, a thoughtful adviser, and a kind and gentle colleague."

Post (with Philip Jolly) established in 1957 that Na and K ion movement across the membranes of human red blood cells is stimulated by the addition of adenosine — that is, it is metabolism-dependent — and that the ratio of Na exit to K entry is 3-to-2. These observations implied that during this process a net positive

charge is ejected. These findings, along with those of Skou, suggested that the mechanism responsible, being present in two such diverse preparations, was likely to be of widespread importance.

In 1960, Post and his colleagues provided more evidence that the ATPase activity in red blood cell membranes participates in the ion movements and identified seven characteristics shared by ion translocation and ATP hydrolytic activity. Among the most striking was the completely specific inhibition of both processes by ouabain, which Hans J. Schatzmann in 1953 had reported to inhibit ion movements in red blood cells. Knowledge of the mechanistic basis of this drug's action provides a rationale for the widespread use of cardiotonic steroids to treat cardiac insufficiency.

Post then shifted his investigations to the enzymatic ATPase activity present in many cell membranes and over the next 15 years provided much of what we now know about how the process of active ion transport is coupled to the hydrolysis of ATP. In 1965 Post, with Amar Sen and Alan Rosenthal, established that the terminal phosphate of ATP becomes covalently attached to the protein as an intermediate state during the process. Soon after this, Post (with Shoji Kume, Thomas Tobin, Betty Orcutt and Sen) and, in separate studies, R. Wayne Albers and colleagues established that there are two interconverting forms of the phosphoenzyme, and this E1P–E2P model became the central characteristic of what now is referred to as the Albers–Post model for the molecular mechanism of this class of enzymes, the P-type ATPases.

These membrane proteins are responsible for the active transport and homeostasis of Na, K, calcium and many other metal ions in almost all cells. Their action underlies various physiological processes, including muscle contraction, digestion, gastric acid secretion, kidney function and neurotransmitter biosynthesis. Their disruption causes an array of human diseases. These proteins couple the translocation of ions across cell membranes using the energy derived from ATP hydrolysis to drive the ion transport.

Post's major contributions also include the realization in 1973 that a specific aspartate amino acid residue on the protein accepts the phosphate group in E1P and E2P, and in 1972 that, following release of the phosphate, the K ions are occluded (or trapped) within the protein as a transport intermediate. The multiple modes of transport carried out by these proteins are rationalized in the context of the Albers–Post mechanism.

It is worth recalling what Skou wrote in his 2017 memoir: "Though I had opened up a new field of research, I did not subsequently make any decisive contribution to the further understanding of that field, and therefore doubted that I deserved the (Nobel) prize even when awarded it."

Skou then singled out Ian Glynn (whose rigorous dissection of the many modes of ion transport mediated by the Na pump provided a basis for coupling transport to enzyme activity) and Robin Post (whose cleverly designed experiments and beautiful logic placed the central roles of phosphorylated intermediates and occluded cations at the center of our pictures of pump action) for their contributions, having provided the most important information for the understanding of the pump mechanism. "I would have liked to have shared the Nobel Prize with them," Skou wrote.

In his youth, Robin Post was an assiduous jogger and avid sailor. During his career, he was a widely appreciated inspiration to those familiar with the man and his work. He was a patient and logical thinker, a thoughtful adviser, and a kind and gentle colleague, particularly to young investigators. His scientific contributions live on, and his passing is a great loss to all of us who knew him and valued his presence.

Jack H. Kaplan (kaplanj@uic.edu), professor emeritus of biochemistry and molecular genetics at the University of Illinois College of Medicine at Chicago, is a leading authority on the structure and function, biosynthesis, assembly and trafficking of P-type ATPase ion pumps and on copper transport and homeostasis in human cells.

Paul J. DeWeer (deweer@pennmedicine.upenn.edu), emeritus professor of physiology at the Perelman School of Medicine at the University of Pennsylvania, is a leading authority on the kinetics and thermodynamics of the Na/K-ATPase sodium–potassium pump.

Joseph F. Hoffman (joseph.hoffman@yale.edu), professor emeritus of cellular and molecular physiology at the Yale School of Medicine, is a leading authority on the physiology of red blood cells, particularly the mechanisms of plasma membrane movements of salt and water.

Charles C. 'Chuck' Hancock (1935–2021)

By Ralph A. Bradshaw

The histories of the American Society of Biological Chemists (which became the American Society for Biochemistry and Molecular Biology in 1987) and the Journal of Biological Chemistry are deeply interwoven. Managing this relationship was a prime reason that in 1961 the society created the position of executive officer to coincide with the establishment of its first permanent home in Beaumont House, a residential estate in Bethesda, Maryland, that the Federation of American Societies of Experimental Biology had purchased to house its offices and those of its six member societies.

Heretofore, elected officials had managed the affairs of the society from their (usually academic) offices, while the fiscal activities of the journal had been handled by the editor (who enjoyed the title of managing editor to signify this financial responsibility). Managing both JBC and the ASBC became too large a task to be done part time, and when John Edsall became the editor of JBC in 1958, he was quite happy to turn over the fiscal side of journal operations to an executive officer.

Robert Harte was hired in 1961 as the first ASBC executive officer and held the post until he retired in 1974. Harte was a trained scientist but with considerable executive experience in the pharmaceutical industry and facilely managed both entities during his 13-year tenure. His replacement was Russ Hilmoe, who held the post from 1975 to 1979.

COURTESY OF RALPH BRADSHAW

Chuck Hancock had two decades of leadership in the Air Force when he took over as executive director of the American Society for Biochemistry and Molecular Biology in 1979.

Hilmoe also was trained as a scientist, with a doctorate in biochemistry and administrative experience at the National Institutes of Health, but this background proved to be less effective in managing the society and the journal. This precipitated a debate within the society leadership as to whether the search for the next executive officer should emphasize scientific training or business and management skills. Fred Richards, the president-elect and chair of the search committee, clearly favored the latter, and the advertisements for the post reflected this bias.

The right assets

The successful candidate of this search was Charles C. Hancock, known to everyone as Chuck, a 21-year veteran of the Air Force, where he had commanded a missile launch crew, been an advisor to the Korean air force, served as a satellite systems engineer and held several posts at the Pentagon. At his retirement, he was a lieutenant colonel and had been awarded the Distinguished Service Medal. He was a graduate of Stanford and held a master's degree in electrical engineering from Texas Tech that he earned while in the service. His engineering and management skills along with his organizational and administrative abilities struck just the right chord with the committee, and they proved to be the right assets for overseeing the affairs of the two entities.

In his application and during his first interview, Chuck successfully obscured his military background; it only came to light during his second meeting with the committee. When a committee member asked him why he hadn't included this information in his application, he replied, "If I had told you, would you have even interviewed me?" She admitted that they probably would not have, given the generally distrustful attitude of academics to the military, which was exacerbated at the time by the Vietnam War.

Chuck began with the ASBC in

1979 and became the society's longest serving executive officer, retiring in 2003. The 1980s and 1990s, the principal period of his tenure, were challenging times for the society and the journal, and Chuck proved to be the ideal person for managing both entities. Both showed significant growth during this period and underwent changes in their financial structures.

When Chuck first came on board, the society's major income came from the national meeting, but over time, attendance dropped as splinter societies formed and began running meetings of their own. Dedicated meeting organizers such as Gordon Research Conferences and Keystone Symposia offered increased competition. JBC took up the slack and by the 1990s became the society's principal financial engine. Chuck superbly managed this transition, working closely with the Finance Committee to introduce more fiscally sound budgeting and set up reserve funds that protected the solvency of both entities. His financial acumen during this period was one of his most important contributions to the society.

Going online

Chuck also was deeply involved in creating the online version of JBC through a collaboration between the society and the Stanford University Libraries. Other key players in this development were Mike Keller, John Sack, Bob Simoni, Herb Tabor and Barbara Gordon.

As treasurer of the society during this time, I was privileged to sit in on all the germane meetings. Chuck was pivotal in this pioneering activity. HighWire was created as the electronic imprint of the Stanford University Libraries, and, working with Cadmus, the society mounted a five-month frenzied effort to produce the first online version in May 1995, in time for the national meeting in San Francisco. JBC was already a large entity at the time, making the online experiment a real challenge; had it failed, it would have damaged severely, even ruined, the society.

Chuck was convinced that digital journals were the way of the future and saw that being the first major biology journal to go online would reflect well on the society for years to come. He was entirely right. The flood of journals that immediately followed suit was testimony to that. Chuck played a central role in subsequent related developments, such as the electronic submission system, placing the entire back content (start-

COURTESY OF RALPH BRADSHAW

Herb Tabor, editor of the Journal of Biological Chemistry; Ralph Bradshaw, editor of Molecular & Cellular Proteomics; and Chuck Hancock, executive director of the American Society for Biochemistry and Molecular Biology, at Beaumont House, where the ASBMB had its offices from the early 1960s to 2011, the year this photo was taken.

ing with 1905) online and developing a pricing structure for the online version.

More journals and a history

Chuck also played a major role in extending the publishing activities of the society by catalyzing the creation of Molecular & Cellular Proteomics. The concept of starting a new journal came from a society leadership retreat in May 2000. The ASBMB never had created a journal de novo; both JBC and the Journal of Lipid Research (which the society was then in the process of acquiring from its nonprofit owner) were started outside the society. This proved to be a significant challenge, in part because two other proteomics journals began at about the same time. As the editor-designate, I worked with Chuck to develop a plan that took advantage of our experiences with JBC to create an online journal that rapidly became a highly rated publication. Chuck passed the baton to Barbara Gordon after a couple of years, but his early input was essential.

Another of Chuck's important contributions to the society was the writing and publishing of the ASBMB centennial history "100 Years of the Chemistry of Life." He joined with Nicole Kresge, then a staff member at the ASBMB, and me to produce a 522-page volume documenting the first 100 years of the society's history. His extensive knowledge and experiences with the society were invaluable in this project.

Taking the train north

Charles Cavanaugh Hancock Jr. was born in Riverside, California, on October 19, 1935, and grew up in Imperial, California, close to the Mexican border. His parents were both in public education (principal and teacher), and he excelled in high school in both classwork and sports. He was very proud of his roots in this agricultural community and spoke fondly about working for a local crop duster during the summer. At his father's urging, he applied to Stanford, a campus he never had seen, and was accepted with a full academic scholarship. He enrolled as a chemical engineering student.

Knowing (and sharing) my interest in California history, he enthusiastically recalled the train ride to Palo Alto, in part on the defunct San Diego & Arizona Eastern (the SD&AE — known locally as the "salt, dust and alkali eastern") railroad, traversing a spectacular stretch of Southern California desert and the mountains of the coastal range from Calexico to San Diego, including the famous (to railroad buffs) Goat Canyon trestle bridge in Carrizo Gorge. At a length of 597 to 750 feet and a height of 186 to 200 feet, it is the world's largest curved all-wood trestle.

Chuck made the transition to the Bay Area easily and became an excellent student, a lifetime Stanford supporter and eventually an enthusiastic alum. He graduated in 1959 with a bachelor's degree in engineering and a commission in the Air Force, in which he served for the next 21 years.

A commonsense approach

In both halves of his career (USAF and ASBMB), Chuck demonstrated unique abilities as a leader. His managerial success, particularly at the society, stemmed not only from excellent organization and administrative skills but also from his easy association with a wide variety of personalities. Societies such as the ASBMB are run by elected members, usually academics, who present a broad array of attitudes and opinions in an ever-changing rotation. Chuck treated all with deference (even though sometimes I know he was seething inside) and always carried out the wishes of the officers whether he personally agreed with their decisions or not. The more astute of these learned quickly to ask Chuck his opinion, as over the years he became an invaluable source of knowledge on essentially every aspect of the society, its programs and its operations. He passed this knowledge to his successor, Barbara Gordon, who retired this year, ensuring the continued well-being of the organization.

Chuck made the transition to the Bay Area easily and became an excellent student, a lifetime Stanford supporter and eventually an enthusiastic alum.

Chuck had a commonsense approach to problems, characterized by clear thinking and decisive action. Michael Jackson, who served as the FASEB executive director for nearly 10 years in the 1980s and '90s, told me he often wandered across the campus from his office in the Lee Building to Beaumont House to schmooze with Chuck — sometimes to get his opinion and sometimes to garner his support — as the federation was growing into a much larger group of societies. He

COURTESY OF RALPH BRADSHAW

Chuck Hancock, Ralph Bradshaw and Nicole Kresge, authors of "100 Years of the Chemistry of Life," a history of the American Society for Biochemistry and Molecular Biology, at Beaumont House in 2009.

Over the years he became an invaluable source of knowledge on essentially every aspect of the society, its programs and its operations.

greatly valued Chuck's sage input and advice.

Chuck and I shared many experiences in our activities for the ASBC/ASBMB, and we became quite close friends as a result. We spent many hours together above and beyond society obligations, such as a long weekend with our wives in Cabo San Lucas (following a biochemistry department chairs meeting) or when he spent a week in England with us (right after he retired) while we were on sabbatical at Cambridge. I enjoyed innumerable dinners with him and spent many relaxed nights at his place in Virginia (which beat the Marriott in Bethesda by a mile).

After his retirement, Chuck became involved in the Kyle Petty Charity Ride, taking long-distance motorcycle rides across various parts of the country, and he was a proud supporter of Kyle Petty's Victory Junction camp for children with serious medical conditions. I was sad for him when he injured his hip and had to give up motorcycle riding. Whenever he talked about one of his cross-country rides, he just glowed with enthusiasm. He spent his last years in Florida, close to his sons and grandchildren.

Chuck enjoyed two highly successful careers and amassed an impressive number of accomplishments; his legacy will continue to serve the ASBMB long into the future. I will miss him as both a friend and a colleague.

Ralph A. Bradshaw (rablab@uci.edu) is a professor emeritus of physiology and biophysics at the University of California, Irvine, and a professor of pharmacology at the University of California, San Diego.

Upcoming ASBMB events and deadlines

APRIL

APRIL

7	Supporting mental health and well-being of STEMM graduate students: Highlights from the National Academies' report (webinar)
12	Advanced registration deadline for the 2021 ASBMB Annual Meeting
14	**World Chagas Disease Day**
25	**DNA Day**
27–30	2021 ASBMB Annual Meeting , held in conjunction with Experimental Biology
30	Abstract deadline for Teaching science with big data

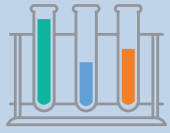
MAY

MAY	**Asian American and Pacific Islander Heritage Month**
	National Stroke Awareness Month
1	Registration deadline for PDB50: A special symposium celebrating the 50th anniversary of the Protein Data Bank
4–5	PDB50: A special symposium celebrating the 50th anniversary of the Protein Data Bank
5	Deadline to apply or submit a nomination for ASBMB annual awards
9	**National Women's Health Week**
10	**National Lipid Day**
11, 18, 25	Protonic bioenergetics and action potential: Latest discoveries and progress in mitochondria, neurons and other biosystems (webinar)
15	**Dementia Awareness Week**
21	Early registration deadline for Teaching science with big data
23	**World Melanoma Day**
27	Abstract deadline for Extracellular vesicle studies: From benchtop to therapeutics

JUNE

JUNE

1	Deadline to apply for Marion B. Sewer Distinguished Scholarship for Undergraduates
6	**National Higher Education Day**
14	**World Blood Donor Day**
16	Regular registration deadline for Teaching science with big data
19	**World Sickle Cell Day**
20	**World Refugee Day**
20–25	Teaching science with big data
21	Flux-independent signaling by ionotropic receptors: Unforeseen roles and complexities
25	Early registration deadline for Extracellular vesicle studies: From benchtop to therapeutics



The International Lipidomics Society: Who we are and where we are heading

By Robert Ahrends & Kim Ekroos

The human body must regulate lipid metabolism and signaling tightly to maintain homeostasis. Loss of control can result in unwanted cascades of events triggering disorders and diseases such as insulin resistance, metabolic syndrome, lipidic storage diseases, neurodegenerative disorders or cancer. Lipidomics technologies have evolved to monitor such changes, with researchers expecting these technologies to provide improved opportunities to study lipids in health and disease and advance lipid biology at systems scale, including complex lipid signaling and metabolism.

Methodologies, workflows and data presentation differ vastly in lipidomics, and many studies do not report absolute lipid concentrations. This hinders biological interpretation, which only can be done using quantified molecule numbers, such as moles. The broadly recognized discrepancies in published data, such as misidentification and broader issues of irreproducibility, weaken lipidomics research and hinder its use as noted in a paper by Gerhard Liebisch, Robert Ahrends and other members of the Lipidomics Standards Initiative Consortium in the journal Nature Metabolism in August 2019. This has a negative effect, causing deliveries in market segments to fall short and interfering with advances in drug and biomarker discovery programs, interlaboratory studies and transitions into clinical practice.

To start tackling these challenges, we have formed the International Lipidomics Society, or ILS, with the aim of fostering international communitywide coordination and communication to create lipidomics-specific guidelines for good scientific practice and future development.

We founded the ILS in June 2019 with Gerhard Liebisch, Harald Köfeler, Michal Holčapek, Xianlin Han and Markus Wenk. The society sees itself as the point of contact for lipidomics research, development and commercialization. By working together, we aim to unlock the full potential of lipidomics and its adoption in the clinical arena.

Our goal is to stimulate conversation with our colleagues in lipid biology, medicine and related disciplines. We intend to engage researchers around the globe who are working on developing lipidomics standards guidelines, reference materials, clinical lipidomics, instruments and methodologies. We also have started interest groups that are working on such hot topics as applied bioinformatics, lipid ontology and lipid function. All these groups are up and running and are engaging with the ILS; the first white papers are on their way to transform lipidomics research.

During the first year of the ILS, we held vibrant workshops on subject areas including lipidomics bioinformatics. Participants discussed topics such as one-stop workflows, data formats, visualization of lipidomes and the engagement of junior researchers. The interest group reference materials included the first intercontinental ceramide ring trial across 47 labs. Similar activities now are being organized by our clinical lipidomics group. The Lipidomics Standards Initiative released updated lipid nomenclature together with our friends at Lipid Maps and currently is publishing new guidelines for lipidomics research.

ROBERT AHRENDS

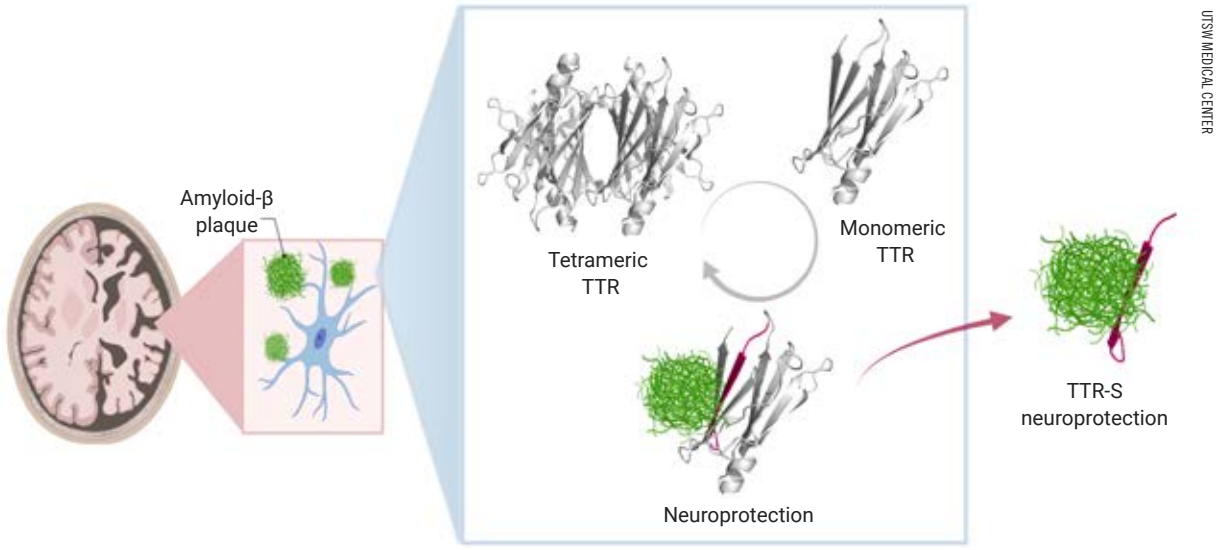
To learn more about the ILS, visit lipidomicssociety.org or send an email to contact@lipidomicssociety.org.

Robert Ahrends (robert.ahrends@univie.ac.at) is a professor of chemistry in the department of analytical chemistry at the University of Vienna.

Kim Ekroos (kim@lipidomicsconsulting.com) is the founder and CEO of Lipidomics Consulting Ltd., Esbo, Finland, and president of the International Lipidomics Society.

Protein that can be toxic in heart and nerves may help prevent Alzheimer's

University of Texas Southwestern Medical Center



UTSW MEDICAL CENTER

Abnormal deposits of the protein amyloid beta in the brain have been linked to Alzheimer's disease. The above illustration reveals a potential way discovered by UTSW researchers to stop this process, leveraging the protective nature of the protein transthyretin, or TTR, to identify a segment of this protein, TTR-S, that halts plaque formation and facilitates its degradation in a test tube.

A protein that wreaks havoc in the nerves and heart when it clumps together can prevent the formation of toxic protein clumps associated with Alzheimer's disease, a new study led by a University of Texas Southwestern researcher shows. The findings, published in the **Journal of Biological Chemistry**, could lead to new treatments for this brain-ravaging condition, which currently has no truly effective therapies and no cure.

Researchers long have known that sticky plaques of a protein known as amyloid beta are a hallmark of Alzheimer's and are toxic to brain cells. As early as the mid-1990s, other proteins were discovered in these plaques as well.

One of these, a protein known as transthyretin, or TTR, seemed to play a protective role, explained Lorena Saelices, assistant professor of biophysics at the Center for Alzheimer's and Neurodegenerative Diseases at UTSW, a center that is part of the Peter O'Donnell Jr. Brain Institute. When mice modeled to have Alzheimer's disease were genetically altered to make more TTR, they were slower to develop an Alzheimer's-like condition; when they made less TTR, they developed the condition faster.

In healthy people and animals, Saelices said, TTR helps transport thyroid hormone and the vitamin A derivative retinol to where they're needed in the body. For this job, TTR forms a tetramer — a shape akin to a clover with four identical leaflets. However, when it separates into molecules called monomers, these individual pieces can act like amyloid beta, forming sticky fibrils that join together into toxic clumps in the heart and nerves to cause the rare disease amyloidosis. In this condition, amyloid protein builds up in organs and interferes with their function.

Saelices wondered whether there might be a connection between TTR's separate roles in both preventing and causing amyloid-related diseases. "It

seemed like such a coincidence that TTR had such opposing functions," she said. "How could it be both protective and damaging?"

To explore this question, she and her colleagues developed nine different TTR variants with differing propensities to separate into monomers that aggregate, forming sticky fibrils. Some did this quickly, over the course of hours, while others were slow. Still others were extremely stable and didn't dissociate into monomers at all.

When the researchers mixed these TTR variants with amyloid beta and placed them on neuronal cells, they found stark differences in how toxic the amyloid beta remained. The variants that separated into monomers and aggregated quickly into fibrils provided some protection from amyloid beta, but it was short-lived. Those that separated into monomers but took longer to aggregate provided significantly longer protection. And those that never separated provided no protection from amyloid beta at all.

Saelices and her colleagues suspected that part of TTR was binding to amyloid beta, preventing amyloid beta from forming its own aggregations. However, that important piece of TTR seemed to be hidden when this protein was in its tetramer form. Sure enough, computational studies showed that a piece of this protein that was concealed when the leaflets were conjoined could stick to amyloid beta. However, this piece tended to stick to itself to quickly form clumps. After modifying this piece with chemical tags to halt self-association, the researchers created peptides that could prevent the formation of toxic amyloid beta clumps in solution and even break apart preformed amyloid beta plaques. The interaction of modified TTR peptides with amyloid beta resulted in the conversion to forms called amorphous aggregates that were broken up easily by enzymes. In addition, the modified peptides prevented amyloid seeding, a process in which fibrils of amyloid beta extracted from Alzheimer's disease patients can act as a template in the formation of new fibrils.

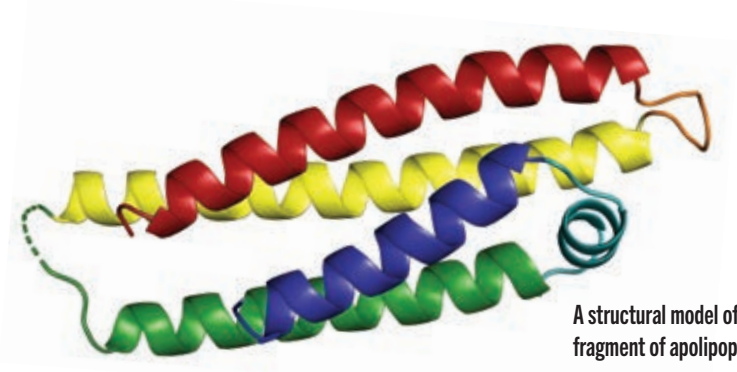
Saelices and her colleagues are currently testing whether this modified TTR peptide can prevent or slow progression of Alzheimer's in mouse models. If they're successful, she said, this protein snippet could form the basis of a new treatment for this recalcitrant condition.

"By solving the mystery of TTR's dual roles," she said, "we may be able to offer hope to patients with Alzheimer's."

DOI:10.1074/jbc.RA120.013440

Common blood protein isoforms show promise for Alzheimer's testing

By Leia Dwyer



APOLINO/WIKIMEDIA COMMONS

A structural model of the 22k fragment of apolipoprotein E4.

Apolipoproteins are amphipathic proteins, meaning they both mix with and repel water. Therefore, they can transport lipids and fat-soluble vitamins through the body's water-based circulatory system. While apolipoproteins have been well studied in the blood, researchers focus less on them in the cerebrospinal fluid, or CSF, despite their role in transporting lipids to regulate lipid metabolism in the brain. Dysfunctional lipid metabolism in the brain is implicated in neurodegenerative conditions such as Alzheimer's disease.

Dobrin Nedelkov, president and founder of Isoformix, works with Yueming Hu to develop next-generation mass spectrometry clinical tests to differentiate isoforms of proteins that may have clinical significance in human disease. Standard clinical assays cannot detect these differences. In a recent paper in the **Journal of Lipid Research**, Nedelkov, Hu and collaborators compared truncated and glycosylated isoforms of three apolipoproteins in plasma and CSF samples.

Nedelkov and Hussein Yassine, a researcher at the University of Southern California, have a long-standing collaboration studying lipoproteins and a friendship born from years of shared research. "We are both determined and curious, and we are not afraid to try new things together," Nedelkov said. "It's easier to find reasons why not to do it than to do it."

Previously, they have studied lipoproteins in plasma from patients with diabetes and cardiovascular disease. In this study, Nedelkov was excited to expand their collaboration to another area of Yassine's research: Alzheimer's disease, for which no diagnostic test exists. "We always wanted to work with Alzheimer's disease, but there was no easy access for us to get samples," Nedelkov said.

A set of matched plasma and CSF samples from 61 healthy patients without clinical Alzheimer's disease from the USC Alzheimer Disease Research Center presented a rare opportunity to study how protein isoforms correlate between the blood and brain. For CSF samples, patients undergo a lumbar puncture, which is more invasive and time-consuming than blood sampling.

Few researchers have studied apolipoproteins in the CSF. "When we started looking, we didn't even know what we were going to find out," Nedelkov said.

The team found a significantly higher percentage of the truncated protein isoforms of two apolipoproteins, apoC-I and apoC-II, in the CSF compared to blood, as well as a higher percentage of the glycosylated forms of a third, apoC-III. In each of these findings, the changes in CSF protein isoforms correlated with measured changes in the plasma samples, suggesting plasma sampling could help researchers better understand processes in the brain.

The researchers also compared the apoE ε4 allele status of the donors with those increased apolipoprotein isoforms. This allele is one of the strongest available genetic predictors of Alzheimer's. The team found differences in the isoform profiles in individuals carrying the allele, suggesting an association between Alzheimer's and apoC processing and function in the brain, which might someday be used to predict disease risk.

Nedelkov hopes the results of this work will help overcome challenges to adopting mass spectrometry protein tests in clinical labs due to cost and complexity. The ability to distinguish protein isoforms and the relationship between these biomarkers in plasma versus CSF could open the door to minimally invasive clinical tests.

DOI: 10.1194/jlr.RA120000919

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

Messy data, robust conclusions

Researchers define dengue–Zika distinctions

By Laurel Oldach

Elodie Ghedin and Christine Vogel had wanted to work together for years. They were friendly colleagues at New York University, both running interdisciplinary labs: Ghedin's focused on genomics and Vogel's on proteomics.

The opportunity to collaborate arose in 2016 with what Vogel playfully recalled as "a call from the NIH saying, 'Elodie, can you help us fix Zika?'"

Program officers at the National Institutes of Health had $152 million in emergency funding to learn more about the emerging virus as quickly as possible. They called on Ghedin and others with experience in viruses and in neglected tropical diseases.

At the time, one clinical challenge was differentiating between infections with Zika and related viruses, including the deadlier dengue and chikungunya, when both were circulating. Polymerase chain reaction diagnostics can differentiate dengue and Zika but only early in infection. If a patient suffers through a few days of fever and aches before arriving at the hospital, it may be too late to detect viral RNA. Because the viruses are so similar, antibody tests often used later in disease tend to be inconclusive.

During outbreaks of Zika and dengue in 2016 and 2017, doctors at the University of the West Indies in Trinidad did their best to diagnose patients based on ambiguous lab tests and secondary Zika symptoms such as vomiting and pain behind the eyes. They also started a clinical trial, collecting serum samples from over 60 patients.

"We were lucky we even got access to these samples," Ghedin said; competition among researchers was intense.

The data set was challenging to work with. There was no healthy control group, and some records were missing information about symptoms; one even lacked the participant's gender. Although the researchers had planned parallel transcriptome and proteome analyses, they had to scrap the transcriptomics, because the samples' RNA had degraded somewhere between the clinic in the Caribbean and their freezers in New York.

After proteomic analysis and rigorous statistical filtering, the two teams identified 13 proteins with different abundance between Zika and dengue infections, as they wrote recently in the journal **Molecular & Cellular Proteomics**. The differences, although small, could give new insights into Zika disease biology. For example, Ghedin said, they were surprised to observe that most proteins upregulated in Zika compared to dengue patients also are linked to pregnancy — which may yield new hypotheses about how the virus causes pregnancy complications and long-term health problems for newborns. The researchers emphasized that more validation work needs to be done before their observations can be used in the clinic.

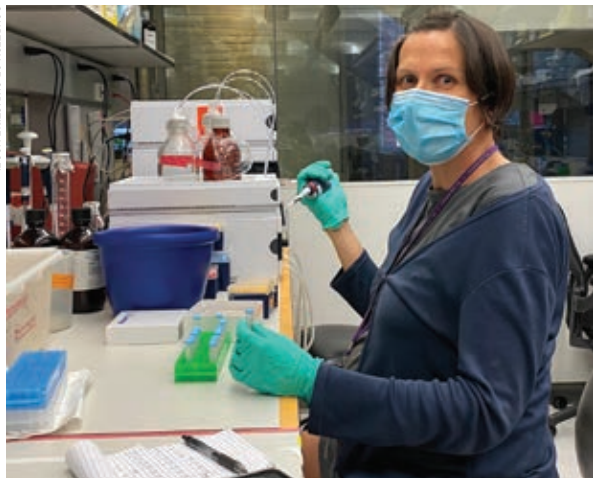
Although urgency about understanding Zika ebbed with the epidemic, Vogel and Ghedin, who now works at the National Institute for Allergy and Infectious Diseases, continue to collaborate on multiomics studies. While studying samples from COVID-19 patients, Vogel has relied on lessons she learned from the Zika study.

"In the early days (of an outbreak), you do not have controlled studies. You just have whatever samples you can get," she said.

"I find a lot of my research is like that," Ghedin added. "You do what you can with the samples you can actually lay your hands on."

DOI: 10.1016/j.mcpro.2021.100052

COURTESY OF CHRISTINE VOGEL



Christine Vogel pipetted samples for proteomic analysis the day before her daughter's birth in 2020.

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

From the journals

By Nicole Lynn, Anand Rao & Rajamani Selvam

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

A self-made molecule scatters Pseudomonas

The Gram-negative bacterium Pseudomonas aeruginosa causes hospital infections, particularly in patients with compromised host defense mechanisms, posing a significant health and economic burden. To become virulent, P. aeruginosa must attach to a surface such as epithelial tissue; it then forms a biofilm, whereby the pathogen secretes proteins that aid its spread. Researchers aim to identify agents that can disperse these bacteria and prevent them from propagating after they have attached.

Robert Scheffler and colleagues at Princeton University developed a quantitative single-cell surface-dispersal assay and demonstrated that P. aeruginosa generates several factors that can stimulate its own dispersal. Using bioactivity-guided fractionation, mass spectrometry and nuclear magnetic resonance, the authors showed that one such factor, 2-methyl-4-hydroxyquinoline, inhibits the activity of type IV pili, or THP, the thin appendages that decorate P. aeruginosa, and leads to dispersal of the pathogen.

These findings, published in a paper in the **Journal of Biological Chemistry**, identify THP inhibition as a promising strategy against infection caused by P. aeruginosa.
DOI: 10.1016/j.jbc.2021.100279

Identifying early markers of kidney damage

Chronic kidney disease, or CKD, is characterized by the progressive loss of kidney function and often leads to end-stage kidney failure, which can be treated only by transplant or dialysis. Protein-based approaches to predict progression of CKD have focused primarily on urinary proteins that demonstrate overall kidney failure; however, urinary proteins don't accurately reflect the diversity of tissue damage in CKD.

Ji Eun Kim and colleagues at Seoul National University sought to identify key proteins expressed at the onset of kidney damage, such as those linked to inflammation and fibrosis in CKD. In a recent study published in the journal **Molecular & Cellular Proteomics**, Kim and colleagues assessed protein profiles of cultured renal cells and kidney tissue in rats as well as urine samples taken from CKD patients. Using label-free and tag-based protein detection methods, this team was able to identify the expression of specific proteins associated with various stages of kidney damage.

This study is the first to use multisample protein-based methods to detect key kidney damage proteins and provides a starting point for understanding the functional relevance and future use of these proteins in CKD detection and progression.
DOI:10.1074/mcp.RA120.002159

Ameliorating Alzheimer's with antibodies

The hallmark aggregates of the amyloid-beta, or Aβ, peptide that form in the brains of Alzheimer's disease patients display varying conformations. These different structures could have different pathophysiological consequences; for example, large, high–molecular-weight Aβ aggregates accelerate the accumulation of toxic Aβ fibrils.

In the past, researchers isolated two single-chain variable domain antibody fragments, or scFvs, called C6T and A4, which selectively bind to different conformations of Aβ aggregates and represent a promising therapeutic agent to selectively target Aβ variants.

Recent studies by Ping He and colleagues at Arizona State University use those scFvs to demonstrate that specific Aβ aggregate variants and their location influence the therapeutic response to scFvs in mice. The scFvs, which contained a peptide tag to facilitate transport across the blood-brain barrier, were administered to normal or Alzheimer's mice, and their effects were studied seven months later. C6T restored neuronal integrity in the Alzheimer's mice to nondiseased levels, promoted growth of new neurons and increased survival rates. Treatment with A4, on the other hand, decreased Aβ deposits but did not significantly decrease neuroinflammation or promote neuronal integrity, neurogenesis or survival.

These findings, reported in the **Journal of Biological Chemistry**, suggest that the specific Aβ conformation targeted in therapeutic applications may affect treatment efficacy — including attenuation of neuroinflammation and promotion of neuronal integrity — and that the

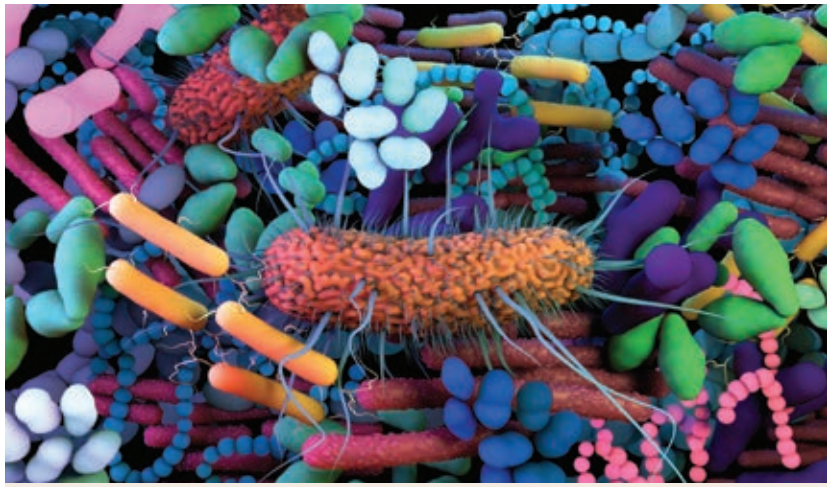
location of the targeted Aβ variants also may be a critical factor.
DOI: 10.1074/jbc.RA120.015327

Genomics can ID plasma lipid traits

Lipids provide energy and essential materials to build membrane components for cellular functions. Genetic and environmental factors can influence lipid characteristics, so understanding the mechanism responsible for lipid regulation is essential. Lipid dysregulation also can play a role in cancer and Alzheimer's disease. Capturing functionally relevant genes and their pathways in lipid signaling cascades can provide insights into the lipid mechanism and its association to the disorders.

In a recent paper in the **Journal of Lipid Research**, Montgomery Blencowe and colleagues at the University of California, Los Angeles, describe an integrative genomics approach they used to identify important genes, pathways and gene subnetworks in tissues that contribute to four blood lipid traits: total cholesterol, high- and low-density lipoprotein cholesterol, and triglycerides. Lipid metabolism, protein catabolism and interferon signaling are among the shared pathways that are common among the four lipid traits. The researchers found that closely related lipid traits exhibit shared and distinct mechanisms. In analyzing the gene subnetwork, they noted that certain traits are associated with cancer and with cardiovascular and Alzheimer's disease.

Future work can validate the molecular processes and genes identified in this study in population genetic and epidemiological studies to ascertain whether these



SCIENTIFIC ANIMATIONS INC./WIKIMEDIA

BOSSS: A new toolkit for lipid biochemists

Our intestinal microbiome is a complex system that influences our metabolism and is affected by extrinsic factors, including diet. For instance, breast-fed infants ingest human milk components, such as lipids, that provide nutrients for certain microbes in the gut, thereby influencing gut microbiome development. Lipids are ubiquitous, so determining their origin and fate is a major research challenge. The development of reporter lipids and click chemistry tools has helped researchers who seek to understand lipids' complexities.

In a recent commentary in the **Journal of Lipid Research**, David Ford of Saint Louis University School of Medicine writes about a novel integrated method developed by Elizabeth Johnson's laboratory at Cornell University known as BioOrthogonal-Sort-Sequence-Spectrometry, or BOSSS, and its application in lipid research. The technique uses a bioorthogonal click analog for the lipid sphinganine containing an alkyne. Johnson gave this compound to mice, whose gut microbiome metabolized the lipid, and the feces were collected. A fluorescent tag was used to distinguish the alkyne-modified sphinganine from the natural sphinganine in the feces.

Johnson found that the alkyne sphinganine differed from natural sphinganine by four hydrogen atoms. Her lab sorted the fluorescently tagged lipids by fluorescence-activated cell sorting, or FACS, then sequenced them to identify microbes. This technique can be used to examine the metabolism and uptake of various fatty acids and lipids in our diverse microbiome.

Ford suggests researchers also can apply the BOSSS platform to systems such as blood and lymph, thereby differentiating the origin of lipids in those systems. By creating amenable bioorthogonal click tags, they can combine the technology with RNA single-cell sequencing and multiomics to understand differences in cell populations and gain insights into the role of lipids in cell biology.
DOI: 10.1016/j.jlr.2021.100025

— Rajamani Selvam

genes can serve as novel targets for lipid-associated disorders.
DOI: 10.1194/jlr.RA120000713

Linking protein turnover with longevity and energy

Protein turnover refers to the cycle of synthesis and degradation that controls protein quality and maintains protein equilibrium in cells. Efficient protein synthesis and degradation often is associated with youth and longevity. As an organism ages, the turnover process tends to get slower or break down.

In a recent study in the journal **Molecular & Cellular Proteomics**, Kyle Swovick and colleagues at the University of Rochester in collaboration with researchers from the Wise Lab at the University of Louisville sought to understand the connections among protein turnover, aging and cellular energetic demands across organisms. Among the cells studied were valuable and difficult-to-obtain cell lines from whales, provided by Native American scientists at the North Slope Borough office of the Department of Wildlife Management in Barrow, Alaska. The team isolated the same cell type from organisms with varying life spans and evaluated the rates of protein turnover, energy consumption and cellular stress using liquid chromatography coupled with tandem mass spectrometry.

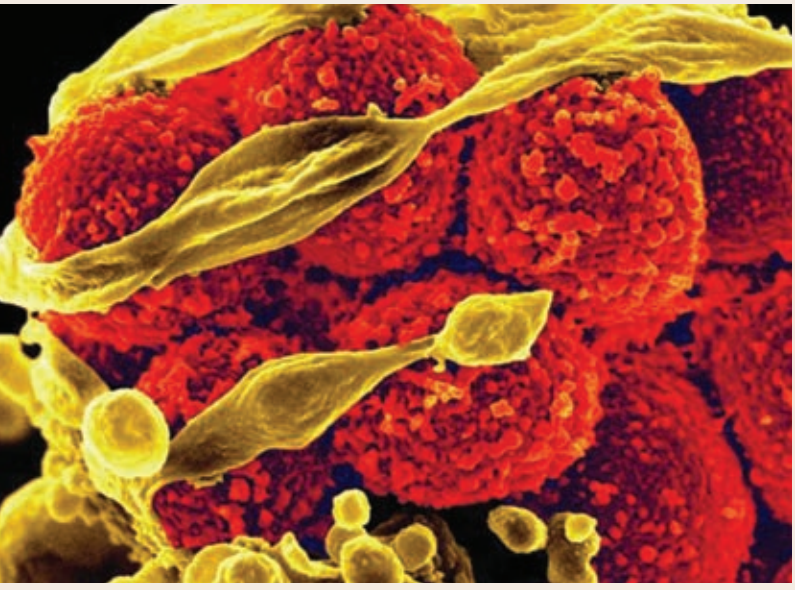
This study showed that despite having slower rates of protein turnover, some long-lived organisms were able to tolerate protein folding stress more effectively than those with short life spans. Further understanding of protein synthesis and degradation across species of varied life spans could help researchers develop potential treatments for

Finding new phosphorylation targets in bacteria

Bacterial virulence is the extent to which a pathogenic microbe can cause disease. Genetic virulence factors in bacteria aid in host invasion, disease progression and evasion of host defenses. Staphylococcus aureus is one bacterium that has become increasingly difficult to treat with antibiotics due to the onset of resistant strains such as methicillin-resistant S. aureus, or MRSA.

In a recent paper in the journal **Molecular & Cellular Proteomics**, Nadine Prust and colleagues at Utrecht University in the Netherlands describe how they improved protein preparation and quantitative detection methods to identify novel targets of protein phosphorylation in S. aureus. The expression of virulence factors in this bacterium is triggered by extracellular cues that set off intracellular signaling cascades; phosphorylation at serine/threonine kinase residues regulates this process.

This scanning electron micrograph shows S. aureus (red) decimating a human white blood cell (yellow) as it escapes its grip.



NATIONAL INSTITUTE OF ALLERGY AND INFECTIOUS DISEASES/NATIONAL INSTITUTES OF HEALTH

Researchers believe that Stk1, one of two eukaryotic-like serine/threonine kinases expressed in S. aureus, calibrates genetic responses to extracellular stimuli via phosphorylation at serine/threonine residues. Alternately, Stp1 removes these phosphates. To determine potential targets of Stk1 and Stp1, Prust and colleagues designed a protein purification protocol that accounted for differences in Gram-positive bacteria, whose thick cell walls can increase contaminants from phospholipids, RNA and DNA. Next, using label-free protein detection designed to isolate and identify phosphorylated amino acids, Prust and colleagues identified 74 potential Stk1/Stp1-related phosphosites in S. aureus. By profiling Stk1/Stp1-deficient MRSA mutants, they were able to generate the most comprehensive S. aureus phosphoproteome to date.

These findings demonstrate that bacterial pathogens such as S. aureus use serine/threonine signaling more than researchers previously thought. By elucidating the role that serine/threonine kinases play in the expression of genetic factors like virulence, researchers can learn more about the causes of antibiotic resistance.
DOI: 10.1074/mcp.RA120.002232

—Nicole Lynn

age-related disease.
DOI:10.1074/mcp.RA120.002301

The duality of coagulation factor V

Factor V, or FV, is a glycoprotein that has a dual role as both an anticoagulation and procoagulation cofactor. Central to its opposing functions is the proteolytic removal of its central B-domain, and researchers seek to understand the mechanisms surrounding this functional switch.

In a paper published in the **Journal of Biological Chemistry**, Teodolinda Petrillo and colleagues at the Children's Hospital of Pennsylvania describe their study of how bond cleavage in the B-domain influences interactions between FV and FV-short, a physiologically relevant isoform with a shortened B-domain, and tissue factor pathway inhibitor alpha, or TFPIα. Using clotting assays, chromatography, fluorescent anisotropy and biochemical analyses, the authors demonstrated that key forms of FV, including FV-short, are physiologic ligands for TFPIα. The authors speculate that strategies that target the interaction of TFPIα with these different forms of FV may provide a new way to strengthen or dampen the coagulation system.
DOI: 10.1074/jbc.RA120.016341

Finding sites that control lipid metabolism

Triglycerides are stored within lipid droplets, which are essential for energy metabolism. The triglycerides are broken down into fatty acids and glycerol via lipid droplet-associated proteins, such as perilipin, or PLIN. Researchers are interested in PLIN5 because it is expressed in various highly oxidative tissues and influences lipid metabolism in response to

A new way to absorb dietary iron

Iron, a mineral found in every cell of the human body, combines with proteins to form the hemoglobin required to transport oxygen. The body also needs iron for physical growth, neurological development and critical biochemical functions, making it an essential nutrient. However, iron in excess is toxic, and the body has no physiological means to excrete that excess. Instead, levels are regulated by iron absorption.

Dietary iron mainly exists in two forms: heme and nonheme. Plant-based and fortified foods are a source of nonheme iron, whereas meat, seafood and poultry supply both heme and nonheme iron. The National Heart, Lung and Blood Institute estimates that 20% of women, 50% of pregnant women and 3% of men have an iron deficiency, which is the most common cause of anemia, a decrease in red blood cells. This deficiency can be treated with iron supplements. However, absorption of available supplements is inefficient, and it often takes several months to reestablish normal iron levels.

Researchers recently identified nicotianamine-iron chelate, or NA-Fe^{2+}, as a new form of bioavailable iron present in mice, chickens and plant-based foods. However, researchers know little about the mechanisms responsible for NA-Fe^{2+} absorption from its dietary sources. In a recent article in the **Journal of Biological Chemistry**, Yoshiko Murata and a team of researchers in Japan identified the proton-coupled amino acid transporter, or PAT1, as the principal channel through which NA-Fe^{2+} is absorbed. Using cultured cells modified to no longer contain the PAT1 protein, electrophysiological analyses of PAT1 overexpression in aquatic frog oocytes and experiments with mice, the authors demonstrated the uptake of NA-Fe^{2+} into the epithelium of the proximal jejunum and iron appearance in spleen, liver and kidney.

These findings confirm that NA-Fe^{2+} is a bioavailable source of iron, uncover the possible mechanism by which NA-Fe^{2+} is absorbed in the mammalian intestine, and may drive development of improved iron supplements.
DOI: 10.1074/jbc.RA120.015861

— Anand Rao

phosphorylation — a post-translational modification in which phosphate groups are added to the protein. Previous work has established that the phosphorylation of serine residues is enough to activate PLIN5-regulated lipid breakdown.

In a recent paper published in the **Journal of Lipid Research**, Stacey N. Keenan and colleagues at the University of Melbourne describe how they identified phosphorylation sites of serine residues in PLIN5 and determined which of these sites are functional using cultured cells and mice. Three phosphorylation sites in PLIN5 were identified: S155, S161 and S163. Out of these, S155 is a functionally important phosphorylation site for lipid metabolism, while the others did not show any effect on lipid breakdown in cultured cells. Using PLIN5 S155A–mutant mice, the researchers showed a reduction in triglyceride breakdown, suggesting a critical role for PLIN5 as a regulator for lipid metabolism. This work provides new information on the role of PLIN5 in controlling lipid metabolism.

DOI: 10.1194/jlr.RA120001126

Sorting out sinking phagocytosis

Phagocytosis, the receptor-mediated ingestion of cellular particles, is the major function of immune cells such as macrophages and neutrophils. Yet more than 100 years after Élie Metschnikoff — the scientist credited with discovering phagocytes — developed his theory of phagocytosis, scientists still know little about the processes that govern this cellular ingestion process. Researchers have described two structurally distinct modes of phagocytosis: phagocytic cup formation, whereby the membrane extends outward and engulfs the particle, and sinking phagocytosis, the inward engulfment of particles. A number of receptors that activate downstream signaling pathways initiate phagocytosis. One such receptor, CR3, is thought to drive sinking phagocytosis. However, evidence of this receptor's involvement is sparse.

In a recent study published in the **Journal of Biological Chemistry**, Stefan Walbaum and colleagues at the University of Münster in Germany isolated resident macrophages from normal unaltered mice and mice genetically altered to lack CR3 receptors to investigate how macrophages engage and internalize particles. Using RNA-sequence analysis, genetic experiments and real-time 3D imaging, the researchers showed that CR3 receptors indeed regulate a mode of sinking phagocytosis and also are involved in the formation and closing of Fc receptors for immunoglobulin G, or fragment crystallizable gamma receptor–controlled phagocytic cups that extend outward to engulf particles.

DOI: 10.1016/j.jbc.2021.100256

Nicole Lynn (nalynn@g.ucla.edu) is a graduate student at the University of California, Los Angeles in the chemistry and biochemistry department.

Anand Rao (arao@asbmb.org) is an ASBMB science communicator. Follow him on Twitter @AnandRaoPhD.

Rajamani Selvam (rajamaniselvam@gmail.com) is an Oak Ridge Institute for Science and Education research fellow at the U.S. Food and Drug Administration in Maryland. Follow her on Twitter @Rajaman06539874

SCIENCE & ART

Seeing is believing

Visualizing science through art and illustration

By Isha Dey

Luciana Giono created this whimsical illustration for the website of the Signal Transduction & Metabolism Laboratory at the Université Libre De Bruxelles in Belgium.

Some 17,000 years ago, on a cave wall in Spain, a person drew a picture of a mammoth with a dark shadow where the animal's heart would be. Some believe this is the earliest example of anatomical drawing.

Today's science illustrators are still expected to know where to place organs and other major structures, but they're also expected to convey the intricacies of living beings' insides — down to the molecular level. Doing that well requires specialized knowledge, often acquired formally.

We spoke to three science illustrators about their career paths.

Academic beginnings

Luciana Giono's family has interests in architecture, music and graphic design, but she ended up studying science, completing the equivalent of U.S. bachelor's and master's degrees in biological sciences at the University of Buenos Aires in Argentina. The school's architecture/design and science departments were in two almost identical buildings next to each other on campus.

COURTESY OF LUCIANA GIONO

While studying for her Ph.D. qualifying exam, Luciana Giono realized how much people rely on diagrams and visuals to communicate scientific knowledge efficiently.

"I used to joke that I went to the wrong building," Giono said.

She did graduate work at the Icahn School of Medicine at Mount Sinai in New York, with research focused on gene expression, cell cycle and DNA damage response. While studying for her Ph.D. qualifying exam, she made a big figure summarizing all the cell cycle details she had learned — and realized how much people rely on diagrams and visuals to communicate scientific knowledge efficiently.

Kate Patterson always has enjoyed doing art but said she put it aside to study veterinary science. During her undergraduate studies at the University of Sydney in Australia, she was intrigued to learn that certain breeds of dogs are prone to specific types of cancer. In practice, she treated many boxers with mast cell tumors (a type of skin cancer) and German shepherds with hemangiosarcoma (cancer arising from cells in blood vessels). Thinking this must have a genetic basis that also might apply to human cancer, she enrolled for a Ph.D. at the Garvan Institute of Medical Research at the University of New South Wales, where she studied how a dual specificity phosphatase called DUSP23 affects ovarian cancer progression.

As a graduate student, Patterson enjoyed making graphs and figures to communicate her work clearly, and she realized this was not something that came easily to everybody. "A component of being a scientist is to be able to communicate your work clearly," she said. "I was one of the weird ones that really enjoyed writing up my thesis and making posters."

Radhika Patnala's mother was an interior designer. "The world of art and design was quite prevalent in my household as I was growing up," Patnala said, "so I developed an interest in fine arts, design concepts and design software from a very young age, even before I was exposed to the wonderful world of science and biology."

Patnala completed her bachelor's and master's degrees in biotechnology from Gandhi Institute of Technology and Management in India and the Australian National University, respectively, and then earned a Ph.D., in neurosciences from the National University of Singapore. "My research was focused on neuroinflammation and epigenetics in the context of a fascinating cell type called microglia," she said. "I did a lot of microscopy during my Ph.D. which exposed me to the visual beauty inherent in life science."

COURTESY OF RADHIKA PATNALA

Soon after completing her Ph.D., Radhika Patnala moved to Germany and started a creative agency, Sci-Illustrate.

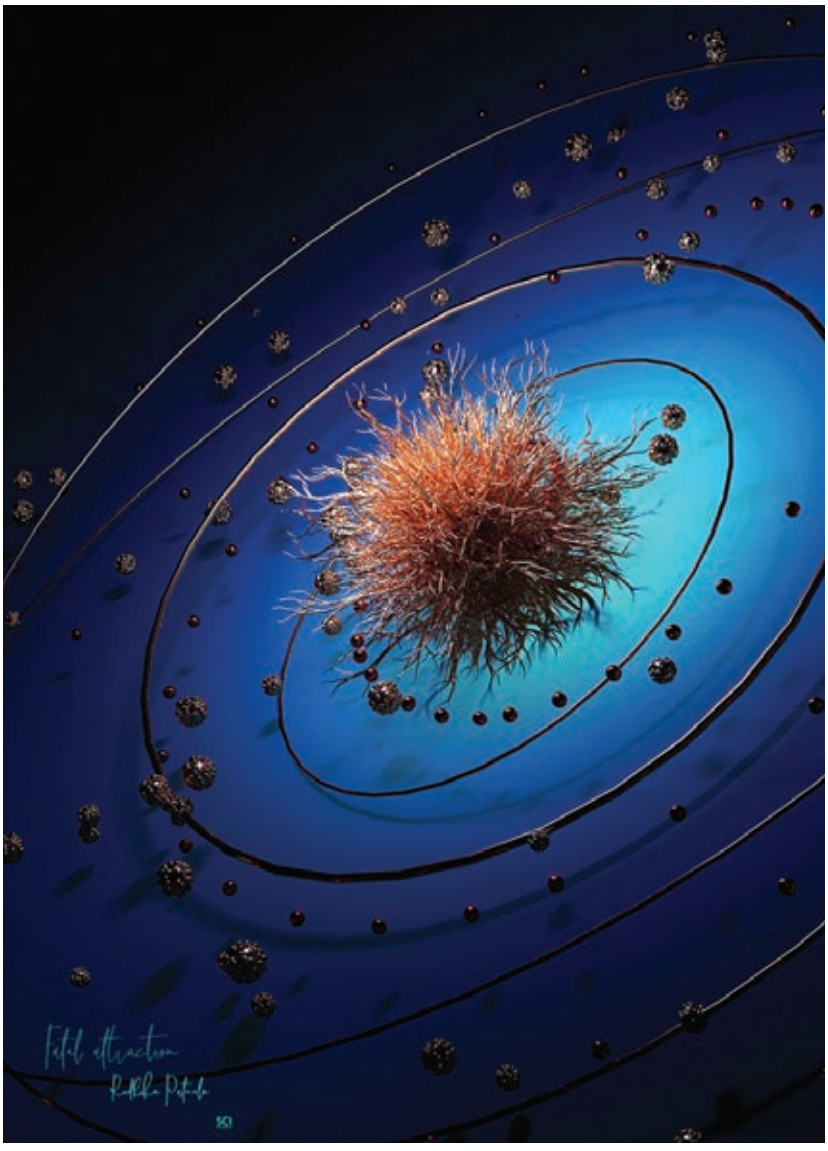
COURTESY OF KATE PATTERSON/GARVAN INSTITUTE

Kate Patterson shows an animation about RNA transcription in the Garvan Institute's Cell Observatory.

Turning an interest into a career

As an extension for their love for arts in science, both Patterson and Giono eventually found themselves making figures for colleagues' papers and posters. "I really enjoy making them, which means I take the time to do it carefully, both in terms of content and looks," Giono said.

She worked as a career investigator and teaching assistant for many years and then began asking journals if they would be interested in having someone dedicated to figure production. Her very first work for a Journal of Biological Chemistry review article consisted of illustrations showing ways of studying RNA–protein interactions at the molecular level. Now a freelance illustrator, for several years she has prepared many cover



This image is one of the first in a series made freely available to the public by Radhika Patnala exploring ideas about COVID-19 and how the world deals with it.

illustrations and figures for JBC and the Journal of Lipid Research. Her illustrations also have been on the covers of other journals including Cell, Nucleic Acids Research and the Journal of Hepatology.

Patterson took an equally indirect route to becoming a science animator. She started out working as a science writer at the National Breast Cancer Foundation and a freelance illustrator through her website, MediPics and Prose. "In Australia, there is no formal training to become a science illustrator, so there aren't many people in this area," she said.

About a decade ago, the Australian government funded an animation program as part of "VizbiPlus — visualizing the future of biomedicine," a project to create a more "scientifically engaged Australia." Patterson was one of the three people who received a grant; they created public-facing animations from scientific findings across Australian institutions to raise general awareness about science and medicine. This program, which she describes as "awe-inspiring," helped Patterson make the transition from illustrator to animator.

Her very first animated short documentary, called "Cancer Is Not One Disease," showed the complexities of the disease based on the experience of a patient living with pancreatic cancer.

She has worked for the past decade as a visual illustrator at the Garvan Institute of Medical Research, putting complex scientific concepts and discoveries into the form of visual stories that scientists can utilize and also that nonscientists can understand. She is now the institute's senior visual science communications officer — a title she said was invented upon her appointment, because she was the first person to do such work there.

During Patnala's doctoral training, arts and aesthetics were an integral part of the overall skill set she developed, along with the realization that science communication is a large part of doing science as we know it. "Eventually, the two aspects came together to dictate what I am going to do as a next step" she said.

Soon after completing her Ph.D., Patnala moved to Germany to be with family and started a creative agency, Sci-Illustrate, to explore the use of scientific illustrations and visuals to aid in science communication. Since then, her science-inspired art has been featured on covers of Cell and JBC and the covers of Nature Reviews

Neurology for all of 2020. Based in Munich, Sci-Illustrate now provides design services such as scientific illustrations, motion graphics and data visualization to biotech companies, organizations and research labs in health care and life sciences. A passion project at Sci-Illustrate is the Women in Science initiative which, Patnala said, highlights "the personal journeys of women in science from India and around the world over the past two years through art and words."

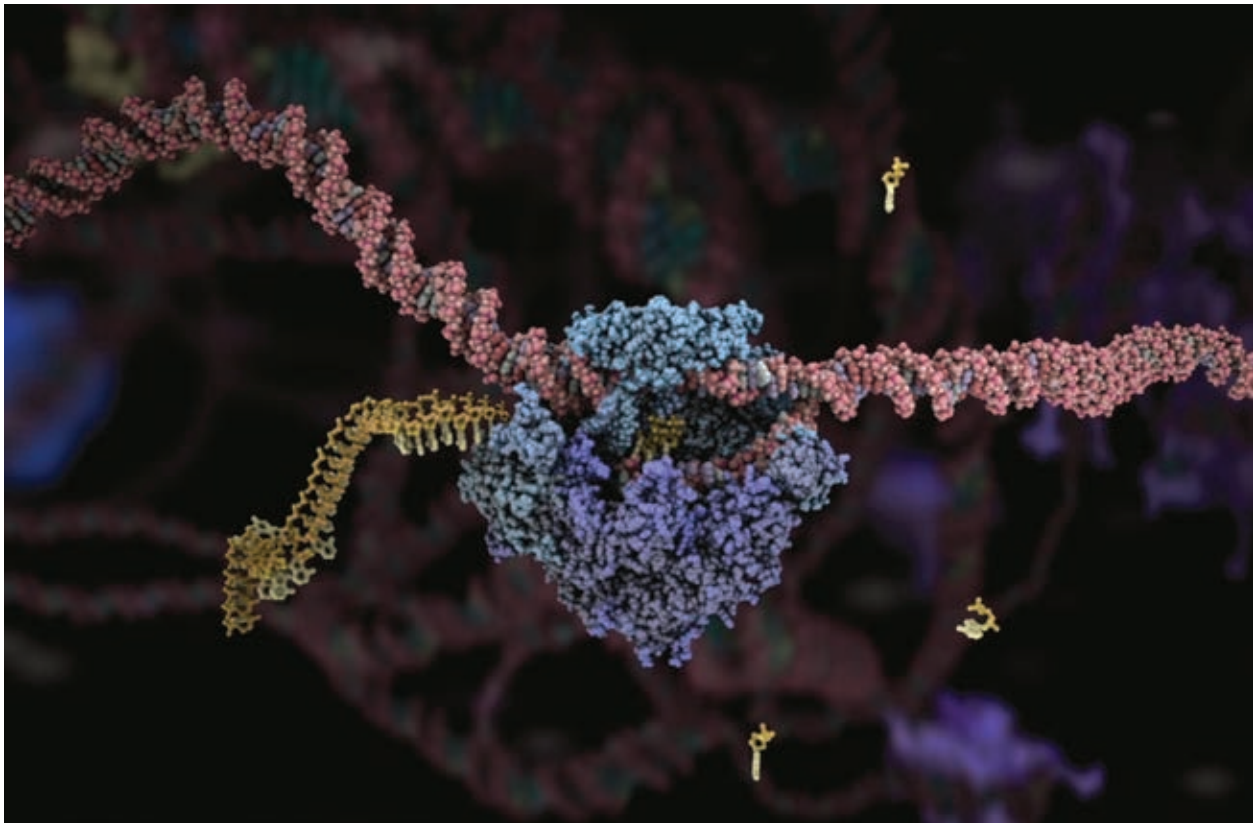
A science background helps

Although their careers took them away from research, Patnala, Giono and Patterson agree that their years at the bench were not wasted but actually helped them along the way.

"I would think my science background is actually my greatest asset, or at least one of them," Giono said. Years of learning science as well as critical reading, discussion and writing of scientific papers gave her the ability to grasp concepts and find the information she needs for her illustrations. She also is able to point out errors in figures and propose alternatives.

JBC publishes papers on a wide variety of topics and reaches a large audience. Giono might not be an expert in all the topics, but she can place herself in the readers' shoes and find the best way to communicate the scientific knowledge through her illustrations.

Patterson said her veterinary science training helps her understand what pieces of information are necessary to communicate a message clearly to the audience. Pet owners often do not have detailed scientific knowledge, so she learned to simplify complex concepts to help them understand their animals' diseases.



This screenshot from Kate Patterson's animation shows RNA being transcribed from DNA by the molecule RNA polymerase.

"We All Come From Fishes" is a skateboard Radhika Patnala designed as part of her #Futurepopart: Lifescience Edition art series.

But even with talent and knowledge, science illustration — like all career paths — has its challenges.

When Patnala went to set up her company in Munich, she found that all the official documents were in German, a language she does not read or speak. She said she still relies on her husband to help her out with such formalities.

During Patterson's gradual transition from postdoc to science illustrator, learning how to use the powerful animation software was initially a challenge. To overcome these roadblocks, she attended conferences and talks by practitioners in the field of biomedical animation and accessed online courses and tutorials to help learn how to use the software effectively.

Science illustration vs. science art

Science illustration is a broad term, Giono said, that encompasses everything from "'a boxes and arrows' kind of diagram to an elaborate 3D human body illustration, to even an illustration for an editorial or news article."

A science illustration caters to the technical needs of the customer, she explained, while science art allows for some poetic license. For example, a figure model summarizing results in a research article is a science illustration, while a journal cover could be science art.

When a science illustrator receives an assignment, Patnala said, the person needs to be careful that the depiction is scientifically accurate so it communicates the necessary information. Science art, on the other hand, can be influenced by the artist's perception of a scientific concept rather than purely based on factually correct information.

Creating an illustration requires communication with clients to understand what they want, Giono said, and catering to clients' specific needs sometimes requires compromise. Nevertheless, she enjoys the challenge of coming up with innovative ways of presenting a scientific report or idea on journal covers.

"Then the greater challenge comes when you send your image to the author and are waiting to see if they will like it or hate it," she said.

Raising awareness through advances in tech

Whether creating art or literal illustration, professionals use tools such as Adobe Illustrator and Adobe Photoshop for static illustrations. Many graphics can be directly created with such software, but Giono said she

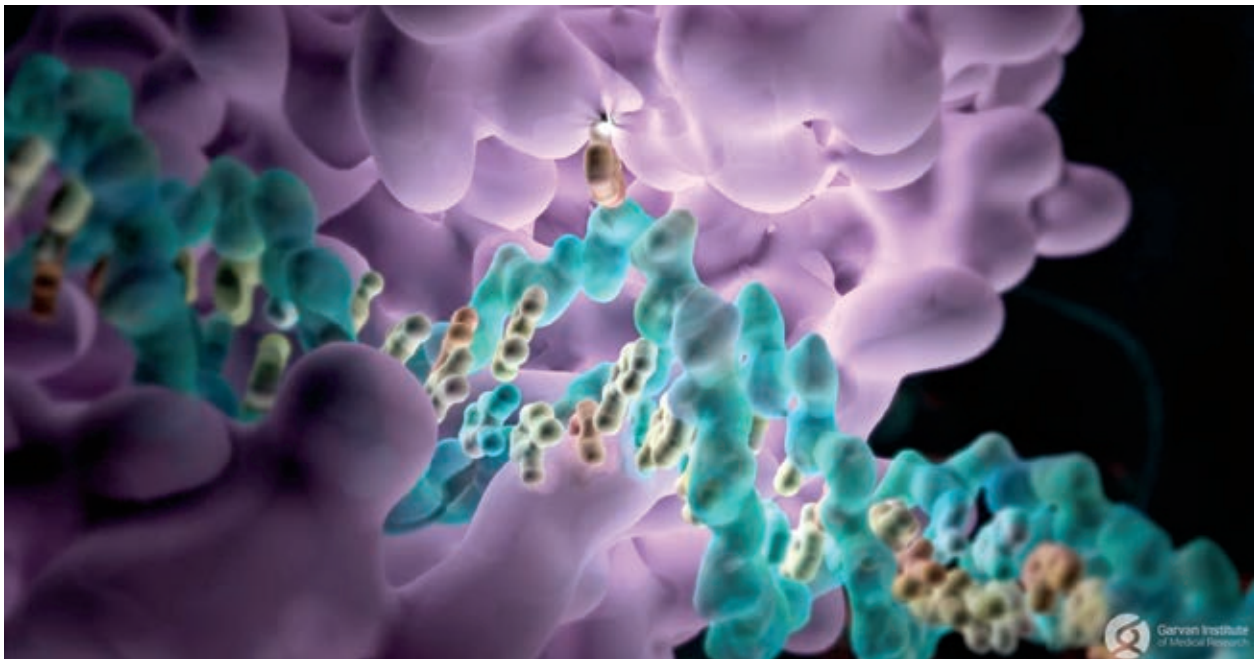
sometimes prefers drawing by hand, scanning the art and coloring it using Photoshop, especially for journal cover images.

Patterson uses the 3D animation software Autodesk Maya to create animations. When animating a protein that has a known crystal structure, she imports Protein Data Bank files into a plug-in called Molecular Maya. The plug-in gives her the 3D coordinates of all the atoms in the molecule, and using those coordinates she can animate the molecule in its entirety. For the past year, Patterson has been involved in creating a virtual reality experience at the Garvan Institute. They have built an immersive visualization dome called the Cell Observatory, where visitors are transported to the inside of a cell. Animations of processes such as DNA transcription appear on the curved ceiling while scientists explain what specific proteins do in the process.

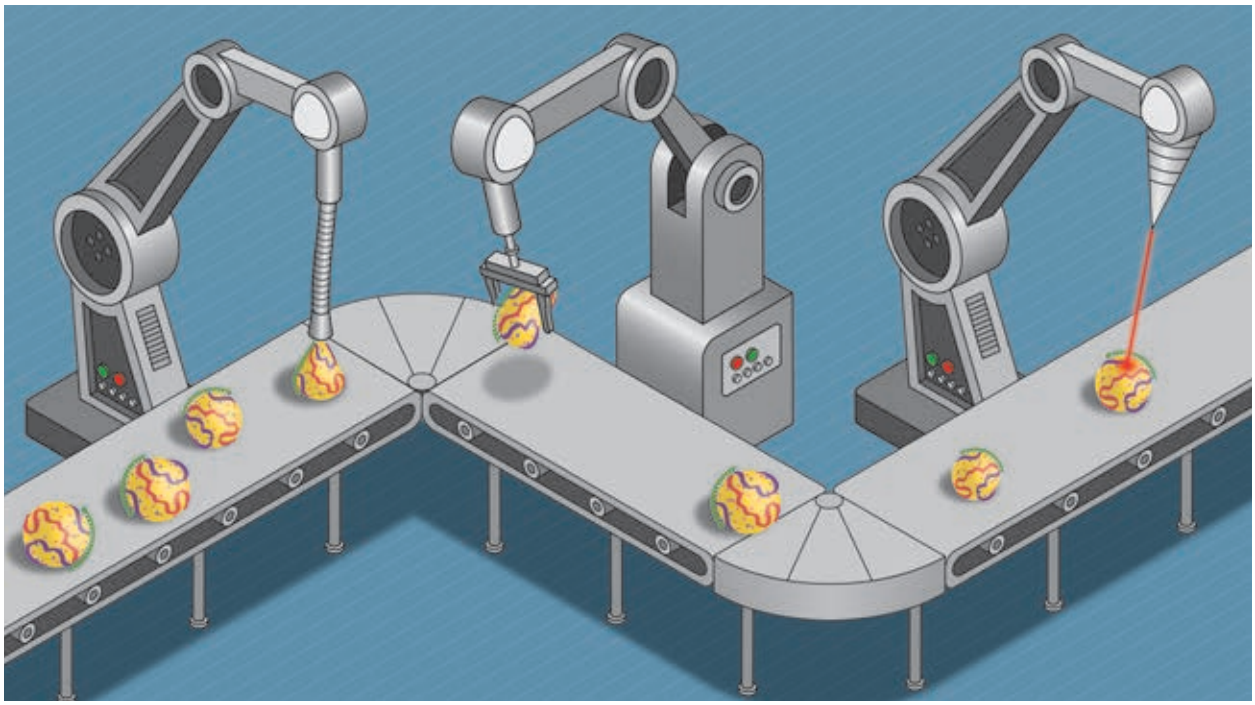
With the help of hand-held controllers and a head-mounted display such as the Oculus Quest, visitors can move the RNA polymerase onto the DNA strand to make RNA. During a Christmas event, the Garvan staff set up an outdoor booth for a similar virtual reality experience, Patterson said, and people were playing with molecules on the street using the headset and controllers.

With technologies such as Google Cardboard, people can use their phones to visualize scientific processes in three dimensions and 360 degrees. Such experiences leave a longer-lasting impression than reading about the same process in textbooks, Patterson said, or even seeing it as a movie.

Scientific articles and reviews are read by a niche audience, but the same findings presented in the form of a diagram or a movie can be understood by a broader community. Using their skills to bring science to the masses in this way serves as a big motivation for science illustrators. Patnala's favorite projects include "#Futurepopart," a series of 30 skateboards depicting 30 different concepts in life sciences, and a recent 10-part series of illustrations called "The COVID Dreams." With so much energy and passion invested in her work, "I end up liking most of



This screenshot from Kate Patterson's animation shows DNA being methylated on a cytosine base by enzyme DNA methyltransferase.



Luciana Giono created this cover illustration for an issue of the Journal of Lipid Research titled "Exploring the nuances and complexities of lipoprotein clearance."

my creations," she said.

"Science is about communication," Giono said, "and the central role of visuals in that communication cannot be stressed enough."

For many people, the biggest barrier to understanding the basic scientific concepts that govern life is a fear of asking questions. Nonscientists are intimidated by jargon. According to Patterson, public activities such as the cell observatory help break down these barriers and initiate conversations. The Garvan Institute encourages school trips so children can be exposed to the fun in science. In addition, Patterson has worked with teachers to find ways to include illustrations and animation in their lessons.

'It's a lot of fun'

While science illustration can be a creatively satisfying job, there are roadblocks to making it a career. Few full-time positions are available. It is often a freelancer's job, so finance becomes a confounding factor and there is not a set career path.

Both Patnala and Patterson advise beginners to build their portfolios while doing something that makes them financially independent and developing skills required to make illustration a full-time job. It is also possible to enroll in a full-time course offered by various online platforms and some institutions to learn the skills of illustration and then seek employment. In fact, Patnala's company offers an intensive science illustration workshop for life scientists and health care professionals.

"You've got to find your own adventure and create your own job because they don't get advertised very often," Patterson said, but whatever the challenges, "It's a lot of fun and you should do it."

Isha Dey (ishaadey@gmail.com) is a scientist at Thermo Fisher Scientific in India.

Unraveling the mind's eye — science through a novel lens

By Kamalika Saha

From the Perseverance rover landing on Mars to a record-shattering vaccine timeline for COVID-19, scientific developments continue to amaze us by pushing boundaries and bridging the gap between imagination and reality. And from NASA's stunning pictures of the Martian landscape to electron microscopy images of the viral capsid, striking visual displays often bring the unseen facets of our world around us to life.

How can these visual marvels be re-created for individuals with low vision or who are blind? An initiative known as sensory science aims to make the results of research accessible in new ways.

This accessibility forms the crux of Erica Tandori's work. A legally blind artist, researcher and academic, Tandori strives to make science inclusive for all. By exploring the intersection of art, vision loss and science, she creates multisensory displays to articulate the findings of biological research.

As artist-in-residence at Jamie Rossjohn's laboratory in the Monash University Biomedicine Discovery Institute in Australia, Tandori captures the scientist's research in tactile sculptures designed for the low-vision and blind community. Topics to date have included infection and immunity and cancer biology. She describes her large-scale models of sometimes invisible phenomena as "delicious and juicy artworks."

COURTESY OF ERICA TANDORI

This 2016 oil-on-canvas painting titled "The Vegemite Jar" by Erica Tandori depicts the entoptic effects caused by Stargardt's disease.

Nuances between brain and vision

Tandori's life story inspires her mission. She grew up in a family that owned a successful art business, so fine arts were a natural career aspiration. During her first year in art school, she was diagnosed with Stargardt's disease, a genetic form of macular degeneration that leads to the progressive loss of central vision. The diagnosis came as a shock and led to an abrupt halt in her art education. Tandori pursued acting and singing for a few years. But art was her calling and passion, and she returned to school to pursue a formal arts

An initiative known as sensory science aims to make the results of research accessible in new ways. This accessibility forms the crux of Erica Tandori's work.

COURTESY OF ERICA TANDORI

Erica Tandori created this clay sculpture of a human dendritic cell as part of the Monash Sensory Science Initiative exhibition.

education.

As a part of her doctoral research, Tandori focused on her lived experience of blindness. This choice was driven by the huge gap between perceived notions of blindness and the reality of how low-vision individuals see the world.

"The doctors can look into my eyes, but they can't see through my eyes and relate to the delicate nuances between my brain and vision," she said. "They assume that I might be seeing a central black spot (called a scotoma) due to the dead macular cells. In reality, cortical completion takes charge, and my brain fills the scotoma with color and patterns. Vision loss is gradual and dynamic."

Few artists can depict the process of vision loss, Tandori said, so she attempted to create an accurate picture of her vision loss.

Few artists can depict the process of vision loss, Tandori said, so she attempted to create an accurate picture of her vision loss. The aim was to provide a direct comparison of the images she perceived to those seen by a person with perfect vision. With a digital camera, she created an image as seen by a normal eye. She then modified it with digital and conventional tools to resemble what she saw.

Her research brought together two disparate institutions that study a common topic — the eye. The department of ophthalmology at the University of Melbourne studies the eye "outside in," and the Victorian College of the Arts studies the eye "inside out," she explained.

Tandori's broader goal was to bring the lived experience of people with disabilities into policy-driven discussions of workplace inclusion and creating suitable work environments and opportunities.

Sharing science across the spectrum

The Monash Sensory Science Initiative was a brainchild of Jamie Rossjohn, professor of structural immunology at Cardiff University, head of the Infection and Immunity Program at the Monash BDI and laureate fellow of the Australian Research Council. The idea stemmed from a broader aim of disability inclusion.

In 2018, he was thinking about organizing an exhibition to communicate the nature of biomedical research to the blind and low-vision community. He proposed this to the nonprofit Vision Australia, and they were enthusiastic about it. As luck would have it, he was connected to Tandori, who was in search of an opportunity, and Rossjohn recruited her as a part of this initiative. The first exhibition involved tactile 3D models, 2D graphic displays and olfactory displays with text in large-print and braille formats. It transported the audience to a life science wonderland. This paved the way for several successful exhibits.

"I want it to grow and for other institutions to take this up and increase participation for broad spectrums of the community," Rossjohn said. "We need to open the doors for everyone.

Great ideas can come from anywhere."

Tandori recently collaborated with interaction designer and video artist Stu Favilla on the HIV Capsid Data Projection project, an interactive sculpture of viral RNA coated in a protein capsid that can be explored both on the outside and by climbing inside. Its hexagonal cardboard tiles were smothered with millions of tiny foam balls to mimic the texture of the viral surface. To capture dynamic viral mutations, computerized color-coded patterns synced to music were projected on the sculpture. The tactile component coupled with the sensory outputs, providing an elevated sensory experience.

The world contains a rich diversity of patterns and textures waiting to be unraveled, Tandori emphasized. "We are in a continuum of discovery," she said. "If we look back at the scientific discoveries of the ancient civilizations, we are echoing from the past and building on the greatness of our predecessors."

Using a blend of natural and hybrid materials, she has made another HIV capsid with couscous and chicken wire and a yeast cell with yeast and dough. She took her multisensory approach to the next level by incorporating an unpleasant-smelling fruit in a smallpox sculpture.

"None of us can see the cells with our naked eye — in that, all of us are blind," Tandori said. "We use powerful technology like synchrotrons and microscopy to extrude the images on screen. I am adding another dimension to it through my work."

And the experts in those technologies also are impressed by her work, she said. "The scientists marvel when they hold the cellular models of the organisms that forms the crux of their research in their hands."

Making disability irrelevant

Tandori's future projects include what she calls an exhibit in a book. Keeping the ongoing global pandemic in mind, these books contain laminated pages and interactive tactile models that can serve as personal displays — no exhibition space needed. She also is working on a multisensory COVID-19 sculpture and an initiative to make art in museums accessible to the low-vision and blind community.

Tandori said that there's much more work to be done in sensory science and science inclusiveness. She stressed that engaging people with disabilities in discourse around science outreach will be a great equalizer and affect their lives in a powerful way.

"I want to strive to make science accessible and super-inclusive irrespective of socioeconomic factors," she said. "I would like to create a working environment so that disability is irrelevant and is not treated as a deficit."

She recalled meeting a blind indigenous girl during an exhibition in Perth, Australia. "She was very smart and aimed to become a chemist. Why should vision be a barrier to her dreams? I hope to help young minds like hers through my work."

Tandori said every individual has inherent talent and harnessing that power will make the world a better place. She signed off by saying, "Do you know what is greater than science? Art and science is greater than science — how powerful are they together?"

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

COURTESY OF ERICA TANDORI

As artist in residence at the Rossjohn lab in Melbourne, Australia, Erica Tandori creates tactile 3D models to communicate biomedical research. "I would like to create a working environment so that disability is irrelevant and is not treated as a deficit," she said.

The world contains a rich diversity of patterns and textures waiting to be unraveled, Tandori said.

Eternal memories and an overdue tribute — storing digital data in DNA

By Ankita Arora

DENNIS WISE/UNIVERSITY OF WASHINGTON

Members of the #MemoriesInDNA project posing with their portrait of Rosalind Franklin are, from left, Luis Ceze, David Ward, Bichlien Nguyen, Kate Thompson and Karin Strauss. Not pictured are Xiaomeng Liu and Jeff Nivala.

What if you could save a memory forever? What would you want it to be? A family picture, a favorite vacation spot, an art performance or a message to future generations?

What about the face of a groundbreaking scientist whose work largely was overlooked in her lifetime?

For the #MemoriesInDNA project, researchers at the Molecular Information Systems Lab, or MISL, at the University of Washington and Microsoft crowdsourced 10,000 images representing treasured memories and stored them indefinitely in synthetic DNA manufactured by Twist Bioscience.

#MemoriesInDNA turned what seems like science fiction into reality. But then the researchers took the project a step farther. They collaborated with Seattle-based artist Kate Thompson to create a portrait of an often overlooked star of DNA discovery, Rosalind Franklin, using the synthetic DNA encoding the memories mixed with acrylic paint.

Luis Ceze, professor in the UW's Paul G. Allen School of Computer Science and Engineering, explained in a news release: "We had this massive collection of image files signifying what people want to preserve for

posterity, and this new storage method. So, we thought, why not use them to demonstrate the science we've been working on while paying tribute to the scientist who started it all?"

How does digital data storage in DNA work?

Digital data is binary, composed of 0s and 1s. DNA stores genetic information in cells, but rather than being binary, it operates on a four-letter code (A, C, G and T). Computers and DNA speak two different languages, so the researchers needed to develop a translator.

First, the digital data was converted, or encoded, to the A, C, G and T of DNA. Then, the researchers needed to write the DNA one base at a time to store the data.

"This is where Twist Bioscience plays an important role — we write the DNA base by base, like building a Lego tower," said Angela Bitting, Twist's senior vice president of corporate affairs.

To retrieve the data, the researchers take the DNA out of its storage container and sequence it to read the A, C, T, G series. Once they have the sequence, they decode it, using the same algorithm first used to encode, back into 0s and 1s.

Why store data in DNA?

Storing digital data in DNA has advantages over storage in traditional media, including a higher capacity, increased stability and ease in copying data.

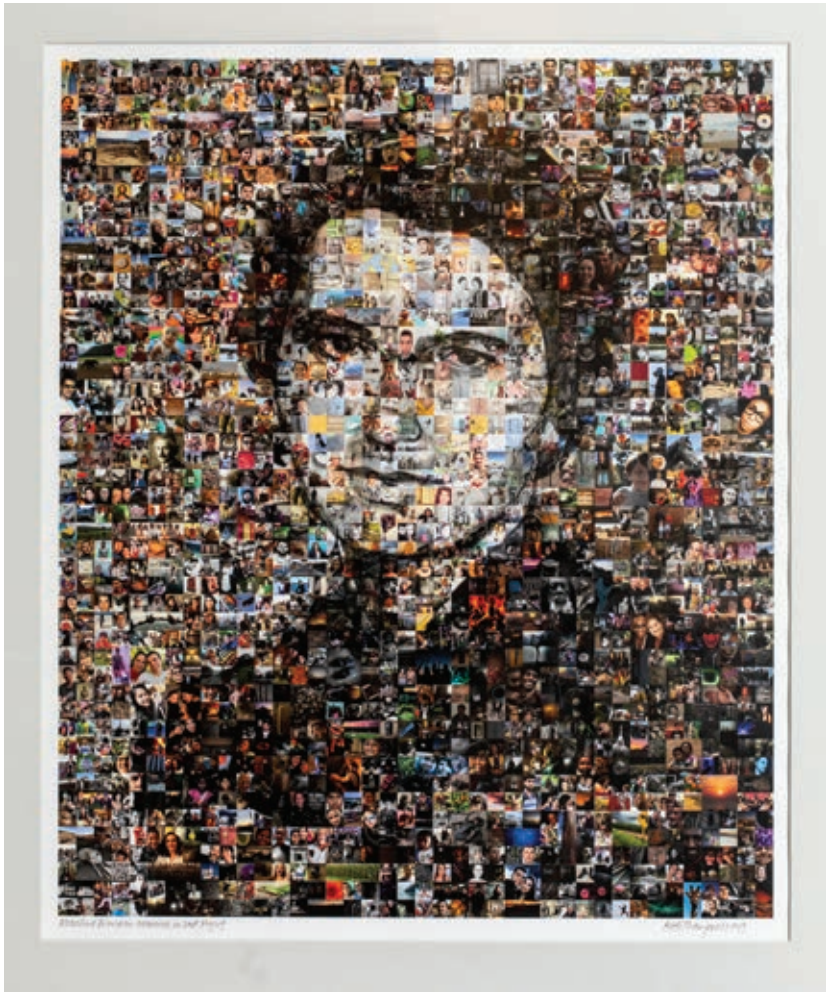
Demand for digital data storage is growing exponentially and outpacing storage capabilities. However, nature has provided a solution to this storage problem: DNA.

DNA's information storage density is six orders of magnitude higher (1018 bytes per cubic millimeter) than any other known storage technology. One kilogram of DNA can store more data than flash memory drives containing 109 kilograms of silicon.

Existing digital data archiving technologies degrade over years and must be replaced approximately every decade. In contrast, DNA can preserve information for centuries or even thousands of years — as evidenced by the DNA extracted from fossils.

The unsung hero of the double helix

Most people know about the seminal paper by Watson and Crick published in Nature in 1953 propos-



DENNIS WISE/UNIVERSITY OF WASHINGTON

English chemist and X-ray crystallographer Rosalind Franklin and one of her students created X-ray diffraction images of DNA that led to the discovery of the DNA double helix. This portrait is made up of thousands of images that have been stored on synthetic DNA.

> "Rosalind Franklin was largely responsible for uncovering the structure of DNA, nature's own perfected storage medium."
>
> – LUIS CEZE

ing the double helix model of DNA structure. But fewer know that in the same issue of Nature, a paper by Franklin and her doctoral trainee, Raymond Gosling, provided critical evidence supporting Watson and Crick's arguments. Specifically, the famous photo 51 that shows DNA is, in fact, helical.

Watson, Crick and Maurice Wilkins went on to share the 1962 Nobel Prize in physiology or medicine. The contributions of Franklin, who died four years before the Nobel announcement, only began to gain recognition decades later. Her work was highlighted in Photograph 51, a 2015 play by Anna Ziegler, which starred Nicole Kidman.

"Rosalind Franklin was largely responsible for uncovering the structure of DNA, nature's own perfected storage medium," Ceze said in the UW news release. "Her work opened up a whole new avenue of scientific research and discovery for which, to this day, she does not really get the credit that she deserves."

David Ward at work in the Molecular Information Systems Lab at the University of Washington in Seattle. The lab, a collaboration between UW and Microsoft Research, is developing techniques for long-term storage of digital data using synthetic DNA.

MARK STONE/UNIVERSITY OF WASHINGTON

#MemoriesInDNA

Once the MISL team gathered the thousands of images from more than 80 countries, they encoded them in DNA, then retrieved and converted the individual molecular files back into digital photographs.

The researchers were interested in making the project more tactile, and a chance encounter with artist Kate Thompson led them to embark on a science art journey — in this case, using the encoded memories to ensure that Franklin's contributions to the field of DNA are sealed in memory forever.

The team previously had partnered with Twist Bioscience to preserve significant cultural artforms in DNA. These include musical performances at the Montreux Jazz Festival, the top 100 books of Project Gutenberg and the Universal Declaration of Human Rights in 100 languages.

This project was different, however, and the researchers had concerns. If they put the DNA encoding the images into acrylic paint, would they be able to recover it and retrieve the digital information? What concentration of DNA is sufficient for retrieval?

"Once we had figured out the lowest working concentration of the DNA required, making the painting was practically plausible," said Jeff Nivala, an assistant professor at MISL.

The science art journey

Thompson came to the project with a long-standing interest in emerging technologies, particularly those that focus on sustainability.

During a meeting with Ceze over a glass of wine to discuss details, Thompson said, what started as a project to make a photo collage soon transformed into the elegant idea of superimposing Franklin's portrait on

top of it and encoding the full piece in DNA.

"An artist can take a complex process and turn it into metaphor that makes them real for a lay person," she said.

One challenge was to sift through piles of images that people, mostly graduate students, had submitted; this required a lot of art direction and photo editing.

"The next leap was to pick pictures and morph them into the language of Franklin's face and her story, like layering two things on each other," Thompson said. "There are so many untold stories of women in science, especially in that era, and this was a way to commemorate all of them."

After printing out the mosaic, Thompson painted the final image on archival paper with black acrylic ink mixed with a binding substance and the synthetic DNA that codes the images' information.

Measuring 40 by 30 inches, the portrait is now on display in the Bill & Melinda Gates Center for Computer Science & Engineering on the UW Seattle campus.

If any portion of the artwork is submitted to DNA analysis via polymerase chain reaction for amplification, the molecular information can be converted back to digital 0s and 1s.

The future of DNA data storage

The next breakthrough in DNA storage involves moving to data processing directly in DNA — without having to convert the images back into their electronic form. Let's say we need to find all images in the collection with a dog in them. The researchers can use a short complementary DNA strand that encodes for a dog. This complementary sequence serves as a search query that can act as a bait and bind to the sequence coding for a dog within the image — allowing researchers to fish out all images with dogs from the database.

Among the challenges to making such data storage commonplace are the current high cost and slow speed of reading and writing DNA. But the UW researchers are optimistic.

"In the next 10 years, computers may have a molecular processing unit (composed of DNA molecules) as an accessory for compute intensive jobs such as image search on a large data set," Nivala said. "This will increase efficiency not just in monetary gains but also lowering our energy footprint."

MARY BRUNO

Artist Kate Thompson works on the portrait. After sifting through all the images, she said, "The next leap was to pick pictures and morph them into the language of Franklin's face and her story, like layering two things on each other."

Ankita Arora (ankita.arora@cuanschutz.edu) is a postdoctoral fellow at the University of Colorado Anschutz Medical Campus. In her current project, she is trying to decipher rules that govern RNA transport in brain cells. Follow her on Twitter @arorankita.

A molecular biologist by day and a science artist by night

MEET BEATA MIERZWA

By Martina G. Efeyini

IFTHENCOLLECTION.ORG

Beata Mierzwa uses science art in her fashions. "What keeps me going is really the passion," she said. "I love working on something that nobody has ever seen before."

Beata Mierzwa is a postdoctoral researcher at the Ludwig Institute for Cancer Research at the University of California, San Diego. She is also an artist with a growing science art brand.

At the bench in the labs of Karen Oegema and Arshad Desai, Mierzwa studies the cell division machinery.

"I use genomewide CRISPR screens to discover new genes that are essential for these cell type-specific divisions," she said. "Uncovering such genes has the potential to identify new targets for cancer therapy, opening up new and exciting avenues to treat cancer in the future."

Through her brand, Beata Science Art, she creates illustrations for other scientists and research groups, including journal covers and art for scientific presentations.

"One thing that I really enjoy about making drawings and illustrations for other people is that it doesn't really feel like I get disconnected from science," she said. "I read a lot of scientific papers … and learn about all the amazing discoveries that are being made right now."

Using science as a tool to create art

Mierzwa was born in Poland and grew up in Austria. Her mother, who works as a makeup artist at an opera company in Vienna and creates oil paintings, taught her how to draw and paint. Her father repaired electronic devices professionally and now does engineering projects, such as building a 3D printer from scratch, on the side.

In high school, Mierzwa enjoyed crafting and learned how to sew her own clothes. But, she said, she did not know she could combine science and art in a career, so she focused solely on science.

While she was earning her combined bachelor's and master's degree in molecular biology from the University of Vienna, she interned at several laboratories. She finished her master's thesis at the ETH Zürich in Switzerland in Daniel Gerlich's laboratory and continued working in his group at the Institute of Molecular Biotechnology in Austria, where she earned her Ph.D. in molecular biology.

While working on her Ph.D., she noticed the beauty of cell division under a microscope and wanted to find a way to incorporate art into her work.

With support from her group leader and the communications department at her institute, she began working on art projects in her spare time in 2013 and recognized that art is a powerful tool for science communication.

As a scientist, she said, "Traditionally, the only kind of value you get

COURTESY OF BEATA MIERZWA

Beata Mierzwa presents her science art at an exhibit. Shown are, from left, paintings titled "Chromosome Segregation," "The Final Cut" and "CRISPR Arrow Poison."

from your scientific work is publications. Science communication is just as important; it's just not measured the same way."

She started Beata Science Art to create scientific illustrations and science-inspired clothing. She said she aims to show the beauty of cell division and communicate science across audiences.

"My biggest science art inspirations are Ahna Skop and David Goodsell, both of whom have been pioneers in bringing together art and science throughout their careers," she said. "I also admire the artists M.C. Escher and Vladimir Kush, who create surreal worlds through fusing seeming unrelated elements and imagery."

In 2017, she opened her Etsy store, which has had more than 1,300 sales and is a top-rated shop for gifts, with five out of five stars. Her best-selling items are science-themed face masks, specifically her cell-division microscopy images and drawings of chromosome segregation designs. She also sells scarves, ties, art prints and science jewelry crafting kits.

For fashions, she uses images from the microscope to create patterns to print on fabric. She said she is learning how to draw on a tablet and create animations.

"Once I started sharing my art online, people were reaching out to me — authors who want to submit a cover for their accepted manuscripts, editors from scientific journals or research groups who want to illustrate their research. Most of my commissions are drawings for journal covers that illustrate specific research papers, but sometimes I get other exciting requests too (like space mission patches or award medals). I love the variety of projects and that I get to learn something new every time," she said.

Illustrating research for clients

During the day, Mierzwa works in the lab doing experiments or data analysis (due to the pandemic, she is doing more computational work). Then, in the evenings and on weekends, she works on other projects including art and outreach.

Clients generally contact her via email for commission projects, and they discuss a timeline that will work

> "I realized people could remember my research even years after I presented it," Mierzwa said. "I realized there's a whole community about science and art; everyone is approaching it in a different way."

so she can create the science art to meet their needs.

Research is the first step in any art project Mierzwa tackles. She begins by learning about the topic in order to determine the best way to illustrate the core findings. Usually, the client sends her a manuscript to read.

After making a detailed pencil drawing on paper, she takes a high-resolution scan of the drawing and then adds the colors digitally.

So far, she has made covers for the EMBO Journal, Nature Genetics, and Molecular Biology Evolution. (See them in the gallery section of her website.)

Also, she recently presented her work at the 11th International Meeting on Visualizing Biological Data at the University of Southern California Bridge Institute.

Looking into the future

Along with using art to communicate science, one of Mierzwa's goals is to make science accessible to all, especially young girls.

She is a AAAS IF/THEN Ambassador and the vice chair of Young Women in Bio–Southern California and works with girls who are interested in science careers.

She recently released the preview of a science-themed video game that she designed. Called Microscopya, the game helps the player understand the inside of the cell. This project is funded by a grant from the American Association for the Advancement of Science IF/THEN Initiative and the American Society for Cell Biology COMPASS Outreach Grant.

"In a perfect world, I would absolutely love to continue doing both science and art … I cannot imagine stopping either of them. We will see what the future brings," she said.

To find out more about Beata Mierzwa's work, check out her website or follow her on Twitter.

Martina G. Efeyini (mefeyini@gmail.com) is a toxicologist, science communicator and advocate for the next generation of scientists. She works at the University of Maryland, Baltimore, CURE Scholars Program and is a careers columnist for ASBMB Today. Follow her on Twitter @mefeyini.

'Become the protein'

Scientists put their best feet forward for 'Dance your Ph.D.' contest

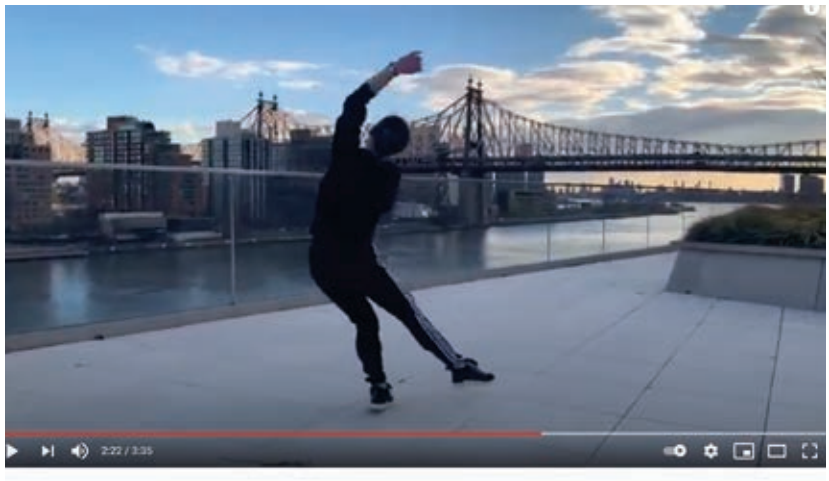
By Laurel Oldach

Gathered on a rooftop in masks, rapping about aerosol particle formation, Finnish physicist Jakub Kubečka and his team won the grand prize in this year's "Dance your Ph.D." contest.

The American Association for the Advancement of Science and Science magazine contest, now in its 13th year and with a new corporate sponsor, artificial intelligence company Primer, invited researchers from across the sciences to film a dance video explaining their dissertation research. The winners, selected by a panel of professional dancers and artificial intelligence researchers, received cash prizes of up to $2,500.

Where viewers once could expect to see troupes of scientists performing together, this year's competition looked a little different. Many entries were solo projects, and others involved masked dancers who kept a careful distance from each other. Still, scientists found fun and accessible ways to represent their work in motion: One plant biologist imagined synthesis of terpenes as a tap dancing step — and mutant plants as barefoot dancers unable to make sounds. A researcher studying invertebrate motility restyled the lyrics of a well-known Ed Sheeran song to as "Come on now, follow my cantibead."

Many biologists choreographed dances in which they played the proteins they study. As the caption in a video by entrant Rachel Leicher put it, "What do you do when your Ph.D. advisor gives you a hard project? You become the protein."



RACHEL LEICHER/YOUTUBE

Rachel Leicher, a Rockefeller University student, appears in a still from a breakdance video she filmed with lab mates and friends. Leicher studies the polycomb repressive complex, PRC2.

Leicher, a graduate student at Rockefeller University in New York, said she enjoyed watching past "Dance your Ph.D." videos and had fun choreographing her single-molecule studies of the polycomb repressive complex. One particular challenge was depicting how the complex brings nucleosomes (portrayed by Leicher's lab mates and friends) into proximity, while observing social distancing requirements. She solved the problem with a break-dancing move that let her sweep her legs toward the other dancers without approaching them.

"Yes, these (proteins) are making contacts with each other, but they're not covalently bound," she said. "Not having people physically touching might actually be more realistic."

Many biologists choreographed dances in which they played the proteins they study.

2021 "Dance your Ph.D." winners

OVERALL & PHYSICS: Jakub Kubečka, Ph.D. student at the University of Helsinki | "Formation, structure and stability of atmospheric molecular clusters"

CHEMISTRY: Mikael Minier, software engineer who recently earned his Ph.D. from the Massachusetts Institute of Technology | "Biomimetic carboxylate-bridged diiron complexes: From solution behavior to modeling the secondary coordination sphere"

SOCIAL SCIENCES: Magdalena Dorner–Pau, a postdoctoral researcher at the University of Graz, Austria | "Playful (de)scribers. Examination of performative methods for the promotion of descriptive skills of children In linguistically diverse elementary school classes using the example of image description"

BIOLOGY: Fanon Julienne, postdoctoral researcher at the University of Le Mans, Paris | "Fragmentation of plastics: Effect of the environment and the nature of the polymer on the size and the shape of generated fragments"

COVID-19: Heather Masson–Forsythe, a graduate student at Oregon State University | "Biochemical and biophysical studies of the COVID-19 nucleocapsid protein with RNA"

Leicher said that she planned to use clips from the video when she defended her dissertation in March to make the talk more accessible to nonscientists in the audience.

Krishna Zivraj–Nair, a science writer and dance teacher in England, envisioned the protein she studied when she was a graduate student, which is involved in mRNA transport in neurons, as a mother guiding her child on a journey. She cast her son as the mRNA and her daughter as the resulting protein in an imagined travel diary filmed at home during the U.K.'s second lockdown.

Heather Masson–Forsythe, a graduate student in biophysics at Oregon State University, won the COVID-19 research category with a video about the SARS-CoV-2 nucleocapsid protein, whose structure she studies using nuclear magnetic resonance, or NMR, spectroscopy. Her representation of the protein's structure and its molecular tumbling in an NMR tube is a highlight of the video.

"I knew that I wanted to show very structured versus very disordered proteins," she said. "And so I just freestyle danced being structured and stuck in one place, versus a disordered protein that had a lot of movement."

Masson–Forsythe organized the solo video like a scientific paper, with each section set in a different location and choreographed in a different dance style; for the introduction, she chose ballet, calling it "the basis of all dance," while she performed the forward-looking future directions section as a hip-hop routine.

Masson–Forsythe, who also runs a popular TikTok channel aimed at making science fun for teenagers from diverse backgrounds, said the

HEATHER MASSON–FORSYTHE/YOUTUBE

Heather Masson–Forsythe, a graduate student at Oregon State University, filmed her video about the SARS-CoV-2 nucleocapsid protein in several locations, with sequential dance styles chosen to match the flow of a scientific paper.

pandemic has made it easier to attract viewers to biochemistry-themed videos.

"That's kind of an amazing result of a terrible thing," she said, adding, "People really think it's delightful to see dancing in the lab."

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

KRISHNA ZIVRAJ–NAIR/YOUTUBE

Science writer and dance teacher Krishna Zivraj–Nair plays a transporter protein guiding her son, an mRNA, from one part of a neuron to another. Zivraj–Nair's daughter also appears in the video.

Advocacy for Black women's well-being blends science and art

By Latavia Hill

COURTESY OF SHANNON BONO

Shannon Bono, a London-based artist, began her studies as a biochemistry student and earned a master's degree in arts and sciences at Central Saint Martin's University of Art and Design.

With the goal of helping to provide accessible health care for Black women, Shannon Bono initially considered a career in medicine as an OB/GYN. A "lack of exposure to black female artists and family pressures" led her to pursue an undergraduate degree in biochemistry rather than art, she said.

During her undergraduate years, Bono determined that the best way for her to combine science with advocacy for the Black female body was through her art. Since her education always had included both the arts and the sciences, she seamlessly merged these two passions and completed a master's degree in arts and sciences at Central Saint Martin's University of Art and Design in London.

Although she decided not to study medicine, Bono maintained a strong interest in cell biology, microbiology and anatomy, and she uses this imagery "to metaphorically and sometimes literally depict what is occurring internally to the central figures" in her works, she said. Bono's parents are from Sierra Leone and the Democratic Republic of the Congo, so she also uses colors and designs from African fabrics and female figures from African artifacts in her works to pay homage to her origins. Completing

ethnographic and archival research for her artwork, she said, "has increased my intrigue with African spiritualities and my own family history."

Now a visual artist and associate lecturer at the University of the Arts London, Bono views it as her mission to educate others on the issues and successes of minority individuals, with a focus on exploring the totality of Black womanhood.

She also would like to change perceptions about art. When Bono was a master's student, she said, she looked around her art history class and noted, "There isn't much diversity." She now wishes to "help decolonize the curriculum" to ensure that all artists are represented and that nonwhite culture is appreciated. Her interest in this area is fueled by examples of Black women in history, such as Sarah Baartman, a South African Khoikhoi woman who faced brutal objectification in 19th-century Europe due to her distinct body features.

The recent Black Lives Matter worldwide protests, issues affecting transgender women in the U.S. and U.K., and the disproportionate effect that the COVID-19 pandemic has had on minority people have been the focus of Bono's 2020 series titled "Lock Down." One example is her "Say their names" piece, which pays homage to six minority women, including Breonna Taylor, who were victims of racial injustice.

COURTESY OF SHANNON BONO

Shannon Bono combines images from biology and news photos in this work titled "Na yu wan grain mi get!"

In what she describes as "attempts to decolonize the curriculum," Bono started her academic teaching practice in 2020. She recently completed a residency as a painting tutor at The Koppel Project Campus, a nonprofit providing communal studio and event spaces in central London. She also is completing a postgraduate certificate in academic practice with a focus in art, design and communication. She has been part of numerous group exhibitions, and her art has been featured in several publications.

Bono says the most rewarding part of her work is the "therapeutic de-stress" of painting and the creative process. Specifically, she enjoys spending time in her studio and trying new techniques for future artwork.

During her undergraduate years, Bono determined that the best way for her to combine science with advocacy for the Black female body was through her art.

Shannon Bono celebrates her African heritage with images of African artifacts in pieces such as this one, "Untitled (Mangbetu)."

Latavia Hill (lataviahill@ku.edu) is a graduate student studying microbiology at the University of Kansas.

ON THE WEB

See more of Shannon Bono's work on her website, bono-art.com, and on Instagram @bonoart.

Picture this

The 2nd annual JBC Methods Madness tournament

Vic De Luz

If you've ever been part of a March Madness office pool, you know the drill. Fill out your brackets to predict which National College Athletic Association basketball teams will prevail, put a dollar in the kitty, and then cringe as your brackets get busted — usually well before the Final Four.

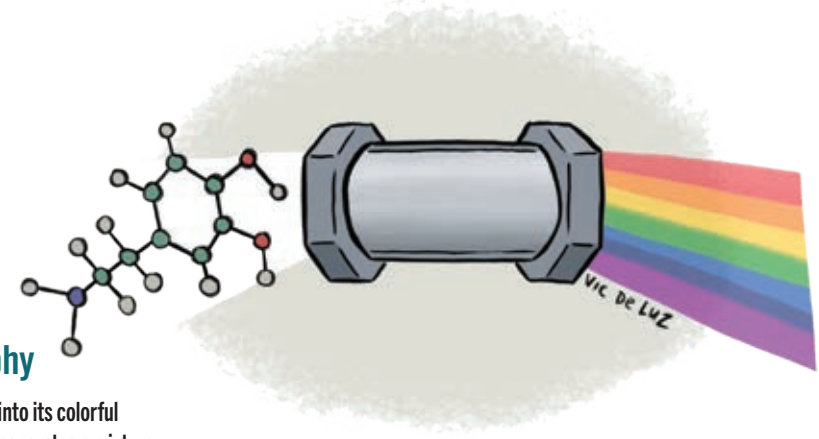
Well this is the Journal of Biological Chemistry version, so instead of teams we bring you competing scientific methods and a chance to sway the outcome with votes (and maybe some trash talk) on Twitter. As this issue of ASBMB Today goes to press, we just learned that #TeamMassSpec is the 2021 champion, beating out last year's winner, #TeamCryo-EM, in a nail-biter, every-vote-counts finish.

OK, not exactly like March Madness — but we do have some pretty adorable team mascots. Thanks to Vic De Luz, the executive assistant in the American Society for Biochemistry and Molecular Biology's publications department, our competing methods have been brought to life.

Check out De Luz's images and descriptions on these pages, and look for details of the 2021 Methods Madness tourney at asbmb.org/asbmb-today.

3D organoids

A nostalgic pair of paper anaglyph glasses highlights this organoid's 3D distinction.



Advanced chromatography

In the same way a prism divides white light into its colorful spectrum of wavelengths, chromatography separates a mixture into its components.

Advanced live-cell imaging

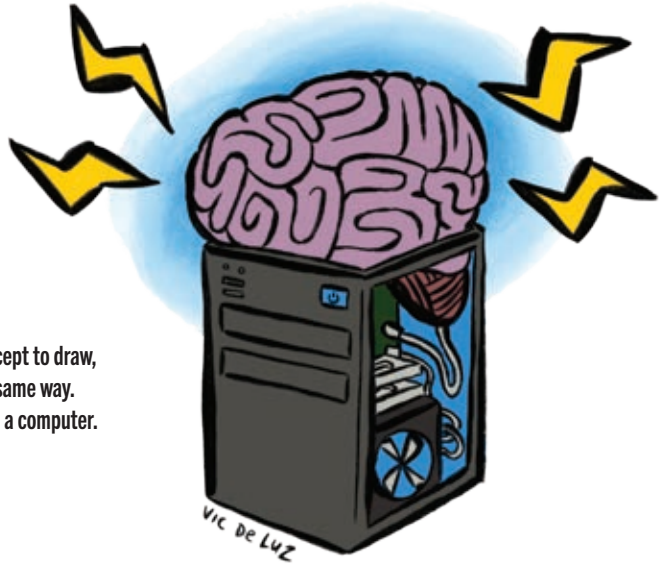
It's tough to encapsulate all the advancements in live-cell imaging in one cartoon, so this cell-fie gets at the broader concept.

Sanger sequencing

I focused on the chain termination step of Sanger sequencing here, in which the target DNA is "clipped" into fragments of various lengths.

Super-resolution imaging

I'm always enchanted by mega–high-resolution photos when I see them online. I wanted to evoke that same sense of massive scale and clarity here, even though spotting a single cell from space might be hyperbolic (for now).

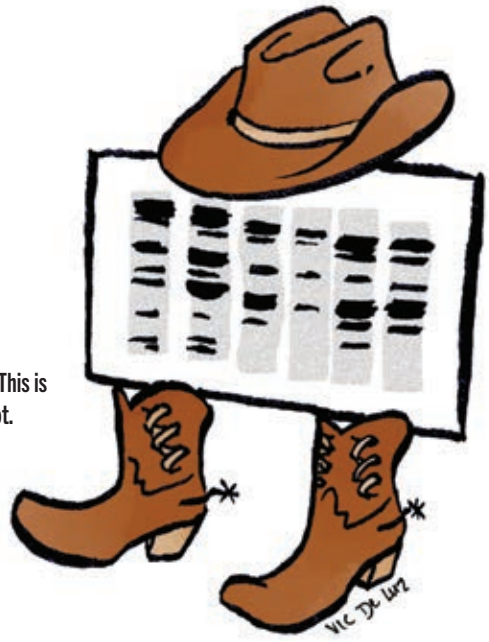


Machine learning

A self-improving algorithm is a pretty abstract concept to draw, but the human mind improves with experience the same way. Therefore, I've plugged a familiar-looking brain into a computer.

Cryo-EM

Last year's winner, cryogenic electron microscopy, is literally the coolest imaging method, represented by this icy microscope. Stay frosty, #TeamCryo!



Immunoblotting

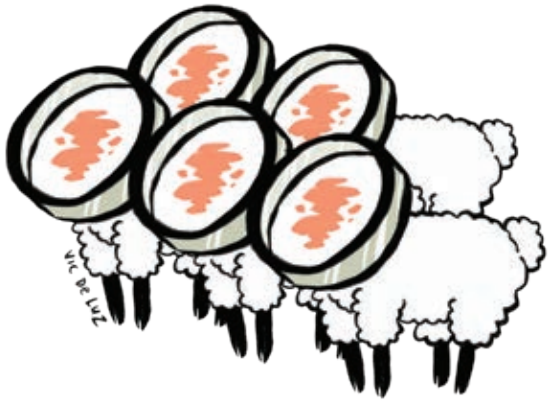
Sometimes a name demands a pun. This is one of my favorites — a Western blot.

X-ray crystallography

Possibly the cutest method mascot, this little guy has Rosalind Franklin's iconic "Photo 51" of DNA's double-helix structure as a big round eye.

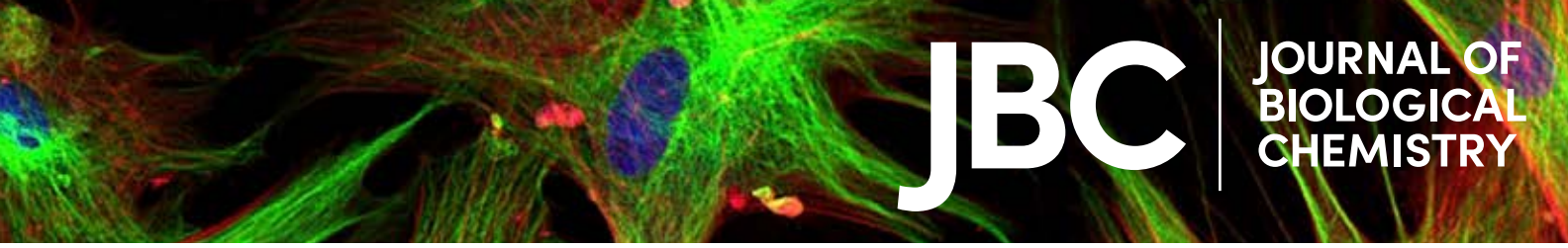
Mass spectrometry

Some of these came out more sports-mascot–like than others. #TeamMassSpec won this year's championship, making a strong comeback in 2021, just like my mass-building spectrogram here.



Molecular cloning

A lot of widely used methods in BMB seek similar goals — to differentiate this image from PCR's, I leaned on Dolly the sheep, the original cloning mascot.



EDITOR-IN-CHIEF
The Journal of Biological Chemistry

The American Society for Biochemistry and Molecular Biology welcomes nominations and applications for the position of editor-in-chief of The Journal of Biological Chemistry. The JBC publishes original research that makes novel and important contributions to the study of the molecular and cellular bases of biological processes. The next editor-in-chief should be a public-facing thought leader, a committed advocate for authors and readers, a leader who listens and delegates, and an active researcher of significant accomplishment.

Candidates should possess:

- broad, general knowledge of biological chemistry;
- strategic planning experience;
- a commitment to publishing the very best science;
- an appreciation for data-driven decision-making;
- the ability and desire to recruit outstanding scientists to serve as contributors, associate editors and editorial board members;
- a willingness to provide sustained and consistent editorial direction;
- proven interpersonal, communication, leadership and coalition-building skills; and
- scientific editorial experience.

The editor-in-chief will:

- provide visionary strategic editorial direction that continuously improves the Journal's stature,
- act as the steward of the quality of the journal's scientific content;
- engage with ASBMB senior management and elected leadership;
- establish and refine journal policies and editorial guidelines;
- lead inclusive, productive meetings for board members and associate editors;
- respond to media requests and actively participate on social media;
- cooperate with ASBMB journal staff;
- represent the journal at meetings and other venues; and
- write quarterly (or more frequent) editorials.

The editor-in-chief will serve a five-year term, with the possibility of reappointment, beginning July 1, 2021. ASBMB will provide administrative support and a stipend.

A search committee appointed by the president of ASBMB will review nominations and applications.

Nominations and applications will be reviewed until the position is filled.
Send to the ASBMB Editor-in-Chief Search Committee
c/o ASBMB Director of Publications, Isabel Casas (EICSearch@asbmb.org)

ASBMB
American Society for Biochemistry and Molecular Biology

Lessons from plants: A changing environment

By Beronda Montgomery

The following is an excerpt from Beronda Montgomery's new book, "Lessons From Plants," published by Harvard University Press.

HARVARD UNIVERSITY PRESS

I vividly remember one of the first science experiments I ever performed, when I was in kindergarten. By watching a simple bean seedling grow, I learned about the remarkable ability of plants to adapt to their environment — and now, decades later, I am still in awe at that ability. The experiment was coordinated by my kindergarten teacher, who instructed each of us to grow a bean seedling on a windowsill at home. We were to put wet cotton balls or some wet soil in the bottom of a plastic cup, add a few beans, and observe them daily. One day when I looked at my beans, I made an exciting discovery. I noticed that a crack had appeared in one of them, and a tiny root was emerging from the crack. Then, in the days that followed, a stem began to emerge from the other end of the bean, and tiny leaves unfurled. Reaching toward the sun in our window, the bean plant continued to grow.

A few weeks later, the teacher asked all of us to bring in our seedlings for show and tell. The plants, I was surprised to see, were not all the same: Some were short and stocky, while others were tall and spindly. The teacher explained that these differences depended on how much light we'd each had coming through our window. If the windowsill was shady, the plant would grow tall to try to reach the light. This was my first exposure to an essential feature of plants — that they are exquisitely attuned not just to light levels, but to a whole array of environmental conditions.

Plants are aware of light, water availability and moisture level, and nutrient abundance in the soil. They perceive changes in these factors as they scan the environment and assess what responses they need to make. Based on the information they gather, they are able to alter their behavior, morphology, and physiology in response to changes in their surroundings.

Most of us know that bean seedlings, like other green plants, use light to make food through the process of photosynthesis. But few of us know the fascinating details of how they respond to shifting light conditions. Light influences plants from the very beginning of their life cycle; while still underground, some seeds are stimulated by light to germinate. While the root follows gravity to grow downward, the shoot grows upward toward the light. The first leaves to appear are the embryonic leaves, or cotyledons. They accumulate molecules of the pigment chlorophyll, which "captures" light energy. The bean seedling's leaves appear green to the human eye because chlorophyll absorbs red and blue light, leaving the green portion of the visible spectrum to pass through or be reflected. The photoreceptors in our eyes see the

wavelengths that are not used by light-gathering photosynthetic pigments.

As the seedling continues to grow and mature, its leaves stretch toward the sun to gather photons — quanta of electromagnetic energy. Chlorophyll molecules in the leaves convert light energy to chemical energy. That energy is then used to turn carbon dioxide into carbohydrates. It is through this process of photosynthesis — the harvesting of sunlight to drive conversion of inorganic carbon, in the form of carbon dioxide, to fixed carbon, in the form of sugars — that plants make their food.

The bean's new leaves are not just passive recipients of light. They make adjustments depending on how much light they receive. But how do they measure the light? Scientists have discovered that plants are able to detect the number of photons absorbed by a unit of leaf surface area per unit of time. The rate of photons hitting the surface of a leaf affects many plant processes because it controls the rate of photosynthetic reactions; more photons means more excited electrons, which means faster reactions.

The chlorophyll molecules that are central to this calculation of photon density are contained in complex light-gathering systems, called "antennae," that trap and transport light energy to "reaction centers," where the chemical reactions take place. The efficiency with which plants collect, convert, and harness energy can easily rival any solar cell. But the bean plant in your garden can do something no solar cell can currently do — it can modify its light-gathering structures in response to dynamic external cues such as dim versus bright light, or a change in the predominance of different colors of light.

Experiments that my laboratory and others have conducted with plants and cyanobacteria — bacteria that carry out photosynthesis — reveal a remarkable ability to adjust the light-gathering system to adapt to different light conditions. If light is too dim, levels of photosynthesis can be too low to provide the organism's energy needs. But too much light exposure is also detrimental. When available light exceeds the capacity for light absorption, the excess energy can generate toxic byproducts. What a plant wants to do is to maximize light absorption while limiting damage. It does this by "tuning" its light-harvesting system to external light conditions.

Plants and photosynthetic bacteria tune their antennae in several ways. They are able to match the specific light-harvesting proteins contained in the antennae to the wavelengths of light available. They can also adjust the size of their light-harvesting complexes; these complexes become larger in low light conditions, to increase light absorption, and smaller in bright conditions, to limit potential damage. It is an intricate balance to obtain just enough but not too much light energy. Through these complex modifications of their light-gathering system, plants maximize their energy production to support essential activities.

At the same time that a newly sprouted seedling is making these adjustments within the cells, it is also adjusting its stem and leaves in an effort to maximize light absorption. The difference in height of the bean seedlings that my fellow kindergartners and I had brought to class was the result of coordinated communication between the seedlings' tissues and organs based on available light. Stem position is vitally important, since it determines the location of the leaves, and it is the leaves that absorb the light required for producing chemical energy and sugars. When the leaves sense that they are in a favorable position for receiving adequate light, they send a chemical "stop" signal to the stem, which inhibits further elongation. This process, known as de-etiolation, results in plants with short stems and well-developed leaves. If the leaves are not able to harvest enough energy because of poor light conditions, however, they send a "go" signal to the stem to elongate, with the goal of getting the leaves into better light. This process, etiolation, results in seedlings with long stems and few leaves.

Beronda Montgomery (mont133@msu.edu) is MSU Foundation professor in the departments of biochemistry and molecular biology and microbiology and molecular genetics at Michigan State University. Her lab studies how individuals perceive, respond to and are affected by their environments, including responses of photosynthetic organisms to external light cues. She is a member of the ASBMB Today editorial advisory board. Follow her on Twitter @BerondaM.

Early-career scientists need pandemic relief funds

By Sarina Neote

The COVID-19 pandemic has affected workers in every sector of the American economy. In the biomedical enterprise, early-career scientists, especially those from historically underrepresented backgrounds, have been hardest hit.

University campus closures have limited access to classrooms and labs, delaying degree and research project completion. Social distancing has made hands-on instruction and in-person collaboration impossible, slowing learning, innovation and problem-solving. Increased domestic and caregiving responsibilities have eaten up both time and mental bandwidth, especially for women.

These new challenges sit atop longstanding ones faced by early-career scientists, including limited research funding and intense job competition.

Federal science agencies are working to quantify the pandemic's effects on the education and career prospects of graduate students, postdoctoral scholars and new investigators, but in the meantime, those early-career scientists are desperate for help — and having to make difficult decisions.

BALDWIN

"It was either you had to just come into the labs and risk your safety or just end up having to lose months and months of work," said Dominique Baldwin, a third-year Ph.D. student at Indiana University. Baldwin continues to conduct research in his lab but within the limitations of social-distancing measures in place.

Early-career scientists certainly need support from their institutions and colleagues. But more importantly, they need help from the federal government, which has the most to lose if they ultimately leave the science, technology, engineering and mathematics workforce. The federal government, after all, has invested taxpayer dollars,

in the form of research grants, in their now-imperiled careers.

The American Society for Biochemistry and Molecular Biology is urging Congress to pass immediate, targeted COVID-19 relief for junior scientists. In a policy proposal released Feb. 9, the society recommended that Congress provide an additional year of funding for students and early-career researchers whose grants expired in 2020 before they could complete their training and research.

Several publications, such as a report in August by the Council of Governmental Relations and a white paper in January by the nonpartisan research organization NORC at the University of Chicago, have recommended that institutions extend deadlines for graduate students and postdocs by at least one full year after the pandemic ends, if not longer. Doing so would allow STEM students to complete high-quality research and would increase the likelihood that they'll remain in STEM fields.

But many institutions simply do not have the money to support such extensions. Without federal support, vulnerable but valuable scientists are at risk of dropping out of the biomedical workforce — at a time when they are needed most.

Negative impact on science career trajectory

According to the National Institutes of Health's COVID-19 impact survey, released in November, 65% of trainees believe the pandemic will have a negative impact on their careers.

They're not wrong.

According to the National Science Foundation, significant career gaps, such as running out of federal grant funding or delaying the completion of graduate education, could result in a significant loss of STEM talent.

Prior to the pandemic, numerous studies showed that women and minorities are pushed out of STEM fields at nearly every career transition or milestone and that women who stop doing research find it especially difficult to reenter the research enterprise.

The pandemic is exacerbating these existing challenges.

A study published in Nature Human Behavior in July found that women have been hit with a double whammy during COVID. "Female scientists and scientists with young dependents reported that their ability to devote time to their research has been substantially affected, and these effects appear additive: the impact is most pronounced for female scientists with young dependents," the authors wrote.

The COVID-19 childcare crisis has resulted in women leaving the U.S. workforce at a rate four times higher than men.

Women of color, in particular, are bearing the brunt of this public health crisis. Health disparities created and perpetuated by structural racism put them at higher risk of experiencing severe COVID-19. Not only do they have higher rates of preexisting conditions, but they also are more likely to live in multigenerational households that make social distancing and isolation difficult.

It is no surprise that they are experiencing more cases, hospitalizations and deaths and, on top of that, the biggest economic losses compared with other groups.

If these trends continue, the STEM workforce will be significantly less diverse, reversing the gains that all women, women of color specifically, and other underrepresented minorities have made in recent decades.

If Congress establishes pandemic relief funds specifically for junior women in STEM, more of them will complete their education or training and persist in the STEM workforce. The ASBMB's policy proposal strongly recommends a prioritization strategy that ensures that women of color and other minorities, specifically, get the funds they need.

Not enough time in the lab

Prior to the pandemic, scientists reported spending an average of 61 hours per week on planning experiments, collecting or analyzing data, fundraising, and other administrative or clinical duties.

New standards for research operations have redefined how scientists do their work for the past year. These include restricted access to laboratories, social distancing within labs, staggered shift scheduling and additional time required to clean lab space and equipment.

Total working hours for scientists have decreased by 11% on average, and time devoted to research itself has declined by 24%, according to the study in Nature Human Behavior.

By September, eight out of 10 postdoctoral researchers reported the pandemic had hampered their ability to conduct experiments or collect data, according to a survey of 7,670 postdocs by the journal Nature.

The graduate students ASBMB Today talked to also reported productivity declines.

MAGRINO

"The pandemic has slowed down myself and others because labs are working in shifts," said Joseph Magrino, a Ph.D. candidate studying macromolecular machines at the

University of Massachusetts Medical School. "You have to socially distance in some capacity, and that has been a major hurdle."

Others have been able to do at least some of their research from home.

Baldwin's principal investigator at Indiana University runs the medical school's proteomics core. "Because our lab is a big data-focused lab, one of the luxuries for us is that there's a lot of research time spent on a computer analyzing data," Baldwin said.

Productivity and dissemination affected

Junior scientists are having fewer interactions with their mentors and colleagues, which also reduces productivity.

It's important for junior scientists, and especially women and underrepresented minorities, to work with mentors. But as demands on everybody's time have increased during the pandemic, maintaining mentee–mentor relationships has become more difficult.

"An increasing challenge is that (your) PI — they don't need to come to campus," Magrino said. "I see my mentor mostly virtually. He used to come in every day to check in on us. And now he has a million more tasks to do."

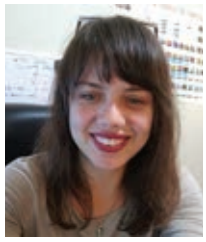
As the pandemic extends well into 2021, established scientists are figuring out how to network with junior scientists and maintain relationships that might have eroded during the pandemic. Social media, in particular, has played a crucial role in connecting scientists with one another.

However, more than half of the respondents in the Nature survey over the summer said they were finding it harder to share their work with their lab heads or colleagues. And according to the NIH impact survey, trainees were most likely to report being negatively impacted by being physically separated from colleagues.

That includes people in their own cohort. Student–student interactions facilitate learning while doing research, but social distancing requires staggered shifts in the lab.

Magrino said that for first-year graduate students, working with others in your cohort is vital to understanding challenging research papers and to overcoming roadblocks in experiments.

Julia de Amorim, a Ph.D. candidate at Emory University, agreed: "I definitely relied heavily on my classmates — not just for actual understanding of the material, but, you know, moral support."



DE AMORIM

Baldwin added: "A lot of what I've learned has been from other students in the lab. Now, there's a lot of times, if something is going wrong, I have to wait for my weekly meeting (with my PI)." He said that has caused a significant delay in his research and added stress.

Finally, graduate students and postdoctoral fellows have missed out on in-person scientific conferences at which they present their work, network with lab heads and hiring managers, and exchange ideas.

"An integral part of science is sharing science, and we did that through live talks with speakers or conferences. Now that everything is virtual, it is so hard," de Amorim said.

Grant extensions would make a real difference by giving junior scientists more time with their currently overextended PIs and members of their cohort.

If federal agencies provide grant extensions, junior scientists will have more time to work with their PIs, more time to spend collaborating and troubleshooting with members of their cohort, and more time to network and disseminate their research.

Role of federal agencies

After the U.S. Department of Health and Human Services declared a public health emergency for COVID-19 in January 2020, the NIH extended short-term administrative flexibilities to NIH applicants and recipients. Other federal funding agencies, such as the NSF and the Department of Energy, instituted similar administrative flexibilities, but few policy changes have addressed the unique challenges that junior scientists are facing.

In early February, the NIH issued a notice allowing recipients of fellowship ("F") and career-development ("K") awards to request extensions. But those extensions will be granted only "within the existing constraints of available funding."

Aside from processing daily grant payments, extending deadlines for submitting proposals, and continuing to provide stipend payments to fellows and trainees who may be unable to work as a result of COVID-19, federal agencies have few other options to support junior scientists.

As the NIH struggles to sustain funding and funding extensions for its scientists while prioritizing COVID-19 research, other fields of research are suffering.

Magrino said he is concerned about the future of funding for junior scientists who do fundamental research: "I worry that we're going to lose funding or opportunities for funding for things ... that don't have an immediate translational attribute. The basic sciences are not well-funded

anymore, from a graduate school perspective."

Terri Goss Kinzy, vice president for research and innovation at Western Michigan University and chair of the ASBMB's Public Affairs Advisory Committee, said that continuing to support basic research and the STEM workforce that conducts basic research is more important than ever.

"The COVID-19 pandemic has demonstrated the power of basic research on mRNA to drive the development of a new approach to vaccines," she said. "While we all worry about deficits and possible future spending cuts, we can all do our part to remind Congress of the importance of basic research in solving the nation's problems."

Congress should act

Federal lawmakers recognize that the scientific community needs support.

Two bills introduced in Congress would help mitigate the impact of COVID-19 on the research community: the Research Investment to Spark the Economy Act, or the RISE Act, and the Supporting Early-Career Researchers Act. But neither of these bills focuses on supporting the most vulnerable groups within the scientific community.

Re-introduced in the 117th Congress, the RISE Act, if passed, would authorize nearly $25 billion to support U.S. researchers whose non–coronavirus-related research has been affected by the pandemic. More than 300 organizations have endorsed the RISE Act, but it continues to stall in Congress as lawmakers grapple with the next COVID-19 relief package.

The Supporting Early-Career Researchers Act would authorize the NSF to establish a two-year pilot program to award grants to early-career investigators to carry out independent research programs at their institutions. While this would support future junior scientists, it would not address the impacts of the pandemic on current ones.

If junior scientists don't get the support that they desperately need, the American research enterprise is at risk of losing a vital component of the STEM workforce. This is why the ASBMB is calling for targeted COVID-19 relief for STEM graduate students, postdoctoral fellows and others in similar positions.

"Taxpayers invested in the training of the next generation of American scientists," said Benjamin Corb, the ASBMB's public affairs director. "For those junior scientists who were close to completion and were hurt by the pandemic — we owe it to them and to the enterprise to help see them through these hard times."

While supplemental funding will not solve all the challenges junior scientists are facing as a result of the pandemic, an additional year of funding would help retain talent when the American research enterprise badly needs it.

Sarina Neote (sneote@asbmb.org) is the ASBMB's science policy manager. Follow her on Twitter @SNeote.

How can we recognize and reward innovation in teaching?

By Adele J. Wolfson

Citations, and the metrics they generate, are the currency of academia. Faculty worry about h-factors, and journals about impact factors. Long ago, calculating these numbers was the work of statisticians; now they can be determined by any author or editor.

In addition to the influence these statistics have on careers, citations can open up a dialog between those citing and those cited. Whether the paper citing your work is acknowledging, refuting or building on your results, you know that your research is being read about and scrutinized. You may develop new ideas based on the papers that reference yours. This is a productive and progressive loop.

However, for one group of authors, citations fail to capture readership and, more importantly, don't allow for that dialog. Publications that describe curricular or pedagogical innovations are cited rarely, and their authors get little feedback about their impact.

Many years ago, two colleagues and I published a paper about a set of combined introduction to biology and introduction to chemistry courses. Eventually, I was approached by others thinking about such courses, but for a long time it felt like my colleagues and I were swimming against the stream, especially since some members of the departments thought that the combined course seemed like a waste of resources. It would have strengthened our argument for continuing the offering to hear that others thought it a worthwhile idea, and it might have improved our course cluster to know how other instructors were imagining their own integrated one.

I am not talking about discipline-based education research, known as DBER, or the scholarship of teaching and learning. Publications in these fields are referenced like any other type of research, although, for reasons discussed below, they still are cited less often than laboratory research. I am discussing papers that describe a new course, a new lab module, a case study or problem-based learning exercise, or any other teaching innovation that takes into account how students learn, what the noted educator Ernest Boyer called "scholarly teaching."

When instructors read these papers or find an innovation on a website such as CourseSource, they don't write a new paper that builds on the result — they introduce it in their own classes. This benefits their students but doesn't reflect back to the original authors or give them any credit.

Online metrics such as views and downloads address the question of credit to some extent. However, they do not encourage dialog between author and reader. The authors don't typically know how well the innovation worked in a new setting or how widely it spread in a department or institution.

Instructors reading and using publications about pedagogy are like physicians reading case studies — the paper may inform their own practice, but that rarely feeds back to the original author. To some extent, this is even true for DBER papers, whose findings do generate more research but also simply are incorporated into classroom methods.

Several years ago, I brainstormed with a group of librarians and educational technology types on how the relatively new field of altmetrics might improve both recognition and feedback for instructors publishing their teaching ideas. In 2013, we published a short paper in the journal Biochemistry and Molecular Biology Education about options for citation and recognition. There are, in fact, mechanisms to give credit to authors via some of these metrics, and instructors should build portfolios including these views, downloads, blog mentions and such when they are presenting credentials for reappointments, promotion and tenure.

COURTESY OF ADELE WOLFSON

Adele J. Wolfson, right, in her classroom on her last day of teaching at Wellesley College. To her left is Justin Armstrong, an anthropologist with whom she co-taught a first-year seminar titled "The Science and Culture of Blood."

For feedback, however, simple courtesy may work best. In light of our findings, I started citing the source of every assignment I used or adapted on the handouts to students and telling colleagues when I appreciated their exercises and case studies. This may not have a widespread effect, but it indicated to my own students that they should acknowledge all kinds of intellectual property in all settings, not just in formal publications. It also sometimes indicated to young scholars that I was aware of their work and could be called on for recommendations and reviews.

Some opportunities for feedback already exist, of course, at meetings for long-standing networks such as the POGIL Project (an acronym for process-oriented guided-inquiry learning), and they also occur informally at the small meetings organized by the American Society for Biochemistry and Molecular Biology and Gordon Research Conferences. Perhaps such feedback can be built formally into poster sessions and talks at meetings, both large and small, and websites with educational materials can include more space for dialog. All of this — plus any other ideas that recognize creative teaching activities alongside creative research activities — would benefit the profession.

Citations can open up a dialog between those citing and those cited. Whether the paper citing your work is acknowledging, refuting or building on your results, you know that your research is being read about and scrutinized.

Adele J. Wolfson (awolfson@wellesley.edu) is Schow professor emerita and professor emerita of chemistry at Wellesley College.

"Grad school is just the foundation"

By Laurel Oldach

Rebecca Krisher recently became the global director of reproductive biology at the agricultural biotech company Genus. She sat down virtually with ASBMB Today to talk about some surprising similarities between in vitro fertilization and animal breeding research. This interview has been edited and condensed; read a longer version at asbmb.org/asbmbtoday.

1 Tell me about the transition from the Colorado Center for Reproductive Medicine to Genus.

At CCRM, I was focused on creating better human IVF treatments, doing both very basic discovery and translational work. Here at Genus, we're also doing some basic work and some things we hope will turn into products. I'm still doing IVF but with a different purpose: to improve animal genetics for food production.

2 What's the project you're proudest to have worked on?

Human in vitro maturation. In IVM, you take the oocyte out of the follicle and hold it in meiotic arrest, then release it and let it develop. It's used extensively in cattle but not in humans.

I saw an opportunity to offer something better for patients with polycystic ovarian syndrome. Historically, you had to be careful with IVF in those patients, because triggering ovulation can cause dangerous hyperstimulation. With IVM there's zero incidence of hyperstimulation.

We were able to start from a treatment that did not exist in humans, develop and publish it in animal models, take it to a human trial, and actually see it impact people's lives.

3 What are you working on now?

The goal is to bring the entire breeding cycle in vitro and do male–female pairings without ever producing an animal: establishing stem cells, differentiating them into gametes, making an embryo, then starting again. That is a huge task. It's not going to happen in the next year or maybe even five. But it's so enticing that everybody is pretty excited about it.

4 How did you land the job?

A headhunter reached out because a lot of people had given him my name. At first, I said no. I liked living in Colorado and had reservations about big agriculture. But after 10 years at CCRM, it was time to find a new challenge. A few months later, he called back and told me about what they were trying to do and the resources they had available. I spoke with the chief scientific officer, and went through the interview process, and was impressed not only with the resources but with the really smart people. So here I am.

Rebecca Krisher

CURRENT POSITION
Global director of reproductive biology, Genus

FIRST JOB OUTSIDE OF ACADEMIA
Research director, Colorado Center for Reproductive Medicine, 2010–2020

FAVORITE MOLECULE
"Pyruvate!"

5 What's the most important skill you didn't learn in grad school?

Grad school is just the foundation of your learning. There are so many skills you learn afterward that are critical to success. A lot of them fall into the managing people category. Those are skills that I have constantly developed, often by word of mouth from colleagues.

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

CLASSIFIEDS

Postdoctoral Position Available
Department of Tropical Medicine at Tulane University

A NIH-funded postdoctoral position is immediately available to join the Scaraffia research group. Scaraffia´s lab is particularly interested in unraveling the physiological, biochemical, and molecular basis underlying the regulation of nitrogen and carbon metabolism in mosquitoes, as well as in discovering new metabolic targets that can be used for the design of better mosquito–control strategies. The successful candidate will apply traditional and modern biochemical approaches to investigate the mechanistic regulation of ammonia metabolism in Aedes aegypti mosquitoes.

Requirements

- PhD degree in biochemistry or related discipline with a strong background in protein biochemistry, and metabolic signaling
- Research experience in metabolic studies
- Documented experience in biochemical techniques including western blotting, immunoprecipitation and immunofluorescence microscopy
- Excellent communication skills and ability to work independently as well as part of a team

To apply, submit a single PDF file to mmobilliot@tulane.edu with the subject Postdoc Application and include:

(1) a cover letter describing research interests (no more than 1 page);
(2) your curriculum vitae; and
(3) contact information for three references.

Scientist, Cell Engineering, Discovery
Obsidian Therapeutics

We are looking for a scientist with a strong background in cell engineering, cell biology, or related field to contribute to building Obsidian's regulated gene editing program. The successful candidate will explore the ability to regulate the activity of gene editing proteins in cell lines and primary cells using a variety of delivery methods. This role will be highly collaborative with other members of the team and across the company to help build out a novel focus area for the Discovery team.

- Develop protocols to engineer cell lines and primary cells using transfection, lentiviral, and AAV delivery methods.
- Collaborate with the team to develop and execute assays to measure regulation of gene editing in engineered cell lines and primary cells.
- Interpret results, troubleshoot technical hurdles, and propose solutions to the team.
- Communicate with internal and external stakeholders.
- Maintain excellent records of experiments in Electronic Notebook entries.
- Collaborate across Obsidian organization to support ongoing research projects by contributing insights and presenting to project teams, management, and scientific teams.

https://careers.asbmb.org/job/scientist-cell-engineering-discovery/56304373/

Research Laboratory Manager — Sahin Lab
Boston Children's Hospital

At Boston Children's Hospital, the quality of our care – and our inclusive hospital working environment – lies in the diversity of our people. With patients from local communities and 160 countries around the world, we're committed to reflecting the spectrum of their cultures, while opening doors of opportunity for our team. Here, different talents pursue common goals. Voices are heard and ideas are shared. Join us, and discover how your unique contributions can change lives. Yours included.

A research lab manager position is available in the Sahin Laboratory. The Sahin Lab focuses on translational research in rare genetic neurodevelopmental disorders, primary Tuberous Sclerosis Complex. Position will assist in the management of financial, research and operational activities of a dynamic research laboratory.

https://careers.asbmb.org/job/research-laboratory-manager-sahin-lab/56304240/

Research Associate III / Scientist Biochemistry 1107716
stratacuity

Our Cambridge based client focused in Neurodegeneration is seeking an exceptional RA III / Scientist to join their ranks! In this role, you will be pivotal in helping to execute and drive biochemical experiments that will help generate data for go or no go decision early in the discovery life cycle. You will need to be a self driven, motivated individual to thrive in this role, with a passion for early stage discovery. Apply now to learn more!

Primary Job Responsibilities:

Work independently and as part of a collaborative team to design, plan, and execute experiments, including compound evaluation in both biochemical and cellular assays and study protein function in cellular and biochemistry/biophysics methods

Data analysis using analysis software and database

Compound handling and management

https://careers.asbmb.org/job/research-associate-iii-scientist-biochemistry-1107716/56304089/

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

ASBMB '21
ANNUAL MEETING

The 2021 ASBMB Annual Meeting will be virtual!

Join us April 27–30

SESSIONS AT THE 2021 ASBMB ANNUAL MEETING

Deepen your knowledge of research trends during sessions curated by pioneers and innovators at the ASBMB Annual Meeting, held in conjunction with Experimental Biology.

SESSION TRACKS:

- Biochemistry of lipids and membranes
- Glycosylation and extracellular matrix in development, repair and disease
- Molecular mechanisms of cell signaling
- Molecular machines — structure and function
- New developments in metabolism
- RNA and disease
- Understanding the rules of life
- Education and professional development

See all sessions and register at:
asbmb.org/meetings-events/2021-annual-meeting

The ASBMB annual meeting is held in conjunction with Experimental Biology.

EB Experimental Biology