'On the same wavelength'
2015 CALLS FOR SUBMISSIONS

HOBBIES

We know that a life in science can be grueling. We also know that some of you have very interesting or unusual ways of blowing off steam or finding your Zen. We would like to feature your essays, poems, artwork or multimedia reflecting on scientists’ pastimes. We welcome all creative interpretations of the theme. You could send us a photo of you shooting hoops or jumping out of an airplane. You could send us a video of you jamming with your band. You could send us a poem about a childhood hobby or otherwise abandoned escapes. You could write about a hobby enjoyed by someone else — perhaps a figure in science history or one of your mentors. And you could send us a rant about how you don’t have time for such frivolity.

GENERATIONS

This collection of essays, poems and artwork will explore generations in a very loosely defined way. You might have come from a family of scientists. You might have insights about parenting while doing science. You might have a story to tell about a line of researchers mentored by one scientist. Interpret the theme as you will. It is not a boundary but rather a springboard for the making of meaning.


FORMAT: We’ll print some; others, we will post online. Some might appear both in print and online.

SUBMISSIONS: Email (to asbmbtoday@asbmb.org) your manuscripts as Word documents, static images as JPEG or TIFF files (the higher the resolution the better), audio as mp3 or mp4 files, and videos in something like QuickTime, Vimeo or YouTube. Please indicate to which series you are submitting in your email subject line.

PRESIDENT’S MESSAGE

Down but not out

NEWS

ASBMB annual award winners

NEWS FROM THE HILL

Water, water everywhere — and not a drop to drink

MEMBER UPDATE

JOURNAL NEWS

Report highlights nonacademic careers of STEM Ph.D. holders

NIH UPDATE

NIH launches a public website for bioscientific 3-D printing

ESSAY

‘ON THE SAME WAVELENGTH’

A TALE OF FRIENDLY FRUIT FLIES IN A JAM

Author of new children’s book hopes cute and curious cast of characters will ignite appreciation for model organisms

MINORITY AFFAIRS

Q&A with Pumtiwitt McCarthy

PROFESSIONAL DEVELOPMENT

40  Looking beyond the lab
42  Moving into administration: Is it really that difficult?

OUTREACH

The CASE for informal science education

OPEN LETTERS

An open letter to press officers who won’t promote unembargoed research papers
M y colleague George DeMar-
rimo at the University of
Texas Southwestern Medical
Center at Dallas told me a humorous
story that indicates the devoted
state of our beloved field of biochemistry.
George uses biochemical approaches to
study the proteome, including standard
methods of protein purification.
While interviewing a prospec-
tive postdoctoral candidate, George
explained how he routinely purifies
the proteome, starting with bovine
blood taken from a local slaughter-
together. As the interview progressed,
the applicant lauded George on his
ability to study the purified macro-
molecular machine and stumbled into
the telling question of the interview:
“Thats really cool, but how did you
get the His tag into the cow? ”

It is the unfortunate case that few
of our trainees have any clue about
ammonium sulfate cuts, differential
centrifugation or column chromatog-
raphy. Young scientists instead think
affinity-precipitation of a tagged,
overexpressed protein constitutes
“biochemistry.”

Few would dispute that our field
is one of fashion. What is the in-vogue
science that obscures biochemistry
like a full eclipse of the sun? Topping
the list is the big data science evolving
from genomics.
The ever-expanding iterations of
-omics research offer limitless access
to data. The challenge of gathering
fresh data used to be difficult; now
its a piece of cake. I venture to guess
that the amount of data gathered and
published by the ENCODE consor-
tium last year might, in aggregate,
constitute a larger amount of data
than what has been accumulated
in the entire history of the field of
biochemistry.

There are two wonderful things
about the gathering of huge data sets.
First, it is not-fail science. If I tell a
trainee to immunopurify fragmented
chromatin with an antibody to one
of our transcription factors and then
have our genomics core sequence
the precipitated DNA, the experi-
ment will work every time. What a
deal it is to carry out fail-safe experi-
ments! Second, the top-tier journals
cannot get this sort of research up as if it
were $1,000-per-ounce caviar. Those
of us who have stuck with difficult
and uncertain biochemical research
are viewed as village idiots — how
could we be so stupid not to see the
light?

A friend Deepak Nijhawan
offered a visual correlate of big data
science. When we take our kids to
a venue offering a variety of arcade
games, they gravitate to the game
that consists of a claw that can be moved
in X, Y and Z dimensions by a joy-
stick. Below the claw lies a carpet of
stuffed animals that may have cost less
thousand attempts, the reward is a
prize! Even if the claw wins once in a
finite number of quarters for noth-
ing. Even if the claw wins once in a
thousand attempts, the reward is a
stuffed animal that may have cost less
than what has been accumulated
in the entire history of the field of
biochemistry.

M y colleague George DeMar-
rimo at the University of
Texas Southwestern Medical
Center at Dallas told me a humorous
story that indicates the devoted
state of our beloved field of biochemistry.
George uses biochemical approaches to
study the proteome, including standard
methods of protein purification.
While interviewing a prospec-
tive postdoctoral candidate, George
explained how he routinely purifies
the proteome, starting with bovine
blood taken from a local slaughter-
together. As the interview progressed,
the applicant lauded George on his
ability to study the purified macro-
molecular machine and stumbled into
the telling question of the interview:
“Thats really cool, but how did you
get the His tag into the cow? ”

It is the unfortunate case that few
of our trainees have any clue about
ammonium sulfate cuts, differential
centrifugation or column chromatog-
raphy. Young scientists instead think
affinity-precipitation of a tagged,
overexpressed protein constitutes
“biochemistry.”

Few would dispute that our field
is one of fashion. What is the in-vogue
science that obscures biochemistry
like a full eclipse of the sun? Topping
the list is the big data science evolving
from genomics.
The ever-expanding iterations of
-omics research offer limitless access
to data. The challenge of gathering
fresh data used to be difficult; now
its a piece of cake. I venture to guess
that the amount of data gathered and
published by the ENCODE consor-
tium last year might, in aggregate,
constitute a larger amount of data
than what has been accumulated
in the entire history of the field of
biochemistry.

There are two wonderful things
about the gathering of huge data sets.
First, it is not-fail science. If I tell a
trainee to immunopurify fragmented
chromatin with an antibody to one
of our transcription factors and then
have our genomics core sequence
the precipitated DNA, the experi-
ment will work every time. What a
deal it is to carry out fail-safe experi-
ments! Second, the top-tier journals
cannot get this sort of research up as if it
were $1,000-per-ounce caviar. Those
of us who have stuck with difficult
and uncertain biochemical research
are viewed as village idiots — how
could we be so stupid not to see the
light?

A friend Deepak Nijhawan
offered a visual correlate of big data
science. When we take our kids to
a venue offering a variety of arcade
games, they gravitate to the game
that consists of a claw that can be moved
in X, Y and Z dimensions by a joy-
stick. Below the claw lies a carpet of
stuffed animals that may have cost less
thousand attempts, the reward is a
prize! Even if the claw wins once in a
finite number of quarters for noth-
ing. Even if the claw wins once in a
thousand attempts, the reward is a
stuffed animal that may have cost less
than what has been accumulated
in the entire history of the field of
I n years past, there has been a healthy line of strong voices supporting the research community, and those backers have followed up their talk with action by increasing funding at agencies like the National Institutes of Health. Take, for instance, Newt Gingrich, the former speaker of the U.S. House of Representatives, and U.S. Rep. John Porter, both Republicans who played essential roles in orchestrating the doubling of the NIH budget in the early 2000s. And then there was U.S. Sen. Arlen Specter, the Republican-turned-Democrat who single-handedly fought for $10 billion in federal stimulus funds for the NIH in 2009. These members of Congress valued federal investment in the research enterprise and provided tangible results that shaped the research community into what it is today.

More recently, however, the bench of real champions for research has grown rather thin.

U.S. Rep. Rosa DeLauro, an outspoken Democrat from Connecticut and a cancer survivor, is among the loudest and strongest NIH supporters on Capitol Hill. Sadly, DeLauro works in the House of Representatives, which has reached a point of near uselessness, as partisan politics and unwillingness to compromise rule the day. Republican U.S. Sen. Jerry Moran from Kansas also has shown sincere interest in supporting funding for the NIH and even has proposed funding increases (hereby to many in his party) but has yet to reach a position of authority to follow his well-intended proposals with results.

The 535 members of Congress represent Americans from all walks of life, and I spend much of my professional life talking with these lawmakers and their staff members about the importance of supporting and funding biomedical research. The more time I spend talking with them, the more I become convinced that biomedical research is just not a priority for them. Certainly, you’d be hard-pressed to find a member of Congress who is against biomedical research or against increasing the NIH budget, but it’s a lot harder to find someone actually willing to fight for either. And the reason is simple. They’re not hearing from their constituents that research and research funding are important issues worth fighting for.

These observations underscore the need for scientists to build stronger relationships with their elected officials. Why am I putting the onus on you with your elected officials as part of the ASBMB 50-State Challenge? Because you are the constituents! You have the ears of your representatives. Whether your representative is giving speeches about immigration reform, fiscal responsibility or anything else, it’s because that person’s constituents have conveyed the message that those topics are important. And as much as I’d like for members of Congress to follow through on their talk by funding research, it’s the scientist-constituents who have to pressure elected representatives into putting their money where their mouths are.

Scientists must help lawmakers understand the importance of fund-
The American Society of Plant Biologists named two members of the American Society for Biochemistry and Molecular Biology as recipients of its 2014 awards, honoring excellence in research, education, outreach and service.

James N. Siedow of Duke University won the Lawrence Bogorad Award for Excellence in Plant Biology Research in recognition of his many contributions to plant biology. His work has illuminated new paths of research in plant hormone signaling and has propelled discoveries in plant transcriptional regulation, viral replication and auxin biology. In recognition of the prestige of this lectureship, the American Society of Plant Biologists named two members of the American Society for Biochemistry and Molecular Biology as recipients of its 2014 awards, honoring excellence in research, education, outreach and service.

James N. Siedow of Duke University won the Lawrence Bogorad Award for Excellence in Plant Biology Research in recognition of his many contributions to plant biology. His work has illuminated new paths of research in plant hormone signaling and has propelled discoveries in plant transcriptional regulation, viral replication and auxin biology. In recognition of the prestige of this lectureship, the American Society of Plant Biologists named two members of the American Society for Biochemistry and Molecular Biology as recipients of its 2014 awards, honoring excellence in research, education, outreach and service.

James N. Siedow of Duke University won the Lawrence Bogorad Award for Excellence in Plant Biology Research in recognition of his many contributions to plant biology. His work has illuminated new paths of research in plant hormone signaling and has propelled discoveries in plant transcriptional regulation, viral replication and auxin biology. In recognition of the prestige of this lectureship, the American Society of Plant Biologists named two members of the American Society for Biochemistry and Molecular Biology as recipients of its 2014 awards, honoring excellence in research, education, outreach and service.

James N. Siedow of Duke University won the Lawrence Bogorad Award for Excellence in Plant Biology Research in recognition of his many contributions to plant biology. His work has illuminated new paths of research in plant hormone signaling and has propelled discoveries in plant transcriptional regulation, viral replication and auxin biology. In recognition of the prestige of this lectureship, the American Society of Plant Biologists named two members of the American Society for Biochemistry and Molecular Biology as recipients of its 2014 awards, honoring excellence in research, education, outreach and service.

James N. Siedow of Duke University won the Lawrence Bogorad Award for Excellence in Plant Biology Research in recognition of his many contributions to plant biology. His work has illuminated new paths of research in plant hormone signaling and has propelled discoveries in plant transcriptional regulation, viral replication and auxin biology. In recognition of the prestige of this lectureship, the American Society of Plant Biologists named two members of the American Society for Biochemistry and Molecular Biology as recipients of its 2014 awards, honoring excellence in research, education, outreach and service.

James N. Siedow of Duke University won the Lawrence Bogorad Award for Excellence in Plant Biology Research in recognition of his many contributions to plant biology. His work has illuminated new paths of research in plant hormone signaling and has propelled discoveries in plant transcriptional regulation, viral replication and auxin biology. In recognition of the prestige of this lectureship, the American Society of Plant Biologists named two members of the American Society for Biochemistry and Molecular Biology as recipients of its 2014 awards, honoring excellence in research, education, outreach and service. 

James N. Siedow of Duke University won the Lawrence Bogorad Award for Excellence in Plant Biology Research in recognition of his many contributions to plant biology. His work has illuminated new paths of research in plant hormone signaling and has propelled discoveries in plant transcriptional regulation, viral replication and auxin biology. In recognition of the prestige of this lectureship, the American Society of Plant Biologists named two members of the American Society for Biochemistry and Molecular Biology as recipients of its 2014 awards, honoring excellence in research, education, outreach and service.

Jerry Roder, a leader in human genetics of lipoprotein biology and cardiovascular disease, was named the new chair of the Perelman School of Medicine's genetics department at the University of Pennsylvania. He has been at Penn for 20 years and holds multiple leadership roles there. In addition to heading the Division of Translational Medicine and Human Genetics, Roder serves as associate director of the Institute for Translational Medicine and Therapeutics and co-directs the new Penn Medical BioBank. Roder has a long interest in Mendelian disorders of lipoprotein metabolism and has a strong translational interest in development of novel therapies for these disorders. Along with numerous awards as a physician-scientist, he has received recognition for his outstanding teaching.

Berkeley Lab’s Arkin wins Lawrence Award

Biologist Adam Arkin, director of Berkeley Lab’s Physical Biosciences Division, is one of six recipients of the 2013 Ernest Orlando Lawrence Award presented by U.S. Energy Secretary Ernest Moniz. He is recognized as a leading authority on the evolutionary design principles of cellular networks and populations and their application to systems and synthetic biology. The thrust of Arkin’s research has focused on developing physical theory, computational tools and experimental approaches for understanding the cellular processes that are critical to life. The goal is to provide a framework that will facilitate the design and engineering of new functions and behaviors in cells through synthetic and systems biology. The Department of Energy’s E.O. Lawrence Awards were established in 1959 to honor Ernest Lawrence, the Nobel Prize-winning inventor of the particle accelerator known as the cyclotron. Moniz said that the recipients made significant contributions to the national, economic and energy security of the United States, strengthening U.S. leadership in discovery and innovation. Each recipient will receive a medal and a $20,000 honorarium at a ceremony in Washington, D.C., later this year. Image courtesy of Peg Skorpinski.

Neet appointed to FASEB finance committee

Kenneth Neet recently was appointed to the finance committee of the Federation of American Societies for Experimental Biology. Neet is a professor and the associate dean of research at the Rosalind Franklin University of Medicine and Science in Illinois. Neet, who studies neurobiology, has served on the editorial boards of many science journals and as a member of study sections for the National Institutes of Health and the National Science Foundation. In addition, he served many years as an associate editor for the ASMB’s Journal of Biological Chemistry.

Varshavsky wins Albany Medical Center prize

Alexander Varshavsky is the 2014 recipient of the Albany Medical Center Prize in Medicine. The $500,000 award, given annually since 2001, is one of the largest prizes in medicine and science in the United States. Varshavsky is a professor of cell biology at the California Institute of Technology. The focus of his research is the ubiquitin system. He received this award for his landmark discoveries that have transformed our understanding of how cell behavior affects diseases, including cancer, autoimmune disorders and other illnesses.

O’Shea to receive Ross Prize in Molecular Medicine

John J. O’Shea, scientific director at the National Institute of Arthritis, Musculoskeletal and Skin Diseases, has been named the 2014 recipient of the Ross Prize in Molecular Medicine. The award, which includes a $50,000 prize from Feinstein Institute board members Robin and Jack Ross, was given on June 9 at the New York Academy of Sciences in Manhattan. The award is given to an active investigator who has produced innovative, paradigm-shifting research that is worthy of significant and broad attention in the field of molecular medicine. O’Shea has been a physician and immunologist at the NIH for 33 years and has made fundamental discoveries related to the signaling of cytokines. His research has focused on the molecular cause of primary immunodeficiencies, inherited conditions in which the immune function is impaired and the genetic basis of autoimmunological disorders. O’Shea has received numerous awards and is a fellow of the American Association for the Advancement of Science.

IN MEMORIAM: Ivana Weygan–Durasevic

Ivana Weygan–Durasevic passed away April 7 in Zagreb, Republic of Croatia. Born in 1952, Weygan–Durasevic studied chemistry and molecular biology at the University of Zagreb. She joined the university as a faculty member in 1975 and was an internationally recognized expert in the field of tRNA and aminoacyl-tRNA syntheses, molecules involved in protein biosynthesis. During her career, she authored more than 70 papers and four book chapters, and in 2005 she received the highly prestigious Croatian National Science Award. Her excellent scientific and teaching career earned her election into the Croatian Academy of Sciences and Arts in 2012. Weygan–Durasevic is remembered by colleagues as a dedicated teacher, supportive mentor, and collaborator for renowned and internationally recognized scientists. Written by Nicole Parker
‘Nature’s escape artists’

Thematic series explores the various functions and applications of intein-mediated protein splicing

By Jenna Hendershot

Post-translational protein splicing occurs when intervening intein polypeptides excise themselves from larger precursor proteins and ligate their surrounding polypeptides, known as extins. This is accomplished by a multistep enzymatic reaction mediated by the intein. Sometimes called “nature’s escape artists,” inteins are proteins that have been found in microorganisms from all domains of life.

Even though the first intein sequence was published 25 years ago, details of the splicing mechanism are just beginning to be elucidated. Inteins have fascinated scientists for years, and they have been shown to have a wide variety of applications in protein engineering and drug discovery. A new thematic miniseries on intein-mediated protein splicing appears in the recent issue of The Journal of Biological Chemistry.

In the first minireview, Olga Novikova, Natalya Topilina and Marlen Bystrov discuss the overall function of inteins and the sporadic distribution of inteins among closely related species. In addition, inteins normally are located at protein active sites or in key ligand-binding surfaces. While the rationale for intein localization is still a matter of debate, the authors mention the importance of intein retention. Improper removal of an intein within a conserved protein motif would be deleterious and therefore ensures retention of an active intein for viability of the host. Understanding the evolution and distribution of inteins will shed light on the possibility that inteins function as unique regulatory elements.

In the second minireview, Kenneth V. Mills, Margaret A. Johnson and Francine B. Perler focus on the wide variety of splicing mechanisms. Inteins have evolved to regulate tightly the steps of splicing; however, inteins don’t use a universal mechanism. This review discusses the general strategies for catalysis and the roles of various amino acids during splicing. While the basic steps in protein splicing have been known since the 1990s, how the reactions are coordinated is still unknown. Detailed kinetic and structural studies are needed of multiple inteins to determine whether catalytic strategies are universal or specific to a subset of inteins.

Ertan Eryilmaz, Neel Shah, Tom Muir and David Cowburn explore in the third minireview the structural features of inteins and the variability in splicing mechanisms. While all inteins share the same fold and have highly conserved sequence motifs, inteins have surprisingly different splicing efficiencies. This review describes the structural basis of protein splicing, intein dependence on extins for protein splicing and distal mutations that affect protein splicing. Allosteric networks, the authors conclude, may play a larger role in determining intein activity than previously thought, because mutations distal from the active site can modulate intein activity.

In the final minireview, David W. Wood and Julio A. Camarero share advances in the applications of inteins. Early engineered inteins were used in protein purification, but now optimized trans-splicing and trans-cleaving inteins have enabled a wide variety of applications in protein labeling, metabolic engineering, biomaterials construction, intein-based biosensors, gene delivery and protein cyclization. These new techniques allow specific control over biological functions of proteins in living cells, plants and whole animals. Future applications will build on these techniques and promise to reveal new classes of therapeutic proteins.

The four minireviews in this series help to broaden our thinking about protein splicing. In an editorial commentary, Perler and Norma M. Allewell conclude that significant progress has been made to better understand intein mechanisms; however, there are still many unanswered questions. While evolutionary biologists question whether inteins are selfish elements and biochemists seek to understand how inteins work, intein-mediated protein splicing creates new opportunities to move scientific areas. The numerous intein applications have huge potential for modifying, synthesizing and controlling protein function in the future.

The intricacies of the calcium ion-binding motif in the βγ-crystallin domain

By Emily Tsai

What do a bacterial spore coat and a human eye lens have in common? For one, the presence of βγ-crystallins. The βγ-crystallins are a superfAMILY of Ca2+-binding proteins, grouped on the basis of their characteristic Greek key topology that share a calcium-binding motif. Because the Ca2+-binding motif is evolutionarily conserved, learning more about it in bacteria could improve our understanding of it in other domains of life. In the Journal of Biological Chemistry, biophysicist Yogendra Sharma and his group at the Centre for Cellular and Molecular Biology in India review the intricacies of the Ca2+-binding motif in the βγ-crystallin domain. The authors cover the architecture of the Ca2+-binding motif and Ca2+-coordination, paying special attention to Ca2+-coordination by the signature sequence residues of the Ca2+-binding sites. In the crystal structure of a typical βγ-crystallin, such as Chlorella from the bacterium Clostridium beijerincki, two Greek key motifs together form the Ca2+-binding sites.

The pioneering Greek key motifs share one β-strand (out of four). On top of the domain lie two (N/D)-(X)-(S) sequence stretches that connect the third and fourth strands from their respective Greek key motifs. Each calcium ion is coordinated by residues from both sequence stretches and the β-hairpin loop between the first and second β-strand. In a βγ-crystallin domain, the Ca2+-binding site generally has a coordination number of seven, including four protein ligands and three water molecules, and forms a pentagonal bipyramidal geometry. Ca2+-coordination is mediated via second, third and fifth residues of the (N/D)-(N/D)-(X)-(X)-(S) stretch, along with one residue of the β-hairpin, while the first residue of the (N/D)-(N/D)-(X)-(X)-(S) stretch may play a role in stabilizing the pocket through hydrogen bonding. Meanwhile, the fourth residue of the stretch is involved in forming a hydrophobic core. Ca2+-binding is important for stabilizing the βγ-crystallin domain.

The ever-rising worldwide incidence of metabolic diseases, such as obesity and type 2 diabetes, has made them an important target for researchers. The therapeutic options available so far are rather scarce. Endoplasmic reticulum, or ER, stress, the focus of studies for two decades already, appears to be intimately involved, making it a good candidate for pharmacologic interventions. In a minireview recently published in the Journal of Biological Chemistry, researchers Jaemin Lee and Unnurt Ocan at Boston Children’s Hospital detail the correlation between ER stress and metabolic changes, highlighting some plausible therapeutic solutions.
Energy generation in prokaryotic and eukaryotic organisms is a highly efficient, multistep and tightly regulated process. Normally, glucose is metabolized initially via the glycolytic pathway, generating pyruvate and small amounts of ATP. To harness the full energy content of glucose, pyruvate undergoes further oxidation in the Krebs cycle, generating large amounts of ATP required for cellular functions. The key enzyme complex bridging these two processes is known as the pyruvate dehydrogenase complex, or PDC, and is the subject of a minireview published in the Journal of Biological Chemistry recently.

In this review, Mukuland S. Patel and colleagues have combined the latest developments in PDC research, compared PDC structural and regulatory mechanisms in bacteria and in humans, and considered their implications on human health. Patel, a distinguished professor and associate dean at the State University of New York at Buffalo, and Frank Jordan, a professor at Rutgers University, Newark, have collaborated for several years to understand the evolutionary changes leading to the functioning of these multienzyme complexes, have used novel methods to identify different steps in the catalytic reactions, and have elucidated high-resolution structures of several PDC component proteins. PDC is composed of three distinct catalytic enzymes, namely pyruvate dehydrogenase, dihydroxyacid dehydrogenase, and glycine dehydrogenase, which work in tandem to convert pyruvate into acetyl-CoA, CO₂, and NADH (F₁).

Acetyl-CoA is then used as a substrate for biosynthetic processes, such as lipid formation. The unique interaction of these components in the complex ensures efficiency as well as regulatory mechanisms underlying glycolytic flux.

Glycolytic flux is regulated during the initial steps of glycolysis, including glucose uptake and phosphorylation. Phosphorylation of glucose is carried out by hexokinase. While all cells express at least one hexokinase with extremely high affinity for glucose, select cell types, including liver and pancreatic β cells, also express glucokinase, which has a much lower affinity for glucose. The unique kinetic properties of glucokinase allow it to act as a glucose sensor and translate changes in blood-glucose levels into changes in glycolytic flux. It long has been thought that glucokinase function is weakly regulated. However, in the past few decades, a number of studies have begun to demonstrate that glucokinase activity is not only regulated, but it is regulated differently in different cell types. For example, in the liver, glucokinase is inhibited by G6P, a nuclear protein that selectively binds and inactivates glucokinase during starvation. Gluco- kinase also is inhibited in β cells, although that is done by ubiquitin and ubiquitin-binding proteins, as the activity of human PDC is tightly regulated by tissue-specific kinases and phosphatases, which respond to different nutritional and disease states. For example, some cancer cells have activated levels of the kinase I, resulting in inhibition of PDC, which is not favorable for normal cells but is suitable for cancer-cell survival and growth. By studying structural and compositional aspects of the human PDC and its regulation, one can exploit mechanistic differences for therapeutic advantages to combat cancer and other human diseases.

Pyruvate dehydrogenase complex
From energy generation to novel drug target
By Alok Upadhyay

Glycolysis is a fundamental metabolic pathway that is critical for the production of energy. Glycolytic flux, or the rate at which molecules proceed through the glycolytic pathway, is tightly regulated in response to the cellular environment. In a recent minireview in the Journal of Biological Chemistry, Sigurd Lenzen of the Hannover Medical School in Germany describes the complex regulatory mechanisms underlying glycolytic flux. Glycolytic flux is regulated during the initial steps of glycolysis, including glucose uptake and phosphorylation. Phosphorylation of glucose is carried out by hexokinase. While all cells express at least one hexokinase with extremely high affinity for glucose, select cell types, including liver and pancreatic β cells, also express glucokinase, which has a much lower affinity for glucose. The unique kinetic properties of glucokinase allow it to act as a glucose sensor and translate changes in blood-glucose levels into changes in glycolytic flux. It long has been thought that glucokinase function is weakly regulated. However, in the past few decades, a number of studies have begun to demonstrate that glucokinase activity is not only regulated, but it is regulated differently in different cell types. For example, in the liver, glucokinase is inhibited by G6P, a nuclear protein that selectively binds and inactivates glucokinase during starvation. Gluco- kinase also is inhibited in β cells, although that is done by ubiquitin and ubiquitin-binding proteins, as the activity of human PDC is tightly regulated by tissue-specific kinases and phosphatases, which respond to different nutritional and disease states. For example, some cancer cells have activated levels of the kinase I, resulting in inhibition of PDC, which is not favorable for normal cells but is suitable for cancer-cell survival and growth. By studying structural and compositional aspects of the human PDC and its regulation, one can exploit mechanistic differences for therapeutic advantages to combat cancer and other human diseases.
Use your bean (and grain)

Substituting legumes and whole grains for rice can decrease activity of enzyme promoting atherosclerosis

By Mary L. Chang

A new study detailed in the August 2014 issue of the Journal of Lipid Research suggests substituting whole grains and legumes in place of processed, refined rice can reduce the activity of an enzyme implicated in atherosclerosis while also improving control over blood-sugar levels.

In a study conducted at Yonsei University in Seoul, South Korea, researchers randomly split into two groups of patients with impaired fasting glucose or who had been diagnosed recently with type 2 diabetes. Participants in one group were instructed to replace rice in their diet with a mixture of black soybeans, barley and brown rice for three meals a day for 12 weeks.

Researchers observed significant decreases in fasting glucose, insulin and other markers of metabolic disease, while participants in the other group were allowed to consume their usual diet dominated by refined rice, while those participants had more proteins involved in nutrition, development, and molecular transport, antioxidant activity and the cytoskeleton. These proteins could be responsible for the final formation of organs.

As you can see, the study gives researchers an idea of the processes happening at the different stages of embryonic development. Scientists now can use the data to see if particular processes lend themselves well to creating genetically modified honeybees, an active area of research.

CONTINUED FROM PAGE 11

GRP is not expressed in those cells. While glucokinase activity is important for initiating flux, the most crucial steps in glycolytic-flux regulation are the two fructose steps. These steps, which are carried out by phosphofructokinase/fructobisphosphatase isoenzymes to produce fructose ester products, form a regulatory unit. Both the enzymes that participate in these steps and the products that are formed influence glycolytic flux at multiple levels. For example, the activity of PFK1 is responsible for establishing the glycolytic oscillations that drive insulin secretion. Additionally, the fructose ester products are allosteric regulators of glycolysis, as they can inhibit the FBPases and promote glucose catabolism.

As research in the past 50 years has continued to demonstrate, the mechanisms of regulation of glycolysis are more complex than initially thought. Significantly, movement through the glycolytic pathway is regulated on multiple levels by the enzymes that function in the pathway and by the glycolytic intermediates as well as by regulatory proteins.

The makings of a honeybee

By Rajendrani Mukhopadhyay

Honeybees give us our honey, royal jelly, propolis and beeswax and support the ecological structure of the environment by transferring pollen between plants. Despite their ecological and economic importance, very little is known about how honeybee workers develop from embryos to adults at the molecular level.

In a paper in the journal Molecular & Cellular Proteomics, researchers tackled a proteomic analysis of honeybee embryos.

They found that while there is a central set of proteins involved in common biological pathways that drive development, “embryos at different developmental stages have their own specific proteome and pathway signatures,” says Jianke Li of the Chinese Academy of Agricultural Science in Beijing. “These findings provide a vital resource as a starting point for further functional analysis and genetic manipulation for both the honeybee embryos’ and other eusocial insects, such as wasps, ants and termites.”

The investigators studied worker bee eggs, which are responsible for building the honeycomb, cleaning it, defending the colony, foraging for nectar and feeding the larvae. The worker bees, all sterile females, rise out of fertilized eggs in four stages. The first stage is the egg, during which the body plan of the insect is established. Li and colleagues used liquid chromatography combined with mass spectrometry as well as bioinformatics to see which proteins were present and how expression changed in embryos during their 72-hour development period.

The investigators found that the core proteome of all stages of embryonic development consisted of proteins involved in protein synthesis, metabolic energy generation and consumption, development, and molecular transport. But each embryonic stage had specific sets of proteins turn up on top of the core proteome.

Embryos younger than 24 hours had more proteins involved in nutrient storage and nucleic acid metabolism, which could correlate with the cell proliferation that happens at the early stage. Embryos during the 24- to 48-hour span expressed proteins responsible for cell-cycle control, transport, antioxidant activity and the cytoskeleton. These proteins might ordinarily get broken down in the presence of a normal diet but might be slowed.

The authors conclude that “grains should be consumed in a minimally refined form, and frequent consumption of vegetables and legumes should be recommended to reduce cardiovascular risk factors.”
The August issue of the journal Molecular & Cellular Proteomics features a substantial collection of articles describing recent research findings from investigators supported by the European Union-funded proteomics consortium known as PRIME-XS. For the uninitiated, the acronym PRIME-XS is short for “Proteomics Research Infrastructure Maximising knowledge EXchange and access.” The consortium’s 12 partner institutions offer the critical infrastructure – specialized instrumentation, expertise and training — for proteomics researchers in Europe who otherwise lack access to such resources.

The prologue to the MCP special issue was written by Albert Heck of Utrecht University, Jesper Olsen of the University of Copenhagen and Ruedi Aebersold of the ETH Zurich (all PRIME-XS principal investigators), along with Reinout Raijmakers of Utrecht University (who manages the PRIME-XS project office).

“Prior to the founding of PRIME-XS, proteomics in Europe was already well-established, with several top-notch research laboratories and several proteomics facilities operating at the local and national levels. However, the European proteomics community was not well-organized,” the prologue authors explain.

The EU’s primary funding mechanisms for research and development are known as “framework programmes.” After funding for PRIME-XS was secured under the seventh framework’s infrastructure umbrella, “a major effort was made to organize the community and to establish a coordinated program to provide the European life-science research community with access to top-of-the line (proteomics) facilities.”

Long story short: PRIME-XS put out its first call for proposals in July 2011 and since then has invited 104 investigators from 21 countries to carry out work at the consortium’s six access sites in the Netherlands, Belgium, Switzerland, Spain, the U.K. and France.

“Sometimes guest researchers stay (at an access site) for a single day; others are embedded at a site for weeks or months,” Heck et al. write. “Some users are proteomics novices; others are experienced researchers who want training and access to novel or specialized technologies that are unavailable locally.”

The ongoing and completed work at the PRIME-XS access sites has yielded more than 100 publications so far. The 19 new publications in the special issue of MCP describe “a wide variety of proteomics applications in biology and medicine,” Heck says, including antibiotic resistance, plant pathogens, brain malfunctioning, circadian rhythms and quality-control metrics.

Heck says submissions for the MCP special issue were sought openly from “people working in the PRIME-XS joint-research activity programs and researchers from all over Europe who requested access to the proteomics infrastructures.”

Angela Hopp (ahopp@asbmb.org) is editor of ASBMB Today.

Submit Your Next Paper to an ASBMB Journal!

*ASBMB has eliminated color figure fees for members publishing as corresponding authors.
Earlier this year, the American Institutes for Research issued a report titled “The nonacademic careers of STEM Ph.D. holders.” AIR derived the data from the 2010 Survey of Doctorate Recipients by the National Science Foundation and the National Center for Science and Engineering Statistics. We have reprinted AIR’s key findings with its permission in this issue.

As a preface to its analysis, AIR noted previous research showing that more than half of STEM Ph.D. holders work outside of academe and do so for many reasons, not the least of which is the increased competition for a declining number of jobs in academe.

AIR’s report noted the following:
• The majority of Asian women and men and the majority of white men reported holding nonacademic positions. The other demographic groups surveyed (black women, Hispanic women, white women, black men and Hispanic men) were about evenly split between academic and nonacademic careers.
• Most of those in nonacademic careers worked for private, for profit organizations or for government.

Black women, Hispanic women and white women reported working for government at the highest rates.
• About 20 percent of those in nonacademic careers worked in non-STEM fields. Black women, Hispanic women and white women reported working outside of STEM at the highest rates.

To read the complete AIR report, visit http://bit.ly/1jKL6rt.

Continued on page 18
NIH launches a public website for bioscientific 3-D printing

By Indumathi Sridharan

The National Institutes of Health’s National Institute of Allergy and Infectious Diseases in June launched a free, public online library of 3-D printable files called the NIH 3D Print Exchange (or simply the Exchange). It is the first government-sponsored website dedicated to 3-D printing of scientific and medical models, such as those of bacteria, proteins and anatomical parts.

Visualization of scientific data is a driver of discovery. Typically, converting a digital model into a 3-D printable format is technically demanding and time-consuming, sometimes taking hours even for those who are experienced with it. The Exchange aims to leverage the potential of 3-D printing by saving time, money and labor.

The Exchange allows users to create, upload, download and share printable files of their data. “We created this website as kind of a way to have a YouTube-like experience, but instead of exchanging and sharing and commenting on and remixing videos … we are doing all of those same things with 3D-printable files,” explains Darrel Hurt, a researcher at the NIAID who helped develop the Exchange, in a video about the new site (1).

The repository has a wide range of print-ready files, including an influenza virus, an insulin molecule and even a common lab microscope.

Users of any skill level can obtain ready-to-print files within minutes either by uploading a digital 3-D model file or, in the case of proteins and macromolecules, by entering the Protein Data Bank or the Electron Microscopy Data Bank code. Users also can share files derived from other open-source modeling software, such as Blender, FreeCAD and the like.

Additionally, modeling tutorials, illustrated workflows and other educational materials are available to help novice users build custom 3-D prints. The Exchange also will host online forums for sharing tips and tricks, and users will be invited to upload files of models that can be used for teaching.

This initiative was directed by the NIAID in collaboration with the Eunice Kennedy Shriver National Institute for Child Health and Human Development and the National Library of Medicine. More information about the Exchange can be found at http://3dprint.nih.gov/.

REFERENCE
1. https://www.youtube.com/watch?v=w3z4BEEUT2s

A 3-D model of influenza virus.

A 3-D model of influenza hemagglutinin.

AUGUST 2014
Jennifer Doudna’s laboratory was one of the first to work on the CRISPR/Cas9 gene-editing system.

What is CRISPR?
It stands for: clustered regularly interspaced short palindromic repeats.

It stands for: clustered regularly interspaced short palindromic repeats.

If you had asked Jennifer Doudna a few years ago about the gene-editing tool CRISPR, she would have described the research as “a pretty small effort in my lab, just a few people having fun checking it out.”

That was before a lightbulb went off, before Doudna and her postdoctoral fellow realized that the bacterial defense system could be exploited to fix faulty genes or bestow new functions on existing genes in all kinds of cells. The small effort in Doudna’s lab at the University of California, Berkeley, has since exploded into an international one, with laboratories in several continents furiously working on the gene-manipulation possibilities presented by the system. The method has received much attention in the mainstream press, including the New York Times, which described the adoption of CRISPR by researchers as “scientific frenzy.”

Doudna, who is also an investigator with the Howard Hughes Medical Institute, has found herself to be repeatedly sought after as a speaker and has received numerous accolades. Already a member of the National Academy of Sciences and an American Academy of Arts and Sciences fellow, Doudna won the inaugural Mildred Cohn Award in Biological Chemistry from the American Society for Biochemistry and Molecular Biology last year (for work she accomplished prior to the CRISPR craze).

This year, she received the Lurie Prize in Biomedical Sciences from the Foundation for the National Institutes of Health. The annual prize recognizes outstanding work by a scientist age 52 or younger; Doudna won recognition for the work on CRISPR.

Partnership
It is the morning after the Lurie Prize banquet, a mild spring day in Washington, D.C., with a chance of rain showers, when Doudna and I sit on an outdoor patio at the Ritz Carlton in Georgetown. Doudna’s husband, Jamie Cate, and her preteen son are upstairs in their hotel room packing to fly back to California while Doudna speaks with me. Friendly and warm, Doudna exudes quiet, deep-rooted confidence. Dressed in crisp jeans and a light gray cardigan, she speaks thoughtfully, occasionally using her hands against the tabletop to make her points in measured sentences. Aware that she has a highly successful research portfolio that covers CRISPR, RNA interference and translational control, I ask her how she manages to maintain such a prolific environment in her laboratory of 30 scientists. But Doudna is quick to reveal her secret—her laboratory manager, Kaibing Zhou. “She is the type of person who will do whatever it will take to make the lab successful,” says Doudna. “I owe her a tremendous amount for what we’ve been able to do.”

Fresh out of a postdoctoral fellowship with Tom Cech at the University of Colorado, Boulder, in 1994, Doudna was starting as an assistant professor at Yale University. Zhou was also new to New Haven; she had accompanied her husband for his postdoctoral position at Yale. She was searching for a job at the medical school, fully acknowledging that at that time she didn’t know much about biology. Eschewing the human resources department, Zhou went door to door in the medical school asking faculty members if anyone would be willing to hire her. One faculty member said he had just filled his open position for a technician but recalled that a new faculty member was searching for one. He called Doudna to confirm and sent over Zhou’s résumé.

Doudna failed to see any common scientific ground in Zhou’s résumé but decided to give her a call anyway. Within 15 minutes of getting the call, Zhou was in Doudna’s office. “She had these big neon-green glasses on and a very bright dress,” remembers Doudna. “She was full of energy. She had no idea what my research was about, but she was eager to learn. She said, ‘If you hire me, I will be in your office tomorrow at 8 o’clock unpacking boxes.’ I thought, ‘Wow, this person is just amazing.’ I gave her a chance.”

“I want the lab to be a place where people feel like they are all batting for the same team… As I’ve chosen people to join my group over the years, I’ve always tried to pick those who would foster that kind of environment.”

— JENNIFER DOUDNA, UNIVERSITY OF CALIFORNIA, BERKELEY
CONTINUED FROM PAGE 23

(although Doudna is founder of the social aspects of baseball than the actual sport). “As I’ve chosen people to join my group over the years, I’ve always tried to pick those who would foster that kind of environment,” she says. “For the more senior members of the lab, they need to understand that part of their role in the lab is to provide mentorship to younger students.”

And here is where Doudna says Zhou’s presence is important. “She has maintained the kind of environment where students are pushed to do their very best but are also encouraged to seek help when they need it, to understand that they have the support of people in the laboratory when they run into technical challenges or anything else.”

In 2001, UC Berkeley offered faculty positions to Doudna and Cate, who was at the Massachusetts Institute of Technology at the time. The offer was tantalizing. Doudna would have a joint appointment to the departments of molecular and cell biology and chemistry. Plus, Berkeley is just a five-minute drive from Lawrence Berkeley Livermore National Laboratory, a place indispensible for Doudna’s. Furthermore, Doudna’s mother was in Hawaii, so California would bring Doudna closer to her. They accepted.

Zhou decided to go with Doudna to the West Coast. Doudna’s research into RNA appealed to her, but Zhou says that their relationship was the key factor. Still, it wasn’t an easy decision for Zhou, because she had her husband’s career to consider. They decided the move was worth the effort. Zhou was the only person from Yale to move with Doudna.

Doudna wholeheartedly gives credit to Zhou as an equal partner for making the laboratory successful. And life has taught Doudna that having a true partnership in her personal life also is hugely important. She speaks of Cate: “I didn’t understand when I was younger the importance of having the right partner in life. I only realized it later. Now I feel I do have the right partner in life, and I’m very, very, very grateful for that.”

She emphasizes that choosing the right life companion is especially important for female scientists. “It’s very important to have a partner who can understand your passion,” she says. “We’re a little bit crazed. We’re driven by what we find exciting in science. I think it’s so important for a partner to understand that level of passion. To make it work between career and family, it’s really critical to have a partner who gets it and is willing to share the burdens.”

CRISPR: “Small effort” goes big

Doudna always has been interested in RNA. Her research, starting with work she did with her graduate adviser, Jack Szostak at Harvard University, continued with Cech, has shown over the years that large RNA molecules aren’t a mess of spaghetti-like strings. Instead, they are more like proteins with defined, organized structures. Doudna solved the first crystal structure of a large domain of the prototaxon Tetrahymena ribozyme. Her group got the first detailed structure of the P4-P6 RNA fragment of the group I intron, which showed the RNA to be packed tightly into a proteinlike globular fold. In 1998, her laboratory solved the crystal structure of the hepatitis delta virus ribozyme, work that demonstrated how the virus was capable of hijacking its host cell’s machinery to replicate itself.

When CRISPR came onto Doudna’s radar in the mid-2000s, her group was working on gene regulation by small RNA molecules in human cells and RNA interference pathways. Doudna became interested in CRISPR, an acronym for clustered regularly interspaced short palindromic repeats, because she realized it was a way for her lab to see how bacteria use small RNA molecules in a pathway perhaps similar to RNA interference. She and her colleagues then could search for any evolutionary-ary relationships between bacterial and mammalian systems in using RNA to control genetic information.

Bacteria have three different systems involved in the RNA-mediated destruction of invading bacteriophage genomes by endonucleases. The endonucleases are called CRISPR-associated systems, or Cas. Doudna’s laboratory got involved in studying the type II system when Emmanuelle Charpentier, then at Umeå University in Sweden but now at the Helmholtz Centre for Infection Research in Germany, approached her at a conference. “She wondered if it would be of interest to us to work together to figure out what the function of Cas9 was,” says Doudna. Type I and III CRISPR/Cas systems use a variety of endonucleases; type II is different in that it relies solely on the Cas9 endonuclease.

In a 2012 Science paper, the collaborators described how Cas9 attacked bacteriophage DNA. Two pieces of RNA generated from the CRISPR sequences form a structure that Cas9 uses to find the complementary sequence in DNA. Once it finds the complementary sequence, the enzyme introduces double-stranded breaks.

That’s what happens inside a bacterium. But one day, while Doudna and her postdoctoral fellow Martin Jinek were discussing some data, they both wondered out loud if they could engineer the two pieces of CRISPR-derived RNA as a single RNA chimera. This chimera could still guide Cas9 to DNA and get the enzyme to cut the DNA as a way of gene manipulation. “We looked at each other and said, ‘If we link these two RNAs together into a single RNA, we will have a very simple two-compone-system that if we could get it to work in other cells, it would be a very useful tool,’” she recalls. “That was the turning point.”

CONTINUED ON PAGE 26
The investigators demonstrated a proof of concept in the Science paper using in vitro systems. In the paper, they presciently noted, "Rational design of chimeric RNAs is robust and could, in principle, enable targeting of any DNA sequence of interest with few constraints."

CRISPR isn’t the first gene-editing tool, but its appeal is in its simplicity. All that is technically needed is the Cas9 endonuclease tagged with an RNA strand, which is simple to make in a nucleic-acid synthesizer and could, in principle, enable targeting of any DNA sequence of interest with few constraints.

Researchers have enthusiastically adopted this system because of the relative ease with which you can manipulate complex genomes compared to other similar technologies, such as zinc finger nucleases, transcription activator–like effector nucleases, and other more traditional methods," explains genomics expert Joel Gottesfeld at The Scripps Research Institute. To date, scientists have used CRISPR to edit genes in almost anything they can get their hands on: human cells, zebrafish, fruit flies, mice, worms and rhinos monkeys.

CRISPR gives Doudna a chance to do science with clinical applications. Her hepatitis virus work had a clinical aspect, but the research was far removed from medical applications. Not so with CRISPR. Through an academic collaboration with Hoffmann–La Roche, Doudna’s group is looking to see if the CRISPR/Cas9 system can be used to correct known genetic defects in neurological diseases, such as Huntington’s.

“We’ve understood the genetic cause for a long time, but up until now, there hasn’t been a good tool for how you might actually fix that mutation,” says Doudna. “To me, that’s very exciting, because it helps us to not only work toward having a direct impact on human health, but I think that when we understand better what the potential limitations are with the current system it will help us as mechanistic biologists to improve the tool further.”

CRISPR is also the foundation for the Innovative Genomics Initiative, jointly supported by UC Berkeley and the University of California, San Francisco, and funded by the Li Ka Shing Foundation. The initiative aims to develop genomic analysis to understand disease processes and come up with novel therapeutics.

Doudna, who also received a chaired professorship from IGL, is the initiative’s executive director, with UCSF’s Jonathan Weissman serving as a co-director. Although Doudna sees a great future for CRISPR, she says her heart breaks every time she receives an email from someone who has a loved one suffering from a terrible disease or illness asking if CRISPR can help. It’s too early to tell, says Doudna, but the hope is there. Researchers still have to work out the fine-print details, which include figuring out how to target the gene-editing entities into certain cells and not others in a whole organism.

Zhao says that if the pace of Doudna’s work was brisk before CRISPR came along, she can only describe it now as hectic. She says the laboratory used to hold an annual potluck, but Doudna’s workload and travel schedule have been so relentless that they had to skip the potluck last year. “She’s super busy,” says Zhou. “She’s become a celebrity!”

Passion and perseverance

The possibility of becoming a scientific celebrity isn’t what drove Doudna to science. Biology infused her childhood, which she describes as “a big adventure.” Her father got his Ph.D. in English literature from the University of Michigan, Ann Arbor. When Doudna was 7 years old, her father completed his thesis and moved his wife and three daughters from Michigan to take up a faculty position at the University of Hawaii. Doudna’s mother, a stay-at-home parent in Ann Arbor who held a master’s degree in education, went back to school to get another master’s degree at Hawaii, this time in Asian history, and began to lecture in the subject at the university.

The environmental beauty and excitement of the islands, which included erupting volcanoes, instilled a sense of wonder about the natural world in Doudna. “There were so many fascinating bugs, plants – the natural environment there was so interesting. I was really curious about what makes a plant look the way it does. I always felt very drawn to the underlying mechanisms that work in biology.” At school, Doudna was drawn to mathematics and science. The sense of discovery awed her. She recalls always wanting “to be the first person to know something. That, somehow, inherently was attractive to me.”

Her father was a huge influence. “My dad always fostered a sense of curiosity in the house,” says Doudna. Her father loved to read about science, filling the house with books about science geared for nonscientists; when Doudna was in sixth grade, her father presented her with a copy of James Watson’s “The Double Helix.”

Her high-school chemistry teacher was also an influence. Doudna, who paid homage to Miss Wong in her Lurie Prize speech, remembers her being “very encouraging and taught kids about the joy of having a question about how does something work and setting up an experiment to test it.” But it was in 11th grade that Doudna discovered what she was meant to do. “The state sponsored a lecturership for people who worked at the cancer center in Honolulu on Oahu to travel around the state and go to high schools and tell the kids what they were doing,” says Doudna.

“We had this wonderful woman – I wish I knew her name – who came from the cancer center in Honolulu to my high school. She talked about her work on cancer biology and trying to understand what goes wrong in cells that are cancerous compared to normal cells. That just blew me away. I thought that was so interesting. I

CONTINUED ON PAGE 28
CONTINUED FROM PAGE 27

absolutely wanted to do that kind of work.”

Doudna searched for undergraduate biochemistry programs. “This was
in the early 1980s, so there were not
that many undergraduate colleges
that had biochemistry majors. But
Pomona College in Claremont, Cali-
fornia, did, so I ended up going there
and starting my work in that direc-
tion,” she says. Doudna is the only
scientist in the family – one sister
is a teacher who is working on federally
funded geography projects, and the
other sister is an actress.

When we are sleeping, Jennifer is working.”
– KAIHONG ZHOU, DOUDNA’S LAB MANAGER

Even though she was inspired to
study biochemistry, Doudna remem-
bers having doubts while a sophomore
in college taking general chemistry. “It
was hard for me, and I was trying to
understand why balancing equations
was going to be relevant to my future
life,” she recalls. At the same time,
she was taking a French class and
really enjoying it. She approached her
French teacher and told her that she
probably wasn’t cut out to do science
and would be better off majoring in
French. Her teacher wouldn’t hear of
it. “She said, ‘I can see you’re passion-
ate about it. I know it’s a struggle right
now. But you should stick with it.
That’s going to be a great career path
for you.’”

The importance of being passion-
ate about the work was reinforced by
Szostak during Doudna’s graduate
training. Szostak “has a mild, quiet
manner to him, but gosh, he could
get so excited about science,” says
Doudna, adding that his enthusiasm
for even the most simple result was
infectious.

Zhou says Doudna embodies the
same upbeat spirit as Szostak. She’s
never seen Doudna belittle anyone
for experiments gone awry. “Even if
something fails, she’ll say, ‘Wow, from
this failed experiment, I’ve seen some-
thing really great. Let’s try something
else from here,’” says Zhou. “She
never ever once freaked out because
something didn’t work.”

Szostak influenced Doudna in
another important way. “He would
also tell us students in the lab, ‘Follow
your passion. Don’t worry about your
next career move, because if you fol-
low your passion and do excellent sci-
ence all of those career decisions will
become easy to make, because you’ll
know what you want to do and what’s
right for you.’ That was so true,” says
Doudna. “It’s really guided me in
many moments in my career when
I’ve had to make a decision.”

She respects someone’s enthusi-
asm for a particular research avenue,
because she knows the enthusiasm
will help the person persevere. “I
think people do their best work when
they are very motivated, very excited
and passionate about a project,” she
says. It’s true for her. Zhou describes
Doudna as extremely hardworking,
capable of chipping away at work at
all hours. “When we are sleeping, Jen-
nifer is working,” says Zhou. “It’s not
surprising to get an email from her at
5 a.m.”

Doudna is grateful that serendipity
also has showed up a number of times
in her career. One of those serendi-
pitous moments was meeting Zhou.
She emphasizes more than once how
similar they are. “We think on the
same wavelength,” she says. “Our
goals have always been aligned.”

Passion and excitement for science
is something Zhou says she shares
with Doudna. But she adds there
is something more fundamental to
their relationship – trust and mutual
respect. “This is why we’ve lasted for
20 years. We never ever say anything
unhappy to each other. It’s amazing.
People don’t believe it,” says Zhou.
“We’ve been happy together for 20
years!”
A tale of friendly fruit flies in a jam

Author of new children’s book hopes cute and curious cast of characters will ignite appreciation for model organisms

By Emily Huff

Eight years ago in a cozy coffee shop in Nebraska, biochemist Ruma Banerjee struck upon creative inspiration in a rather unlikely subject: Drosophila melanogaster. It happened during a lengthy discussion in the Lincoln coffee shop with her longtime friend Ted Kooser, a Pulitzer-winning poet and former U.S. poet laureate who recently had completed his first children’s storybook. The two discussed the powerful use of animal protagonists in works for children, which got Banerjee thinking about the storied history of the fruit fly.

“When Ted suggested having an animal as the main character (in a children’s book), my mind immediately went to the idea of a model animal,” Banerjee says. “Drosophila melanogaster is a convenient animal to work with in the lab, and so I thought it would be a good opportunity to introduce children to a scientific research lab.”

Various factors, including the approaching 100th anniversary of the opening of what is known worldwide as the Fly Room at Columbia University, contributed to Banerjee’s decision to make the fruit fly the central character in a children’s book of her own. That book, “Fruity and the Mutants,” was published by the American Society for Biochemistry and Molecular Biology earlier this year.

“Fruity and the Mutants” is the story of a wayward fruit fly, Fruity the wild type, who escapes the clutches of a vicious yellow jacket and finds her way into a band of misfit mutant flies—all named for their various genetic mutations. Their peace is short-lived, however, as that same nasty yellow jacket discovers the flies and chases them down. Then Fruity and her new group of friends must find a way out of the yellow jacker’s clutches or perish.

Making the book

Though Banerjee does not work on fruit flies herself, she had spent several months reading about them and their uses in genetic research. In 2007, Banerjee left her faculty position at the University of Nebraska and moved to the University of Michigan. For several years, the idea for the book simmered on the back burner.

She says the book was begun in earnest during a vacation to Dharamshala, India, in 2012 with her children, Rishi and Maya Ragsdale. “We spent our evenings weaving this story and sharing laughs as we played with the fruit fly names and concocted roles for them in the plot,” she recalls.

They selected a group of mutants with names that seemed like they would work in a story for younger audiences, deliberately omitting a few choices. (For example, “Slowpoke,” with its mating defect, did not seem appropriate for a children’s book.)

In the months that followed, Banerjee and her son, Rishi, drafted a manuscript while Maya, an artist since childhood, painted sample scene illustrations in watercolor.

“Our struggles were those that you might expect for novices—using language that was pitched for the elementary/middle school child and illustrating the book well,” Banerjee says. “At the end, my daughter did a great job with bringing the book to life with her drawings, but her first attempt had the flies looking too true to their insect selves, and Ted recommended that she humanize them.”

Before painting each scene, Maya used thumbnails and sketches to plan the composition and designs. The characters went through at least a few iterations before she found the style she wanted to stick with.

Getting it published

Once the manuscript and illustration samples were complete, Banerjee approached the ASBMB to discuss the prospect of having the society publish the book. “ASBMB has a serious science outreach mission, and publishing a children’s book with a scientific theme is a different way of reaching into the community,” Banerjee says, noting that she had contacted another society about the book but was not met with the same enthusiasm.

“Fruity and the Mutants” debuted at the ASBMB’s annual meeting this spring in San Diego, where Banerjee held a book signing. She also presented the book at an international children’s society about the book but was not met with the same enthusiasm. More information on “Fruity and the Mutants” can be found at http://asbmbchildrensbooks.org/. The book is also available on Amazon.com.
The amazing green fluorescent protein

Events leading to the cloning and expression of its gene and reflections on its impact

By Milton J. Cormier and Richard O. McCann

Only Mother Nature could construct a molecule whose fluorescence quantum yield approaches 100 percent when dissolved in water (1). This characteristic of green fluorescent protein is the reason its gene has revolutionized cell biology. The use of the GFP gene is responsible for advancing our knowledge of mechanisms in many areas of cell biology, such as gene expression, cell division, cytoskeletal organization, vesicle trafficking and neurotransmission. Moreover, only during a time when a project was supported, as a matter of course, because it asked an interesting question about the natural world (in this case, “How do marine invertebrates emit light?”) would GFP have been discovered.

Many of the details leading to the cloning of the GFP gene from the laboratory led by Milt Cormier (one of the authors) never have been reported. Because of the importance of the GFP gene, we feel that these details may be of interest to the scientific community.

From enzymology to molecular biology

Cormier began his graduate work at the University of Texas at Austin under the guidance of Lester Reed and obtained his Ph.D. at the Oak Ridge National Laboratory in Tennessee as a fellow of the Oak Ridge Institute of Nuclear Studies. While at Oak Ridge, Cormier and Bernard Strehler discovered two of the components required for light emission in luminous bacteria (2, 3). During his stay at Oak Ridge, Cormier had the pleasure of meeting many well-known scientists from various parts of the world as a result of the famous G araburg Conferences held each year during this time.

Starting in the late 1950s, the goal of the research program in the Cormier lab at the University of Georgia was to understand the biochemistry and biophysics of light emission in bioluminescent marine invertebrates, with the major focus initially on the sea pansy Renilla reniformis, which is an anthozoan soft coral common along the Georgia coast.

During the 1970s, Bill Ward was a postdoc in the lab. He is now a professor at Rutgers University in New Jersey. Harry Charbonneau was a graduate student at the time and is now a professor at Mercer University School of Medicine in Georgia.

Over several summers, the three of them went to the University of Washington Marine Laboratory in Friday Harbor to collect the bioluminescent jellyfish Aequorea victoria. In that period, thousands of jellyfish were collected and processed, and the extracts were frozen on dry ice for transportation back to the laboratory. After moving to Rutgers, Ward, who continued to collect Aequorea at Friday Harbor alongside the Cormier group, focused his research on the structure and function of Aequorea GFP after characterizing Renilla GFP at the University of Georgia (4). Charbonneau, who was by then a postdoctoral fellow with Tom Vanaman at Duke University, was determining the amino acid sequence of the Ca(2+)-activated photoprotein aequorin (5) using protein purified by McCann at UGA.

By the late 1970s, members of the Cormier laboratory had isolated and characterized the three major proteins involved in bioluminescence in Renilla reniformis: luciferase (6), lucifemin-binding protein (7) and GFP (4). It became apparent that we would never be able to isolate sufficient amounts of these Renilla proteins in order to study their structure-function relationships required for bioluminescence. We had to take a different approach.

There were by then two examples of the cloning of genes in higher organisms. One was the cloning of the gene coding for human insulin. So Cormier decided to change his lab from an enzymology lab to a molecular biology lab. Since Charbonneau had made significant progress in determining the amino-acid sequence of aequorin, an attempt to clone the aequorin gene seemed logical.

This was before the facile cloning of your favorite gene was a routine procedure in every lab: no polymerase chain reaction; no automated DNA sequencers; no commercially available plasmids with multiple cloning sites; no cloning kits; no BLAST, or basic local alignment search tool. From the partial amino-acid sequence of aequorin, we were able to derive oligonucleotide probes that were used subsequently to identify putative aequorin clones.

At this point, the National Science Foundation grant that supported the Cormier lab was up for renewal, so Cormier submitted a new grant proposal to support the cloning work. For the first time in 25 years, his funding request was denied. Fortunately, Cormier had a contact at a major pharmaceutical firm who seemed interested in the project. After he presented a seminar to the company, it offered generous support for the cloning work.

At that point, Cormier began looking for a molecular biologist who could help clone the aequorin gene. Doug Prasher, then a postdoc in the UGA genetics department, was interested and agreed to join the Cormier lab in the early 1980s. By the time Prasher arrived, everything was in place for molecular biology, including some frozen Aequorea tissue. That summer Prasher and McCann went to Friday Harbor to collect more jellyfish and, ultimately, construct an Aequorea cDNA library.

By the autumn of 1984, Prasher felt that he had isolated the aequorin gene based on the hybridization of the aequorin-specific oligonucleotides to several clonal isolates, but he could not verify this, because he was having difficulty expressing the gene. We had a conversation about this problem. McCann suggested Prasher might be expressing aequorin at a low level even from pBR322, which was an early cloning vector in which inserts were cloned into either ampicillin or tetracycline genes but not an expression plasmid, and that this could be measured in E. coli extracts, given that it is possible to detect sub-attomole (10^-18 mole) levels of aequorin.

We suggested Prasher look for expression using a bioluminescence assay used routinely in the lab. The very first try produced so much light that the luminometer became saturated. There was jubilation in the lab. We knew then that we had expression of aequorin. That paper was published in 1985 (8).

Cloning of the GFP gene

Upon completion of our work on aequorin, Cormier suggested that Prasher try to clone the GFP gene, since we already had a cDNA library from Aequorea. Furthermore, Ward was willing to furnish us with partial amino-acid sequence data. Prasher agreed and was successful in isolating a GFP clone. When the gene was sequenced, we realized that the clone represented 70 percent of the coding sequence.

Since Prasher could not identify the full-length gene in that cDNA library, it was obvious that additional collections of Aequorea were required. At this point, Prasher obtained a position at the Woods Hole Oceanographic Institution, but he and Cormier agreed to continue their collaboration on the cloning of GFP.

Cormier was running out of research funds again by then, so he applied to the NSF. Once again, the grant was turned down. This loss of funding forced the closure of his lab. Cormier subsequently retired but insisted that two assistant professors be hired to replace him. That was done. He also remained available while Prasher continued his work on GFP. Fortunately, Prasher obtained independent funding in 1989. An additional collection of Aequorea was made, and the full-length gene was isolated. That work was published in 1992 (9).

Based on the protein sequence of GFP, Frank Pendergast, a professor at the Mayo Medical School in Minnesota who earlier had published a paper on the characterization of Aequorea GFP (10), predicted the likely GFP chromophore structure. Prasher then turned his attention to the expression of GFP. After making a number of attempts to express the gene, he ploned Cormier about the difficulty he was having. Cormier assured Prasher that he would figure it out. However, Prasher’s research position at WHOI was ending. (Had Cormier known

CONTINUED ON PAGE 34
CONTINUED FROM PAGE 33

this, he would have urged Prasher to return to Georgia to complete his work on the expression of GFP. Instead, he encouraged Prasher to return to the United States and work on the same project. The result was the development of the first strain of GFP (13).

Prasher's work on GFP was groundbreaking and had a significant impact on the field of cell biology. He discovered that GFP could be used to visualize the activity of certain proteins in living cells. This led to the development of various GFP variants that could be used to study a wide range of biological processes. For example, Prasher and his colleagues developed a variant of GFP that could be used to study the activity of proteins in the brain (14). They also developed variants of GFP that could be used to study the activity of proteins in the heart (15).

Prasher's work on GFP was recognized with the Nobel Prize in Chemistry in 2008. He shared the prize with Osamu Shimomura and Martin Chalfie, who worked on bioluminescence in the jellyfish Aequorea victoria. Shimomura and Chalfie were recognized for their work on the discovery of GFP in 1962, and they went on to develop a variety of GFP variants that could be used to study a wide range of biological processes.

Prasher's work on GFP has had a profound impact on the field of cell biology. It has led to advances in our understanding of the activity of proteins in living cells and has been used to study a wide range of biological processes. For example, Prasher's work has been used to study the activity of proteins in the brain, the heart, and the eye. It has also been used to study the activity of proteins in the immune system and in the liver.

In conclusion, Prasher's work on GFP has had a significant impact on the field of cell biology. His work has led to advances in our understanding of the activity of proteins in living cells and has been used to study a wide range of biological processes. For example, Prasher's work has been used to study the activity of proteins in the brain, the heart, and the eye. It has also been used to study the activity of proteins in the immune system and in the liver. Prasher's work on GFP is an important example of how basic research can lead to advances in our understanding of the activity of proteins in living cells.

John Matthews, 2014 (11).


couldn’t believe it was happening to me. I’d always worked hard and succeeded – not only succeeded but excelled. Now there I was: I had just finished my second year of graduate school, and I had been told that I had failed my qualifying exam. I was devastated. Not only was this the first time I had worked hard and failed, but it also meant that I could be asked to leave the program, destroying my dream of becoming a scientist. The more I spoke with my committee members about why I had failed, the more I realized that my failure was not just due to my intellectual ability but rather from my inability to cope.

I had thought that sleepless nights and paralyzing stress were normal for a graduate student. What I didn’t know was that these questions and answers often cannot be known in advance and that the answers to these questions are often lead to advances in scientific knowledge and scientific practice that are as revolutionary as they are unimagi-nable and unpredictable.

CONTINUOUSLY CHALLENGING

Graduate school is a whole new stage in a scientist’s development. Gone are the undergraduate days when you work hard to memorize facts so that you can regurgitate them for exams. Instead, you are expected to learn concepts and apply them to real-world problems. The ideas are no longer someone else’s that you have to learn; the ideas are yours that you have to defend. Information comes fast and furious, and you are expected to balance class, laboratory work, journal clubs, presentations and, yes, life.

The increased expectations and workload can bring out problems that you might never have realized existed. Or if you realized these problems existed, maybe you were able to control them just enough to survive. For me, this new stage in my development attacked my self-confidence. I had always suffered from a lack of self-confidence (I still do, in fact, but I know how to manage it now); however, up to the point when I entered graduate school, I was able to deal with this problem, or so I thought. The new demands fueled this negative psychology, fed it like oxygen to a raging fire, ultimately leading to my debilitating and paralyzing panic attacks.

Fortunately, I had a stern yet understanding exam committee. To this day, I remember the wise words of the late John Scocca (a man who scared the heck out of me as a student but whom I remember now with extreme fondness and the utmost respect). “You will always be faced with pressures at every stage of your career. If you want to stay in this profession, you must get this under control!”

Taking these words to heart, I began therapy through the student health program, and over the next year I got my panic attacks under control, which allowed me to demonstrate to my examining committee my true capabilities.
Curricular revision: embracing the journey

By Neil Osheroff

Few words strike as much fear in the hearts of medical-school faculty members as “curricular revision.” It is a long, arduous and often unsettling process. However, curricular revision is a phrase that many, if not most, of us are hearing these days.

A large number of medical schools have revamped their preclerkship curricula over the past decade, and many are in the process of doing so now. It is a trend that is being driven at the national level. Commonly, new curricula are marked by a move from discipline-based to interdisciplinary courses, by decreased time devoted to the foundational sciences, by the devaluation of lectures and other traditional teaching methodologies, and by the inclusion of small-group sessions and other types of learner-centered teaching.

The Vanderbilt University School of Medicine has undergone two major curricular revisions since 2007. The first (now referred to in the local vernacular as Curriculum 1.0) seems relatively mild by today’s standards; however, it seemed earth shattering at the time. That was when we moved from discipline-based courses to interdisciplinary blocks. After directing the medical biochemistry course for 17 years, I had to work with two faculty members from other departments to develop a new course that encompassed biochemistry, cell and tissue biology, and genetics. Prior to Curriculum 1.0, the preclerkship science courses, which were run out of departmental offices, had little to do with one another. For many years, the only interaction that I had with the directors of the anatomy course (which ran simultaneously with biochemistry) was when they sent an annual message telling me when the anatomy exams would be and to make sure that I did not schedule the biochemistry exams too close to those dates. In those days, medical student courses were important to departmental missions, because they provided departments with an identity within the School of Medicine. Although it had become harder to define what a biochemist actually was, everyone knew a biochemistry course when they saw it. Discipline-based courses also gave course directors a certain level of status within their departments. Directors had a time-consuming and often thankless job, and most faculty members were grateful that the responsibility for the course rested in someone else’s hands.

After the initial shock of our mandate for Curriculum 1.0 wore off (along with all of the now-familiar questions: Why are we doing this? What was wrong with the old curriculum?), we settled into our task. Our first foray started with three coordinated semi-independent courses. We soon abandoned this idea and decided that it would be best to work together rather than as separate entities. After several months and many different approaches, we arrived on a mutually acceptable interdisciplinary schedule and christened our new course Molecular Foundations of Medicine. To help set up the block, I generated a color-coded spreadsheet of the classes. I lined up the lecturers for biochemistry (blue) and my co-directors lined up the lecturers for cell and tissue biology (red) and genetics (green). Once we had everyone scheduled, I changed the color scheme to denote the type of class: Blue now stood for lectures, red for exams, green for patient sessions and so forth.

“That was the day that everything changed.”

Although altering the color scheme seemed like a minor modification at the time, it turned out to be a pivotal point in the development of Molecular Foundations of Medicine and in my development as an educator. The block became more than the sum of the individual disciplines. We stopped caring, for instance, whether a lecture on membranes was cell biology or biochemistry and started caring more about how everything in the block fit together. After all was said and done, Molecular Foundations of Medicine was far better than any of the courses that it replaced; it allowed us to place important scientific information into a more logical, appropriate and meaningful cellular context.

The block turned out to be a startling success with the medical students, which was music to my ears after so many years of running biochemistry, “the course that all physicians loved to hate.” I found it much more rewarding to teach as a member of a faculty team than to go it alone. Faculty members from other departments and administrators soon became my colleagues and valued friends. For the first time, I felt that I could translate the creativity I put into my research into my teaching. Although my value to the mission of my department had diminished, my value to the mission of the school had grown enormously.

In 2011, only five years into Curriculum 1.0, we learned that we would be moving to a new model, Curriculum 2.0, starting in autumn 2013. This time around, I had greater responsibilities. In addition to being a block director, I was one of four faculty members charged with developing, implementing and overseeing the entire preclerkship science curriculum. The task was daunting, especially in light of the far more radical (or cutting-edge) demands of Curriculum 2.0.

We had to decrease the preclerkship time for the foundational sciences from two academic years to one calendar year with a later reintroduction of the foundational sciences in the clinical years. Moreover, the individual science blocks were much

CONTINUED ON PAGE 38
more heavily integrated with one another than in the previous curriculum. My eight-week Molecular Foundations of Medicine block morphed into a six-week Human Blueprint and Architecture block that included several hours of pathology, anatomy and pharmacology in addition to its previous core elements. Furthermore, the blocks contained less time for lecture and a featured unifying thread of weekly small group sessions that taught the sciences in the context of patient cases. These case-based learning sessions were critical to the success of Curriculum 2.0 and were allocated six hours a week of in-class time. Despite the complexities of Curriculum 2.0, our experiences with Curriculum 1.0 prepared us for the real-world, interdisciplinary, and collaborative approaches that are necessary to develop the science skills in a model that was unique to Vanderbilt. In contrast with the curricula at many other medical schools, Vanderbilt’s Curriculum 2.0 deftly incorporated a variety of teaching modalities and valued them all. Students, according to their block evaluations, greatly appreciated this approach.

Need help with curricular revision?
If your department or institution requires assistance with curricular revision; the adoption of new teaching methods; or the development of learning objectives, assessment items or competencies, the Association of Biochemistry Course Directors can help.

Founded by the Association of Medical and Graduate Departments of Biochemistry in 2008, the ABCD is a membership organization of nearly 300 biochemistry (and related) faculty members from about 170 schools of medicine, dentistry and pharmacy. ABCD members are educational and curricular leaders who have tremendous experience and expertise in all aspects of curricular design and integration, learner-centered teaching modalities and educational scholarship.

If you are involved in teaching the molecular sciences to professional students, consider joining the ABCD. Faculty members at all levels of experience are encouraged to apply for membership. For more information, visit www.abcd.wildapricot.org.

The successful implementation of the curricular revisions at Vanderbilt required a strong working relationship between the faculty and the administration. Each group valued the other as an educational partner.

first year of Curriculum 2.0. By all accounts, it has been very successful. Initial evidence suggests that students who have participated in the curriculum are scientifically inquisitive, display strong reasoning and team-work skills, and can effectively apply these underlying scientific concepts to clinical scenarios.

The successful implementation of the curricular revisions at Vanderbilt required a strong working relationship between the faculty and the administration. Each group valued the other as an educational partner. Although the administrators established the guardrails for and oversaw our curricular revisions, they did not micromanage the process. They trusted the faculty members to implement a creative and appropriate set of science blocks. This trust allowed the faculty members to take ownership of their blocks, which was a critical contributor to our success and serves as a model for how administration and faculty members can work together on critical projects. I am looking forward to our next major curricular challenge: the insertion of the foundational sciences into the clinical curriculum. I am already certain regarding one aspect of the process: If we want our students to rework themselves in the biosciences while on the wards, we cannot separate the science from the clinical experience. We have to repack the foundational sciences in terms of their patients’ illnesses, symptoms, test results and treatments rather than in terms of the traditional disciplines that defined our teaching. Pilots of such integrated courses show promising results.

Finally, although our two curricular revisions have had a profound effect on the way that we teach our medical students, in many respects they have had a more profound effect on me. By embracing the journey rather than fighting it, I have gone from being a teacher to an educator to an educational leader and have written a new chapter in my three-decade academic career.
Looking beyond the lab
AAAS webinar highlights paths to nonacademic careers
By Shaila Kotadia

The new normal is that most Ph.D.s will have nonacademic positions. Nowadays, success in nonprofits, government, industry, patent law and many other areas employ newly minted Ph.D.s. But how does a budding young scientist transition to these careers? As I was searching for my next step, advice from those that had experienced the transition was priceless.

Earlier this year, when I was looking for my next professional position, I had the chance to view a webinar (now a members-only privilege) presented by the American Association for the Advancement of Science titled “Thinking outside the lab: finding a fulfilling nonresearch career.” A panel of speakers with mixed experiences that led them to positions outside of the lab relayed their personal journeys and the necessary skills they developed along their paths. The webinar was full of gems that are crucial when navigating the career world away from the bench. Here, I recap some of the major points.

The panelists included Marcia McNutt, editor-in-chief of Science magazine; Lori Conlan, director at the National Institutes of Health Office for Postdoctoral Services; and Anu Goel, director of geopolitical affairs at The Boeing Company.

McNutt started on a traditional academic path, even obtaining tenure at the Massachusetts Institute of Technology, but decided to switch careers and accepted a position as a director of a small, not widely known oceanographic research lab. She said that she had taken a personality test for a university study on women in science. The personalities had been organized into a triangle, with the points designated as the leader, the loner and the follower. “This professor called me breathlessly to tell me that I was her Joan of Arc because I had fallen on the midway point between the leader and the loner,” McNutt said. “Basically, she said I was the person who would lead the troops into battle, but if they wouldn’t follow me, I would just do it myself.”

Conlan described her path as “planned happenstance.” She said, “Looking back on it, it looks very planned, but at the time it seemed like a random walk.”

The commonality in this walk was her effort to highlight careers outside of academia while she was in graduate school and during her postdoctoral training. This helped her obtain a position at the Science Alliance at the New York Academy of Sciences and her current job at the NIH.

Goel began by saying, “I like to tell people that I’m actually on my third career now.” He said he began as a graduate student—delaying the process of facing the real world. He kept his eye out for opportunities even if they were outside his comfort zone and found the AAAS Science and Technology fellowship. After working for the government, he decided that he would switch to the private sector, landing eventually at Boeing.

The webinar continued to be a goldmine of advice for a scientist looking to transition to a nonacademic career. Below are several high-lights from which anyone on the job search can benefit.

Educate yourself
One takeaway from the webinar is that when you’re choosing a graduate school or postdoctoral position, you should seek out institutions with career-development offices or grants that allow Ph.D.s to intern at other organizations.

For those already stationed somewhere, Conlan suggested looking to neighboring institutions that offer programs if your current institution does not. In addition, she says that the myIDP resource provided by Science Careers is an excellent resource to match your skills, values and interests with possible career paths. McNutt added that you should push for nonacademic career speakers for seminars.

Sell yourself
But what about that frustrating loop of needing experience to get a job but not being able to get a job due to lack of experience? Goel says that you have more experience and skills than you might think. Being able to think critically about issues is important for many careers. Think hard about how you are selling yourself.

Develop your skills
If you are already in a position meant to develop your skills, consider also gaining new experiences. For instance, Goel said he would have practiced nonacademic writing and presenting to large groups of people by giving speeches. Conlan said that she would have developed office skills by volunteering at nonresearch offices at her home institutions. She said she also valued her service on various committees.

McNutt said that she would have honed her people skills—how to motivate people by recognizing their strengths and weaknesses, bringing them together to work as a team, and assigning tasks that they will excel at and be comfortable with.

If you do not feel ready after graduate school in these areas, consider taking a postdoctoral fellowship. As Conlan said, “A postdoc is a neces-sary career step for some people, not a holding pattern.”

Transitioning to a new marketplace
Goel has made the jump to a new career twice and said he did his homework beforehand. It is important to seek out all of the options that exist and to be able to step out of your comfort zone. In the end, you need to find what best fits you at that time.

McNutt added that she approached every job as the job she would have for the rest of her career. With this strong work commitment, she moved forward in her career to many leadership positions.

Networking
The webinar speakers discussed networking at the most length, and I cannot stress its importance enough. “Networking is the foundation for making the right connections, build-ing personal relationships with people, getting your name and work out there,” McNutt said. Nowadays, with so many scientists and publications, networking is the best way for some-one to connect with you work.

Conlan talked about informational interviewing, which is a great way to build your network. When contact-ing individuals in fields of interest, be prepared to ask better questions by recognizing your skill sets and finding the jobs that best match those.

Prepare to cover four basics:

• the present – what the interviewee's current position entails
• the past – the path the person took who and whom he or she spoke with on the journey
• the future – where the person is headed and where the field is going
• advice – who else you should talk to and career opportunities that might be available

If you are intimidated by network-
Moving into administration: Is it really that difficult?

By Mary Huff and Benjamin D. Caldwell

Editor’s note: This is the second article in an occasional series about transitioning from the faculty ranks into university administration. In February, Benjamin D. Caldwell, dean of the Missouri Western State University Graduate School, wrote about the routes to administrative positions, how the transition affects relationships and duties, and other considerations. Here, Caldwell and Mary Huff, assistant dean of Bellarmine University’s College of Arts and Sciences, continue their series. Here, Caldwell and Huff consider the routes to administrative positions. Here, Caldwell and Huff consider the routes to administrative positions.

Mary Huff, assistant dean of Bellarmine University’s College of Arts and Sciences in Louisville, Ky., and Benjamin D. Caldwell, director of the Missouri Western State University Graduate School, write about the routes to administrative positions, how the transition affects relationships and duties, and other considerations.

A priori, institutions like ours, the administrations tend to grow away from areas in which they have excelled, such as teaching and research. Also, newcomers could bring in fresh perspectives and ideas. We both have been in our positions for about two years now, and we both split time between our administrative and faculty roles. We both love teaching at the undergraduate level. Sharing our passion for biochemistry and watching students become lifelong learners are just two of the highlights of being involved in undergraduate education.

So why’d we do it?

Honest, the idea of moving to what many faculty members refer to as "the dark side" had never appealed to either of us. While we didn’t really know what administrators did, we long had believed that they served to create more work that hindered faculty members like us from doing our jobs! Why would anyone want that type of position?

On the other hand, it was flattering to be offered positions with new responsibilities. And, having great respect for our own deans and administrators, we knew that working with them would be a good experience. So we decided that it was time to leave our comfort zones and see if there was a different way to make an impact at our universities.

The beauty of both of our offers is that they were not going to remove us from teaching. In fact, we both would continue teaching 10 to 12 credit hours per year while performing those mysterious administrative duties. We told ourselves that teaching and having daily interactions with department colleagues would make us different from other administrative types. We’d be faculty members with only one foot on the dark side, and we could save ourselves if we began to approach a point of no return.

Mary’s story

My journey began two years ago. My students often tell me that they can tell that I am busy, but that they have no idea what I’m doing. I am not sure that I can easily put into words what I do.

One major focus is course scheduling. I review all of the schedules as they are developed and make sure that there is enough variety. I also work with the school registrar to maximize classroom space. When registration begins, I monitor the schedule to make certain that we have enough courses and cancel those with insufficient enrollment.

I also oversee textbook orders each semester, working with faculty members and the bookstore staffs. Then there are the other duties, such as mentoring new faculty members, overseeing the faculty development budget, approving student internship applications, reviewing student petitions and sometimes listening to student complaints. Of course, there are endless meetings: meetings with the dean, meetings with the chairs, meetings with other academic leaders, meetings of subcommittees that I lead, meetings over lunch, meetings over breakfast, and more.

Ben’s story

My situation is very similar to Mary’s. I have just completed my second year as dean of the graduate school.

Like Mary, I attend a multitude of meetings. I serve on a number of standing committees that meet regularly (weekly, biweekly or monthly). This can create scheduling nightmares, and I worry about the time I have available for students in my classes and labs. Time management and organization have been essential, and at times, challenging. There are times when both students and faculty members have difficulty tracking me down. Am I in my faculty office or at the graduate-school office across campus? (I am getting more exercise as dean of the graduate school.)

I am responsible for monitoring student registration, course offerings and faculty-member assignments. However, I dedicate a lot of time to overseeing student complaints about grade assignments, requests for course substitutions or exceptions for hardships, and other similar student issues. I also oversee admissions, recruiting and program advertising and marketing – areas in which most faculty members (other than those who specialize in these areas) have little experience.

In general, I do enjoy my role as dean, mostly because I get to interact with all kinds of people across our campus as we build new programs for our students and our community.

In conclusion

Over these past two years, we both have learned that, while the work that we do as administrators is very different from what we do in a classroom, it is not necessarily difficult. It takes organization, an eye for detail and a commitment to meeting deadlines, which can add a level of stress. It also requires patience, strong listening skills and the ability to work with all types of personalities.

Some of the work is routine, yet there are projects that are at the heart of the position that are enjoyable. Our universities are both in a period of growth, and helping to implement the strategic plans is exciting.

Analyzing course and program enrollments to see where we are experiencing growth in our schools, predicting where we need additional faculty members, creating additional office and lab space (sometimes out of utility closets), and looking for new ways to enhance programs is rewarding. It is nice to know and meet faculty members who show passion for their disciplines, and the enthusiasm they exude for their programs is inspiring.

We both have come to realize that administrators and faculty must work together to support the overarching goals of our universities and that we all value the success of our students.

Helping to shape that vision, resolving problems that can hinder the university’s success and knowing that we share a common goal has been a truly transformative experience.
The CAISE for informal science education

Open repository offers thousands of project and activity descriptions for use by scientists and students interested in engaging new audiences in their work

By Angela Hopp

The Association of Science and Technology Centers, a Washington, D.C.-based membership organization, is home to the Center for the Advancement of Informal Science Education, a National Foundation of Science-funded center that houses a repository of informal science-education projects and related professional resources. ASBMB Today’s editor, Angela Hopp, talked to two CAISE staffers: James Bell, the project director and a principal investigator, and Katie Sacco, the program and community manager. The American Society for Biochemistry and Molecular Biology’s outreach coordinator, Geoff Hunt, also joined the discussion. This transcript has been edited for length, style and clarity.

Can you tell me about your backgrounds?

Bell: I’ve been in informal science education for almost 30 years. I started working after having initially a music degree. When I finished my undergrad, I was volunteering at a place called the Exploratorium in San Francisco, a science center. And through my exposure there to a very different way of teaching and learning science, I (made) a career shift. The way things were done there and how creative the enterprise was — (it was) an experience that I did not have as a student in K–12. I just was not engaged. It might have been the teachers; it might have been me … It was through unique learning experiences and a relationship with an informal institution that I changed my career trajectory and began running programs and redirecting my education trajectory so that I could continue working in this field, which I’ve been doing since then.

Sacco: I started getting interested in museum education specifically and working in museums when I was an undergrad in college too. I started at a children’s museum and an anthropology museum in the Bay Area and then took a class up at the Lawrence Hall of Science, which is a science center in Berkeley. While I was there, I ended up getting involved in a whole bunch of different department programs. I started working in the education department doing summer classes and after-school classes for kids of all different ages. And when I graduated, I started working there full time. I was half-time in the research department, doing research and evaluations of different STEM learning programs, both formal and informal, and then half-time as the manager for a national after-school organization called the Coalition for Science After School. I was explicitly interested in museum education — not necessarily science — but working at the (Lawrence Hall of Science) was fun. I guess, like Jamie, I didn’t have a lot of great experiences in formal science education growing up. I was in a small town. There was no real big science museum. So coming at it as a young adult was really exciting for me.

Hunt: This was an undergrad level anthropology class. And so these broader-impacts criteria — which are projects like the ones we try to catalogue and make accessible — help people communicate, engage the public and other audiences through these variety of strategies — from national to citizen-science projects to television to film
gaming.

Sacco: I’ll also just add that, from the informal educators’ side, we always hear that they’re really eager to connect with scientists and to get access to cutting-edge research and resources that are coming out of people’s education and outreach branches of their labs and university departments. So there’s a two-way need there.

How are projects and activities organized in this repository? How should ASBMB members go about digging into it?

Sacco: Every record in our repository — and there are almost 9,000 of them now — is tagged with a set of metadata, and you can use that metadata to search and sort different records. The big bucket categories that records are sorted into are these: Funding source — Which federal agency or private foundation funded the project or piece of research or evaluation? Content — What is the science topic or discipline? Your members might go look for records that fall under the life science metadata tag. Audience — Who is the record for? And that’s for both learners — elementary school children, adults, youth, etc. — as well as the professional audience — a scientist or an undergraduate or graduate student. Resource type — That tells you what you’re looking at — whether it’s an evaluation report, a peer-reviewed research paper, project description, presentation, etc. And the last thing is environment type. That’s the learning setting in which the record you’re looking at takes place … like after-school programs, broadcast media, conferences, exhibitions, etc.

CONTINUED ON PAGE 46
You have both mentioned the media. What are some examples?

Bell: It’s projects at public media stations, for example, that were funded, say, by the NSF to achieve public engagement and learning goals via an innovative approach. One primary example ... is the KQED (program called) “Quest” in San Francisco.

There’s a public media station, and they partner with 16 other organizations locally, some of which are science museums, science centers and children’s museums, but others are actual labs that have outreach offices, all of whom contribute to multimedia stories that Quest produces on local science-related issues.

Sacco: You might be surprised to know that some relatively well-known science programming has been funded by the NSF ISE program. I know this isn’t in the biology sphere, but Neil deGrasse Tyson’s original radio show, “StarTalk Radio Show,” was funded through the ISE program. NOVA has been funded by the ISE and ASSL program at the NSF. A whole variety of other science shows on PBS have been funded by the NSF.

Is there anything else you feel ASBMB members should know about CAISE’s online project repository or informal science education in general?

Bell: If they have any questions or want to contribute anything, caise@informalscience.org is an email address that both Kalie and I receive. And we are here every day. You can get a really quick response and help with figuring out how you can use the resource and/or contribute to it.

Sacco: Exactly — our willingness to help people navigate the website and our eagerness to help your readers connect with the ISE resources that we have and also to learn from what they’re doing.

Hunt: In my eyes, CAISE is the premiere online resource for scientists looking to get involved with science outreach and informal education. It makes my job much easier!

CONTINUED FROM PAGE 45

You have both mentioned the media. What are some examples?

Bell: It’s projects at public media stations, for example, that were funded, say, by the NSF to achieve public engagement and learning goals via an innovative approach. One primary example ... is the KQED (program called) “Quest” in San Francisco.

There’s a public media station, and they partner with 16 other organizations locally, some of which are science museums, science centers and children’s museums, but others are actual labs that have outreach offices, all of whom contribute to multimedia stories that Quest produces on local science-related issues.

Sacco: You might be surprised to know that some relatively well-known science programming has been funded by the NSF ISE program. I know this isn’t in the biology sphere, but Neil deGrasse Tyson’s original radio show, “StarTalk Radio Show,” was funded through the ISE program. NOVA has been funded by the ISE and ASSL program at the NSF. A whole variety of other science shows on PBS have been funded by the NSF.

Is there anything else you feel ASBMB members should know about CAISE’s online project repository or informal science education in general?

Bell: If they have any questions or want to contribute anything, caise@informalscience.org is an email address that both Kalie and I receive. And we are here every day. You can get a really quick response and help with figuring out how you can use the resource and/or contribute to it.

Sacco: Exactly — our willingness to help people navigate the website and our eagerness to help your readers connect with the ISE resources that we have and also to learn from what they’re doing.

Hunt: In my eyes, CAISE is the premiere online resource for scientists looking to get involved with science outreach and informal education. It makes my job much easier!

CONTINUED ON PAGE 48

An open letter to press officers who won’t promote unembargoed research papers

By Angela Hopp

Dear press officer who won’t promote unembargoed research papers,

I know we haven’t met and it’s upsetting when strangers wag their fingers, so let me begin with a bit about how much we have in common.

I wear multiple hats here at the American Society for Biochemistry and Molecular Biology. My primary job is as editor of this magazine. I also am the media contact for the ASBMB’s three scientific journals and annual meeting. Before coming here, I was a press officer at a university on the science beat. Before that, I was a newspaper journalist. I’ve pitched stories, and I’ve been pitched stories.

You probably can see, then, that you and I have shared goals. We are committed to spreading the word about scientific discoveries that have been hard fought and may one day change or save lives. We have the courage to reveal our own wonder and ignorance to scientific experts with the hope that the answers to our questions will increase scientific literacy. We want to showcase the expertise and creativity of researchers, because it’s what we’re paid to do, scientists aren’t very good at doing it themselves, we like helping people and we’re good at it. Most importantly, we want to tell stories that others will share and remember.

I promise: I get you. I respect you. And that’s why I have to tell you that you’re disappointing me. Your refusal to promote research papers that cannot be embargoed is undermining the researchers you represent, devaluing their work and diminishing your profession.

Papers in press

ASBMB journals accept dozens of
submissions every week, and each acceptance letter asks researchers to
contact me if they’re going to work with their institutional press office
on a release. I get queries every day from press officers wondering about
embargoes, and I explain to each the ASBMB in-press policy: All accepted
papers are published online immediately, putting them in the public
sphere and making them ineligible for embargo. I tell them, usually in
these very words, “I know this makes your job more difficult, but it’s good
for science.”

Some press officers get it, and sometimes I get a disappointing
reply, like this one: “The press office
will not consider a paper for a press
release after it publishes.”

While I cannot speak for all
journals that immediately publish
accepted papers online (and there are
many of them), I can tell you that
the ASBMB views its authors as its
primary customers. Those customers
are scientists at universities, federal
agencies and research institutes. In
other words, those authors are the
people that you, as a press officer,
represent.

The scientific community clam-
ors for the rapid dissemination of
research results. Put simply, the hope
is to facilitate the quick production of
more discoveries. The in-press policy
clearly was fashioned in response to
that din. Publishers are meeting your
people’s needs.

While researchers—both journal
authors and those scientists read-
ing their papers—are the primary
beneficiaries of the in-press policy,
the public benefits too. They also can
access these hot-off-the-virtual-presses
results right away. And that’s great,
because, after all, they paid for feder-
ally funded research with their taxes.

The problem
for press officers
I can think of several reasons you
might not want to write about an
unembargoed paper. Among the most
compelling:

• Reading a paper, interviewing
  the authors, composing, checking
  facts, rewriting, editing and collect-
  ing media takes time. Embargoes give
  you that time.
• You cannot promote every paper
  your scientists churn out, so you pri-
  oritize. Embargoed papers, as noted
  above, are relatively convenient.
• The reporters you pitch to
  might ignore an unembargoed news
  release. That means you’ll have fewer
  media placements to report to your
  researcher and, importantly, your
  boss.

I concede all three points. Your job
is more intellectually challenging and
time consuming than most people,
including scientists and journalists,
realize. You are burning calories like
crazy running around your campus,
donning bunny suits to get into the
clean rooms and glad-handing politi-
cians visiting new research centers.

Some (overworked or lazy) reporters
will disregard your unembargoed
press release. Yes, writing about an
unembargoed paper puts you at a
disadvantage.

But you can and, in many cases,
should do it anyway.

It’s the story that counts
Here are my recommendations:

• Don’t operate under a false
  construct. The primary criterion for
  a press release is news value. That
  a paper has been put in the public
  sphere does not diminish its news
  value.
• Don’t undermine your research-
  ers. They’ve worked hard to figure
  out whatever it is that they’ve figured
  out. For all you know, they’ve worked
  on that project for decades. Passing
  on their story is hardly the reward
  they deserve for wanting the scientific
  community to know about their find-
  ings right away.
• Don’t overestimate journal-
  ists. Trust me, most of them are not
trolling journal websites to see which
papers have just been accepted and
published online. They’re lucky to
have you to do the digging.
• Don’t underestimate the impor-
tance of your work. I don’t have to
tell you how influential press officers
are to the news cycle, but it is worth
emphasizing. You’ve seen (and not
taken credit for) plenty of media
reports that were conspicuously
cribbed from your press releases.
• Don’t become complacent. You’re
  a storyteller. That’s why you got into
  this business in the first place. Stretch
  yourself. You know that a great story
  trumps timeliness any day and that
  many times the real story isn’t even
  the result of the study. Tell the story
  right, and nobody will care that the
  paper isn’t under embargo.

I hope that you can acknowledge
that I might have a point. All I ask is
that the next time a researcher with
a new unembargored paper requests
a press release you actually read the
paper and ask a few questions. You
never know. There might be a great
story there.

Best,
Angela Hopp
Editor, ASBMB Today

Angela Hopp (ahopp@asbmb.org)
Editor, ASBMB Today

CONTINUED FROM PAGE 47

American Society for Biochemistry and Molecular Biology

ACCREDITATION & ASSESSMENT
for B.S./B.A. PROGRAMS IN
BIOCHEMISTRY & MOLECULAR BIOLOGY

The ASBMB has launched a national accreditation program for departments and programs offering baccalaureate degrees in biochemistry, molecular biology and other related degrees. Accredited programs gain access to an independently developed and scored examination for assessing student performance that leads to the conferral of an ASBMB-certified degree.

We are currently accepting applications for the October 15 deadline.

Programs seeking ASBMB accreditation will be evaluated on criteria such as:

• Faculty credentials
• Support for undergraduate research
• Faculty access to professional development programs
• Commitment to diversity
• Student advising programs
• Well-rounded curriculum that includes a robust experiential learning component

Newly Accredited Schools:

• Goucher College
• Hendrix College
• Hope College
• Otterbein University
• Pennsylvania State University
• Purdue University
• Roanoke College
• University of California, Davis

For more information, visit www.asbmb.org/accreditation.

Application fees are waived for a limited time.

American Society for Biochemistry and Molecular Biology

48
ASBMB TODAY
AUGUST 2014