SUBMIT YOUR ANNUAL MEETING ABSTRACTS BY NOVEMBER 4

ASBMB today

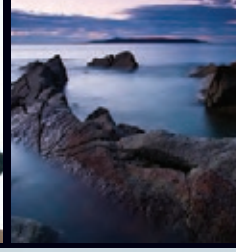
October 2009

American Society for Biochemistry and Molecular Biology

2010 Meetings (in chronological order)

NF-κB in Inflammation & Disease
Advances in Biopharmaceuticals
Structural Biology
Structural Genomics: Expanding the Horizons of Structural Biology
Triglycerides & Triglyceride-Rich Particles in Health & Disease (new!)
Alzheimer's Disease Beyond Aβ
Molecular Basis for Biological Membrane Organization & Dynamics
HIV Biology & Pathogenesis
RNA Silencing: Mechanism, Biology & Application
Molecular Basis for Chromatin Structure & Regulation
Hypoxia: Molecular Mechanisms of Oxygen Sensing & Response Pathways
Adipose Tissue Biology
Neuronal Control of Appetite, Metabolism & Weight*
New Insights into Healthspan & Diseases of Aging
Role of Inflammation in Oncogenesis
Molecular and Cellular Biology of Immune Escape in Cancer
Advances in Molecular Mechanisms of Atherosclerosis
The Macrophage: Intersection of Pathogenic & Protective Inflammation
Antibiotics & Resistance: Challenges & Solutions (new!)
Stem Cell Differentiation & Dedifferentiation
Cell Biology of Virus Entry, Replication & Pathogenesis
RNA Silencing Mechanisms in Plants (new!)
Tolerance & Autoimmunity
Cilia, Signaling & Human Disease
Lymphocyte Activation & Gene Expression
Angiogenesis in Health & Disease
Cardiovascular Development & Repair
Biomolecular Interaction Networks: Function & Disease (new!)
Cell Death Pathways: Apoptosis, Autophagy & Necrosis
Metabolism & Cancer Progression (new!)
Receptors and Signaling in Plant Development & Biotic Interactions
HIV Vaccines
Viral Immunity
Nuclear Receptors: Signaling, Gene Regulation & Cancer
Nuclear Receptors: Development, Physiology & Disease
New Paradigms in Cancer Therapeutics
Integration of Developmental Signaling Pathways
G Protein-Coupled Receptors
Dynamics of Eukaryotic Transcription During Development
Synapses: Formation, Function & Misfunction
Towards Defining the Pathophysiology of Autistic Behavior
Malaria: New Approaches to Understanding Host-Parasite Interactions
Molecular Targets for Control of Vector-Borne Diseases: Bridging Lab & Field Research*
Islet Biology
Diabetes
Computer-Aided Drug Design
New Directions in Small Molecule Drug Discovery (new!)
Developmental Origins & Epigenesis in Human Health and Disease (new!)
Bioactive Lipids: Biochemistry & Diseases
Innate Immunity: Mechanisms Linking with Adaptive Immunity



Prepare to be Inspired!

Submit an abstract and register now for 50+ Keystone Symposia conferences taking place January through June 2010 in a wide variety of life science disciplines:

- *Biochemistry*
- *Biophysics*
- *Cancer*
- *Cardiovascular Disease*
- *Cell Biology*
- *Development*
- *Drug Discovery*
- *Genetics/Genomics/Epigenetics*
- *Immunology*
- *Infectious Disease*
- *Metabolic Disease*
- *Molecular Biology*
- *Neurobiology*
- *Plant Biology*
- *Structural Biology*

Keystone Symposia meetings provide an excellent opportunity to:

- Hear the latest research results from experts in your field;
- Present your research to your peers and gain immediate feedback;
- Build new collaborations, including valuable cross-disciplinary ones;
- Develop new insights and gain a broader perspective.

A few key facts about our conferences:

- Conferences are set in stimulating venues conducive to networking.
- On most programs, speakers for short talks are chosen from abstracts.
- Affordable registration rates are the same for all attendees including those from industry (US$100 lower before early registration deadlines).
- Registration fees are discounted for students.
- Scholarships are also available for students and postdocs.

Register, submit an abstract and apply for a scholarship today for conferences taking place January through June 2010. Visit ***www.keystonesymposia.org/2010meetings*** *for more details.*

KEYSTONE SYMPOSIA™
on Molecular and Cellular Biology
Accelerating Life Science Discovery

1.800.253.0685 • 1.970.262.1230 • www.keystonesymposia.org

contents

OCTOBER 2009

On the Cover:
In this issue, we look at BMB education, from teaching high school students to educating professionals.

society news

special interest

2010 annual meeting

departments

resources

Biochemists gather in Colorado to discuss education. 16

A virtual lab allows users to do DNA extraction. 28

podcast summary

Check out ASBMB audiophiles to listen to a podcast with Tuajuanda Jordan, director of HHMI's Science Education Alliance (SEA).

To hear this and other podcasts, go to www.asbmb.org/Interactive.aspx.

ASBMB today

A monthly publication of
The American Society for
Biochemistry and Molecular Biology

ASBMB Today
Nicole Kresge *Editor*
nkresge@asbmb.org
Nick Zagorski *Science Writer*
nzagorski@asbmb.org
Nancy J. Rodnan *Director of Publications*
nrodnan@asbmb.org
Barbara Gordon *Executive Director*
bgordon@asbmb.org

Magazine design & production: Amy Phifer

For information on advertising contact
Capitol Media Solutions at 800-517-0610
or Danf@capitolmediasolutions.com

ASBMB
www.asbmb.org

2008 APEX® AWARDS FOR PUBLICATION EXCELLENCE

letters to the editor

Rationalizing Wondrous Phenomenon

Greg,

Thanks for writing your very clear-headed article on Francis Collins' attempts to rationalize the Christian God and science. I suggest that Francis spend some time reading the work of Karen Armstrong, especially *The History of God* and *The Great Transformation*. Armstrong carefully analyzes the history of Christianity, Buddhism, Confucianism/Taoism, and Greek rationalism, as those movements have led to the development of certain fundamental moral principles worldwide—such as the "Golden Rule." One needs to keep a very open mind. Science provides amazing insights into how our species, our world, and our universe came into existence, and how these entities function. However, mysteries remain—the most fundamental one being that no one knows (and may never know): what existed before the Big Bang and what caused it to happen. Afterward, we seem to be doing a pretty good job understanding the rest, which includes the origin of the species and humankind.

Although I sympathize with Francis—who of us wouldn't want a God to explain this all, Christian or otherwise—I cannot condone his feeble attempts at rationalizing many wondrous phenomena—the universe, the world, and life—via a pretty simplistic and archaic set of ideas.

Best wishes and keep up the great work.
John Vournakis
Marine Polymer Technologies, Inc.

Changes to Medical School Curricula

Dear Dr. Petsko,

I just read your article on the impending changes to medical and pre-medical education in *ASBMB Today*, and I'm writing to say how much I appreciated it. It was not only informative, but really enjoyable to read. I have taught pre-medical and medical students biochemistry and microbiology for the past 30 years, and I welcome a change from regurgitation to reasoning. I'll pass your article or the AAMC report on to the undergrads in my lab.

Best wishes,
Alfred S. Lewin
University of Florida

Dear Greg,

Over the last year, I have become a regular reader of the ASBMB newsletter, which I previously used to consign to the circular file. The reason is that I enjoy catching up on the "Thoughts of President Petsko," which I find highly entertaining. (Your successor has a problem!)

I too have been following the *sturm* and *drang* that surrounds the pre-medical business these days. It has worried me for a long time, that in 2009, premedical students are still required to take exactly the same course that Flexner recommended they take over a century ago. The report you helped write might just change the behavior of medical schools in this regard, but I am not holding my breath. I am not sure the medics really care all that much.

Over the years, chemistry departments have borne the largest share of the Flexner burden. Speaking as a member of a department of chemistry, I think it safe to say that we would hardly

know what to do with ourselves if we no longer had to offer two terms of general chemistry, two terms of organic chemistry, and two full years of lab to every college student who thinks he might want to become an M.D.

While I have no problem with an idea that is central to the report, namely that we should concentrate on what students have learned, rather than how they came to learn it, I did find that recommendation ever so slightly disconnected from the real, down and dirty world of undergraduate education. The question I found myself asking is: What do the authors of the report really mean by the examples they provide of things they want students to know? What do they think those who man the academic trenches, *e.g.* the poor bastards who teach freshman chemistry, should actually do? It did not escape me that most of the members of the committee—saving their graces—had never been called upon to do such duty. Hence it was a comfort to me that you, who I know has done hard time, were part of the committee. The course recommendations you provide in your ASBMB piece are the beginnings of a practical answer to my questions and for that I am grateful.

Just so long as no one is under any illusion that students with backgrounds in science as thin as the report envisions are going to be ready to do science, let alone biochemistry, I expect all will be well. I am sure my younger colleagues in chemistry are worried that the size of chemistry faculties will shrink as the report recommendations are adopted, but I am not. Chemistry will survive because molecules are central to so much of science, and molecules are what chemistry is all about.

Peter B. Moore
Yale University

Dear Editor,

I want to comment on President Petsko's article "What Doctors Know" that appeared in a recent issue of *ASBMB Today.* As an academician who has dealt with medical education as a pharmacology professor at the University of Michigan Medical School and as an assistant dean, active member of the admissions committee, a professor of biology, and the pre-health advisor at California State University-Dominguez Hills (a minority-serving institution in South Central Los Angeles), I have been disappointed that medical education has not done more to recognize the changes that are occurring in today's society, not only at the level of the preparation of premedical students but also in the admissions and matriculation of medical students.

For example, the rapidly changing demographics of society and the increased prevalence of minority health disparities demand that our work force, particularly in the field of medicine, be more diverse. However, when one looks at those numbers in our medical school classes as well as in the profession itself, it is obvious that we, as medical educators, have not done, and are not doing, what is needed. As such, I am pleased that two recent reports on medical education have recommended major changes, as these are most welcome in helping to address this problem.

These reports are from the group with whom Petsko served (SFFP) and also from a group supported by the Josiah Macy, Jr. Foundation. The SFFP recommendations, as indicated in Greg's article, included a much better definition of the competencies both at the premedical and medical levels. As he stated, to teach freshman chemistry the same way for 30 years for the sake of medical admissions is just not right! Moreover, a major recommendation from the Macy report was that medical schools reduce their reliance on the MCAT for admissions, not only because the evidence has not proved definitively that the scores accurately predict success while in medical school (much less competencies after graduation as a practicing physician), but, equally important, the emphasis on these standardized test scores severely limits any strides in diversity, especially among the underrepresented groups. As Greg states for his group, and if one surveys the composition of the group reporting for Macy Foundation, these individuals are all highly respected scientists with a wealth of experience and expertise in this arena.

Still, the problem, as I see it, is one of how quickly these changes will be implemented, as we know how resistant to change academia is, and in my opinion, the academic medical community resists even more! However, if we do not make such changes, the future of our society and its health care is in grave danger, regardless of what happens with health care reform. Certainly, we as ASBMB members, a large number of whom are involved in medical education, must do our part in supporting, and advocating for, the recommendations for change in this all important area of science education. Now is the time for change, not only according to Bob Dylan, as so appropriately referenced by Dr. Petsko, but also according to Sam Cooke!

Thomas Landefeld
California State University-Dominguez Hills

REPLY

The only artists with more space on my iPod than Bob Dylan are John Fogerty and Sam Cooke.

Gregory Petsko

A Teachable Moment

BY GREG PETSKO

On August 17 I received an email from an old friend, Professor Adele Woolfson of Wellesley College. She was one of the plenary speakers at an ASBMB education workshop in early August in Colorado (see article on p. 16). She presented on the white paper titled, "Biochemistry/Molecular Biology and Liberal Education" that the Society produced for the Teagle Foundation. I don't know if many of you have had a chance to read the white paper, but it has been very well received by Teagle and others (you can download it at http://bit.ly/9dR8X). Here are two paragraphs from her message to me:

"I really think that the findings and recommendations of the Teagle working group are important to the Society. Even more so are the suggestions I made to the Colorado participants, about the need for broad educational goals within the BMB major. I know that, with your own background, you understand that skills like speaking, writing, teamwork, ethics, and cross-cultural competence are at least as important as specific content, but this is a hard sell to most ASBMB members. I hope that you can use your presidential "pulpit" to move these ideas forward.

"I'd be more than happy to sit down with you and discuss ways that ASBMB can be more of a leader in education. As one of the participants said after my plenary, these ideas have implications not just for undergraduates but also for how graduate students are prepared."

I don't know if it's true that the importance of skills like speaking, writing, teamwork, ethics, and cross-cultural competence is in fact a hard sell to most ASBMB members; my guess is that it is not. I think most of us have an instinctive understanding of the value of these things because they come up all the time in our professional lives. But I do think it's true that most ASBMB members probably aren't very involved in the teaching of these things, especially as part of the graduate curriculum in biochemistry if they work in academic institutions. And I also think that such topics generally get rather short shrift at our annual meetings. So there's a disconnect between what we believe and what we are doing, probably due in large part to the enormous time and attention that we all have to spend on research, fund raising, writing papers, and teaching/training in our area of specialization.

Most of my college time was wasted on useless subjects like mathematics, physics, chemistry, and biology. Oh, to be sure, I use some of that information in my daily routine, but what I really should have taken at Princeton were sociology, politics, microeconomics, and abnormal psychology. THAT I would use all the time. Fortunately, I did take a lot of writing-intensive subjects, including a course in creative writing, and that has been a huge help to me in all sorts of ways. But when I look back on it, the most valuable course I had as an undergraduate was probably a course in art history that I only took to fulfill a distribution requirement—I had no interest in the subject whatsoever. Shortly after I graduated, I went to live in Europe for four years while I did my Ph.D. and postdoctoral training, and I must have gone to over a hundred art museums in that period. Everything I looked at resonated with something in the art history course, and the things I saw meant so much more to me because I had a context for them and a crude ability to be critical about them in a systematic way. I have relished looking at art ever since. That course I was required to take, and didn't want to take, changed my life.

I suspect many of us have similar stories, so Adele is sowing seed on fertile ground when she speaks of the need for broad educational goals within the BMB major. The trick will be to find ways to make that happen. The Teagle report is a very good first step in finding such ways. Some of its conclusions are:

- Professors and scientists in the biomedical industry report that the BMB major is strong on intellectual and practical skills but lacking in skills for personal and social responsibility.
- Integrative and critical thinking is valued but appears mainly at the advanced level (use of primary literature, open-ended research projects).
- Pedagogy, especially at the introductory and intermediate levels, is not reflective of research on student learning. Lecture format is emphasized in at least 80 percent of classes at all levels.
- Sustained undergraduate research is valued more highly than other preparation for graduate school and employment. Students gain many of their skills and

knowledge from research, but the experience typically begins in the junior year and is limited to a subset of undergraduates.

- The students in BMB courses and programs fall into three categories: (1) those who will continue in BMB professions; (2) those who will go on to other science-related professions, especially medicine; and (3) those who will not make further direct use of their undergraduate BMB degree. Most of the attention of faculty is directed toward the first group.
- Textbooks are seen as references, not drivers of curriculum.
- There is still a deep divide in the BMB community between those who view themselves primarily as researchers and those who view themselves primarily as teachers.
- The Society is limited in its ability to drive change in programs and curricula because of the lack of accrediting power.

I cannot disagree with a single one of these conclusions. And I wholeheartedly endorse the recommendations of the report for steps to change this situation. These include:

- Work to publicize broadly those innovative, effective pedagogies that are already in use in the BMB community. In spite of much evidence that the lecture format is the least effective for long-term learning or excitement about the discipline, most courses are taught in this way. Educational sessions at our annual meeting and publications in Biochemistry and Molecular Biology Education have not successfully disseminated better methods. Workshops, which provide active learning for scientist/educators, may be more effective.
- The officers of ASBMB and the Society's Education and Professional Development committee should consider the benefits and costs of developing an accreditation system.
- Provide assessment tools for student learning and program evaluation for Society members.
- Reconsider the recommended curriculum and skills for the BMB major. Some skills have become more important since the publication of the earlier list and might be named specifically (visualization, advanced quantitative skills including modeling, citizenship, and engagement with the public).

There is abundant evidence that the time is right to address these concerns. The International Union of Biochemistry and Molecular Biology (IUBMB), of which I am president-elect (thereby establishing conclusively that I do not know how to learn from my mistakes…), has just formed a BMB Educational Guidelines Committee, or BMBEGC. This committee will first take on the task of revising the IUBMB "Standards for the Ph.D. Degree in the Molecular Biosciences" and then, sometime in 2010, take on the larger, but related, task of generating similar guidelines for undergraduate educational programs in biochemistry and molecular biology. Some of our most distinguished, and education-savvy, ASBMB members, including Adele, George Kenyon (University of Michigan), and Dagmar Ringe (Brandeis University), are on this committee. If its recommendations are taken seriously, it could have a significant impact on the teaching of biochemistry in most countries.

In this country, the Obama administration has made it clear that improving science education is one of its chief goals. On August 20, I took part in a White House-initiated conference call headed by Tom Kalil, deputy director of the Office of Science and Technology Policy, and Martin Apple, head of the Council of Scientific Society Presidents. The agenda of the call was to begin to answer several crucial questions:

- Many scientists and engineers are already involved in improving K-12 education. How can the administration, science and engineering societies, and other actors work together to increase the scope and impact of this engagement?
- Would the presidents of science and engineering societies be willing to make a public commitment to work on rallying their members to achieve one or more specific goals?

The Office of Science and Technology Policy (OSTP) is seeking near-term action. After the discussion, we settled on two types of problems that we all have the expertise to solve. The tasks are still in the formative stage, and a third, better one could emerge, but here they are:

1. Many students complete pre-college education with the barest hint of exposure to lab work,with most of it consisting of blindly following recipes and getting predetermined results that require little intellectual engagement. The task is to rapidly scout and find the best science labs the nation, or create new ones of high merit, and even provide professional scientists to help teach them, and turn them into the national models for the nation, including defining and promulgating defined benchmarks that serve to reach substantially improved standards.
2. Our K-12 science teaching work force has an average age approaching 60. Historical trends indicate that a majority of these teachers will retire in a great wave in the next three to four years. No process of changing teacher education or broadening the scope of who becomes

a K-12 science teacher could possibly recruit our way out of this sudden evaporation of the science teaching work force. A recent, rigorous study found that teachers prepared in shorter teacher-education processes teach as well as those prepared in the longer, conventional path to the General Education Degree. This year, many tens of thousands of scientists are retiring early, or finding that full-time research employment opportunities are disappearing due to our economic contraction. While the best of the retiring science teachers are still available to serve as mentors in real classrooms, can we find a way, or several ways, to bring large numbers of scientists and engineers to fill the imminent gaping hole in pre-college science teaching?

"Most of my college time was wasted on useless subjects like mathematics, physics, chemistry, and biology."

So, as you can see, Adele's email to me came in the midst of a perfect storm of activity on the education front. At all levels, from K-12 through graduate study, we are being urged to reevaluate what we do and find ways to do it much better. The ASBMB is going to be on the front lines of this effort, but we won't be able to accomplish anything without the help of our members. Do you have ideas for how we can achieve the ambitious goals that Adele, the IUBMB, and the White House have set forth? Let us hear from you. Send your thoughts to *ASBMB Today*. If you'd rather respond to a question, tell us whether or not you think the Society should get into the business of accrediting undergraduate and graduate programs in biochemistry and molecular biology, as the American Chemical Society does for chemistry. It could be argued that accreditation might be one way of ensuring that the recommendations of the Teagle report and/or the IUBMB committee, for example, are widely adopted.

Either way, let's get a dialogue going—more than that, let's really try to do something.

Because a chance like this may not come again.

New PR Campaign Educates Public about Animal Research

BY CARRIE D. WOLINETZ

The Foundation for Biomedical Research (FBR) has launched an exciting, new campaign to garner public support for the humane use of animals in medical research. The "8Twenty10" campaign—named for the date after which public support for animal research is predicted to drop significantly below the majority—is a multimedia approach to educate the public about the important role animals have played and continue to play in medical advancements. The key messages of the campaign describe how animal research saves lives, how humane animal research is carefully regulated, and how continued use of animals in research is necessary for medical progress. FASEB is proud to support the FBR effort as a complement to our own work protecting the responsible use of animals in research and education. An alarming increase in the targeting of scientists and laboratories by extremists in the animal rights movement has underscored the need for the scientific community to do a better job educating the public about the role animals play in biomedical research.

> **"FASEB encourages society member scientists to learn more about the campaign and participate in the ongoing dialogue at www.researchsaves.org."**

The proactive, public relations campaign began on August 1, 2009 and is already generating a great deal of attention. Television commercials highlight "Jen's story," a heartwarming account of a research scientist's struggle with breast cancer and her fight to find a cure. Provocative billboards along highways and at bus stops ask, "Ever had leprosy? Thanks to animal research, you won't." Preliminary polling data conducted by Zogby have already shown an increase in public support in the areas targeted by the campaign. Nationwide, according to polling results, public support increased to 57 percent (+/- 2.0), up from 54 percent in December 2008. The campaign will run, and polling data will be collected, through August 20, 2010.

FBR is creating innovative marketing tools to support the campaign. For example, the *Advance Animal Directive* is a pointed sign-on document for those who reject the benefits of animal research. It directs their doctors and other health care personnel not to treat the signer with a list of nearly 7,000 therapies and procedures developed using animal models. Podcasts describing recent advances in animal research are also available, as are videos describing how animal research has benefited animals themselves through advancement in veterinary medicine. Accompanying the public relations activities will be the launch of a middle school curriculum, including videos, lesson plans, homework, surveys, and a teacher's guide, to provide accurate, scientifically based information about biomedical research and the roles played by laboratory animals. The curriculum will be freely available and downloadable.

FASEB encourages society member scientists to learn more about the campaign and participate in the ongoing dialogue at www.researchsaves.org. FBR is also asking scientists to support this effort through donations of $20.10 and/or by contributing stories to the *Research Saves* magazine. They are looking for previously published articles, with photographs, aimed at a non-research audience, which highlight the importance of animal models in biomedical research. Finally, if you or someone you know has a compelling story about how animal research has impacted their health and life, you can share it at www.researchsaves.org. For more information, please contact Carrie Wolinetz in the FASEB Office of Public Affairs at: cwolinetz@faseb.org or 301-634-7650.

Carrie D. Wolinetz is director of Scientific Affairs and Public Relations for the Office of Public Affairs at FASEB.

NIH Director Collins Holds Town Meeting with D.C. Biomedical Community

BY PETER FARNHAM

In what was billed as the "first meeting of its kind and size," newly appointed NIH Director Francis Collins spent almost 90 minutes on September 9 fielding questions from the biomedical research community in an effort to open and maintain new lines of communication between NIH and its most interested public supporters. While the meeting broke little new ground, it was widely praised by attendees as a useful "getting to know you" exercise.

In brief opening remarks, Collins praised several of his predecessors, including his immediate predecessor, Elias Zerhouni, as well as Harold Varmus and James Shannon. He also singled out Raynard Kington (NIH deputy director) and Lawrence Tabak (director of the National Institute of Dental and Craniofacial Research) for special praise—Kington for serving as acting director prior to Collins' arrival and Tabak for filling in as acting deputy director. Also in the audience was Jon Edward Porter, and Collins acknowledged his many contributions to doubling the NIH budget when he chaired the House Appropriations Subcommittee on Labor, Health & Human Services, and Education in the late 1990s.

Collins also expressed gratitude to President Obama for his public support of science and noted that the president was a man who also appreciated the value of openness. Collins said he believed that NIH should be in the forefront on openness and that one of the reasons for holding the meeting was to begin an open dialogue with the biomedical community at large.

He then described his thoughts on NIH's mission, which is essentially two-fold. First, he issued a ringing endorsement of basic, fundamental research. He said that sometimes people assume that because of his background as head of the Human Genome Project, his main focus would be on "big science." However, he noted, "This would not be correct." He further stated that investigator-initiated research is the bedrock of this component of NIH's mission, calling it "the engine of biomedical progress." The second component of NIH's mission is to use the fundamental knowledge gained through basic research to improve the health of the American people.

Much as he did on August 17, in an address to the NIH staff, Collins then outlined five areas of special emphasis on which he would like NIH to concentrate in coming years:

1. **Applying unprecedented opportunities in genomics and high-throughput technologies to understand the fundamental biology and uncover the causes of specific diseases.** Cancer is particularly primed for this through expansion of the Cancer Genome Atlas, which will help researchers identify all the reasons why a cell goes bad. Autism, diabetes, Parkinson disease, and mental illness research can also benefit from the advanced technologies now available.
2. **Translating basic science discoveries into new and better treatments.** Collins made it clear that NIH is not abandoning the "translational" emphasis that took hold under his predecessor. He noted that "we are all excited" at NIH about the opportunities for biomedical progress now available through work with embryonic stem cells. He also mentioned a new program for developing therapeutics for rare and neglected diseases.
3. **Putting science to work for the benefit of health care reform.** Collins noted the value of comparative effectiveness research (CER) and said that NIH had been doing this type of research for several years and some agency-sponsored studies have already informed the practice of medicine—including the Diabetes Prevention Program, which cited the effects of diet and exercise on managing diabetes. He emphasized that NIH should embrace CER and be a major player in trying to bend the healthcare cost curve. He stated that the agency should also focus on personalized medicine and behavioral science, especially in the area of health disparities.

4. **Encouraging a greater focus on global health.** Collins strongly supports the concept of NIH focusing on ways to help improve global health as a whole in a variety of areas beyond AIDS and tuberculosis, where it already is active globally. He wants the agency to help third-world countries develop their own research capacities.
5. **Invigorating and empowering the research community through stable and predictable budget increases.** This goal was one that many in the audience had clearly been waiting to hear. He noted that such increases will allow NIH to improve the diversity of its work force, support agency-wide projects through the common fund, invest in training, and encourage young investigators to pursue scientific careers. He also mentioned encouraging new ideas and risky research through the Pioneer and New Innovator Awards programs. He also expressed gratitude for the $10 billion NIH received under the stimulus package this past spring, noting that in addition to stimulating the economy and creating jobs, it was also supporting "truly exciting science."

Collins ended by asking for the community's assistance in "propagating a common and consistent message in support of the importance of biomedical research and developing new and compelling ways to describe the benefits of NIH research to decision makers and the public." He also said he wanted to keep channels of communication "wide open" between NIH and "our constituents."

As part of that communication, he encouraged people to submit one- to two-page summaries of important issues on which NIH should be working to NIH-LISTENS@nih.gov.

The question period then absorbed the bulk of the 90-minute session, but regrettably, most of the questions were rather parochial, including at least one that focused on the questioner's failure to obtain funding for a grant application submitted under the Challenge Grant initiative. Collins noted in response to this specific issue that NIH had received over 21,000 Challenge Grant applications, but could only fund 3 percent of these, which of course meant a huge backlog of very worthy grant proposals that would be resubmitted under other NIH programs at some point in the next year or two.

Other questions mostly focused on specific diseases and programs at NIH that were, in the view of the questioners, either being ignored or underfunded. However, Collins listened respectfully to all of them, and noted at least once that he was unaware that NIH was not supporting work in a specific area. He also referred many of the questioners to the relevant institute directors. Another questioner suggested creating a new institute, but Collins said that a cap now existed on the number of institutes (the number was capped at 27 under the NIH reauthorization act signed into law several years ago).

Only one question built on Collins' goal of stable and predictable funding increases. The questioner asked Collins to publicly commit to seeking "multiyear, sustained increases for NIH over the next 5 to 10 years, starting from the current $40 billion base." Collins noted that answering this sort of question often leads to trouble for administration officials, but he said that he thought it was fair to observe that, in his professional judgment, "those numbers are not out of the realm of what we could use."

Readers of *ASBMB Today* who want to see the meeting in its entirety can do so on the NIH website by visiting http://videocast.nih.gov/launch.asp?15263.

Peter Farnham is director of Public Affairs at ASBMB. He can be reached at pfarnham@asbmb.org.

Retrospective: Emil L. Smith (1911–2009)

BY ROBERT L. HILL AND ALEXANDER N. GLAZER

Emil L. Smith, a longtime member of ASBMB and a former member of the *Journal of Biological Chemistry* Editorial Board, passed away on May 31 at the age of 97. He was among the pioneers in the study of protein structure and function from the very beginning of his graduate studies in 1931 and continued as a prominent contributor to these fields for almost 50 years.

Smith was born on July 5, 1911 in New York City, the son of Eastern European immigrants. The immigration officers on Ellis Island had given his father the name Smith. He attended public schools, and while in high school and college, he played the jazz saxophone with various dance bands well enough to pay in part for his college education. At age 16, he was admitted to Columbia University, where he chose a premedical curriculum. In his sophomore year, two gifted teachers sparked his interest in biology and chemistry. He received his bachelor's degree in 1931.

His choice of Selig Hecht as his Ph.D. advisor in the Laboratory of Biophysics at Columbia was remarkably discerning. Noblest George Wald, also a Ph.D. student with Hecht, described him as "one of the most vivid scientific figures of his time; a pioneer in the development of general physiology in this country; and for more than two decades a leader in his chosen field, the physiology of vision." Smith studied aspects of the visual response to flickered light and received his Ph.D. in biophysics in 1937. Other work that he initiated during his Ph.D. studies led to clear proof that chlorophyll in green plants is protein-bound.

Smith received a John Simon Guggenheim Fellowship to continue work on the chlorophyll-protein complex, and from 1938 to 1939, he worked with David Keilin at the Molteno Institute at Cambridge University, England. Forced to return to the United States by the outbreak of World War II, he finished his fellowship with Hubert B. Vickery at the Connecticut Agricultural Experimental Station at Yale University. From 1940 to 1942 he was a fellow with Max Bergmann at the Rockefeller Institute. Bergmann, the last student of Emil Fischer, was regarded as the most eminent protein chemist in the world. His contemporaries in Bergmann's group included William Stein, Stanford Moore, Joseph Fruton, Klaus Hoffman, and Paul Zamecnik, who became lifelong friends. This period set the research directions for his entire career.

From 1942 to 1946, he worked at E.R. Squibb and Sons in New Brunswick, NJ as a senior biochemist and biophysicist guiding mass-scale production of human plasma proteins for the armed forces. In 1946, he moved to the University of Utah College of Medicine as Associate Professor of Biochemistry, Associate Research Professor of Medicine, and head of the Laboratory for the Study of Hereditary and Metabolic Disorders. He was promoted to professor in 1950. Smith left Utah in 1963 to become the chairman of the Department of Biological Chemistry in the new School of Medicine at the University of California, Los Angeles, where he continued a productive research program until his retirement in 1979.

From 1946 to 1958, the main focus of the research in his group was on the characterization, specificity, and mechanism of action of peptidases. From 1958 onward, the focus shifted to the determination of the sequence of diverse proteins: papain, cytochromes *c*, subtilisins, histones, and glutamate dehydrogenases, in that order. These studies led to a stream of novel findings on post-translational modification of proteins and intriguing insights into molecular evolution and protein function that comparative protein sequence analyses could provide.

The textbook, *Principles of Biochemistry* (First Edition, 1954), which he co-authored with Abraham White, Philip Handler, and DeWitt Stetten, was a lifelong source of sat-

isfaction for Smith. Over 25 years, the book went through seven editions, the last of which was published in 1983.

Smith was very active in promoting international scientific cooperation. Most notably, in 1973, as chairman of the Committee for Scholarly Communication with Peoples' Republic of China, he led a delegation to negotiate in Peking the first exchange agreements between the U.S. and Chinese academies, a breakthrough that ended a long period during which there were no contacts between U.S. and Chinese scientists. During that visit, he met with Prime Minister Chou-En-lai, and a picture of the two was prominently displayed in Smith's UCLA office.

Smith received many honors for his scientific achievements, including a Guggenheim Fellowship (1938–1940), election to the National Academy of Sciences (1962), election to the American Academy of Arts and Sciences (1965), election to American Philosophical Society (1973), the Ciba Foundation Gold Medal (1968), and the Stein and Moore Award of the Protein Society (1987).

This is but a brief sketch of the career of a gifted, multidimensional individual. Several reflections offered below add to the picture. We offer our deepest sympathy to Smith's family.

I was an NIH postdoctoral fellow for two years with Emil Smith at the Metabolic Lab, and I remember him for his opinions in many things besides biochemistry, which he freely expressed in the lunchroom where he ate his brown bag lunch with all others in the lab. After a year or so, I decided to write a paper for submission to the Journal of Biological Chemistry *on my work on the proteolytic enzyme leucine amino peptidase. I thought that I could write reasonably well and after giving him the first draft of the paper, I found that he had revised it extensively and saw little of my prose on reading it. As it turned out, we wrote several papers together, and he effectively showed me how to write with clarity and accuracy on the work I had done. This was an invaluable experience that helped me throughout the rest of my career and (that) I could use to help my own students and fellows write acceptably for publication.*

Robert L. Hill
James B. Duke Professor of Biochemistry
Duke University

I did not know Emil Smith well, as he had long since retired when I came to the department in 1994. However one of his findings was embedded in the field of chromatin. That was the unusual and almost complete conservation between peas and cows of the histone H4 amino acid sequence. In other words, H4, a protein that helps form the nucleosomal building block of the chromosome, had hardly changed in some 2 billion years of evolution. This argued for the extreme importance of almost every amino acid of H4.

Subsequently, when we made even large H4 N-terminal deletions in yeast and found them to be viable, this surprised almost everyone in the field. But this allowed us to have viable strains with which to test H4 N terminus function. Two such functions were discovered in our lab. One is the role of the H4 N terminus as a binding site for heterochromatin proteins to control the expression of the silent mating loci. Another is the role of the H4 N-terminal acetylation sites in alleviating repression by the nucleosome. So I am pleased to have added a small chapter to the study of histone function, a study stimulated by the protein sequence analysis of histone H4 started by Emil Smith.

Michael Grunstein
Chair, Department of Biological Chemistry
University of California, Los Angeles

Emil Smith was one of the true pioneers in the development of protein chemistry, particularly in the immediate decades following WWII. He was a contemporary and colleague of the likes of Stein and Moore, Sanger, and Anfinsen and many others who developed and applied methods that allowed the determination of amino acid sequences on an ever-expanding scale. He worked on a variety of proteins, particularly proteases, cytochromes, histones, and dehydrogenases, and this work was instrumental in providing some of the earliest molecular evidence for Darwinian evolution.

He and his colleagues were also leaders in developing reagents for the chemical modification of proteins and in using these approaches as probes for protein structure-function relationships. They have remained valuable tools that are still used to evaluate three-dimensional structures and as adjuncts to various molecular biological manipulations. In fact, it was the appreciation of the molecular bases of protein function that came from Smith's work, and from many laboratories of the same time frame, that was indeed essential to the development of both structural and molecular biology.

In the latter stages of his active career, Smith played a major role in the founding of the Protein Society, and this remains a tangible legacy of his prominent place in the history of the development of protein chemistry as a central focus in biological research.

Ralph A. Bradshaw
Professor, Chemistry and Pharmaceutical Chemistry
Deputy Director, Mass Spectrometry Facility
University of California, San Francisco

One noontime, as a relatively young UCLA faculty member, I was walking back to campus from an errand in nearby Westwood Village. I ran into Emil Smith, headed the other way. He was the longtime chair of the medical school department of biological chemistry, always friendly to me, but with such a vast store of information that he shared forcefully with those around him, he could be scary. Emil smiled and asked, "What's new?" My mind raced. What bit of news could I possibly come up with that would be worthy of reporting to this intellect of a thousand detailed interests, always possessed of full knowledge about each of them?

With only a slight pause, I hit on it. "Lucy and I were just in London," I replied, "and saw a fascinating new play by Peter Shaffer called "Amadeus."" "Oh?" asked Emil, "What's it about?" "It's about Mozart," I said, "and his relationship with his contemporary composer Salieri, who was driven into hatred of Mozart by jealousy of his musical gifts." I started to fill in the plot, but Emil interrupted. Chortling, he said, "He stole it!" "Shaffer stole it?" I asked in disbelief. "Sure," answered Emil. "That was a play by Pushkin, written in 1830." I could only mumble, "It was?" "Yes," said Emil over his shoulder as he strode off, "and it was later made into an opera by Rimsky-Korsakov."

Crestfallen from my latest failed attempt to convey something new and worthwhile to Emil Smith, I walked on to my office. Then a few weeks later, I happened on The Complete Pushkin in my friend's bookshelf. I leafed through it and was not surprised to find a short play, "Mozart and Salieri," with some of the same elements as "Amadeus."

But what else should I have expected? In previous encounters I had heard Emil hold forth on topics as diverse as the fundamental change in European civilization brought about by the invention of the horseshoe and the misattribution of a cello concerto to Haydn. His interests extended to art, where he had amassed a magnificent collection of pre-Columbian statuettes, and an equally impressive house full of prints, including several of the most famous by Edward Hopper. In music, Emil knew the classical repertoire in detail and also loved jazz. He told me that he had paid for his schooling by playing saxophone in jazz bands, but I could never persuade him to give me a demonstration.

Emil possessed as retentive a memory as anyone I ever met, and it stayed with him until the end of his life. A few months before Emil's death, Dick Dickerson interviewed him about the history of the UCLA Molecular Biology Institute, in which Emil played an early role, including helping to recruit Paul Boyer as its director. In that interview, Emil was able to recall the precise day on which he first visited UCLA some 46 years before.

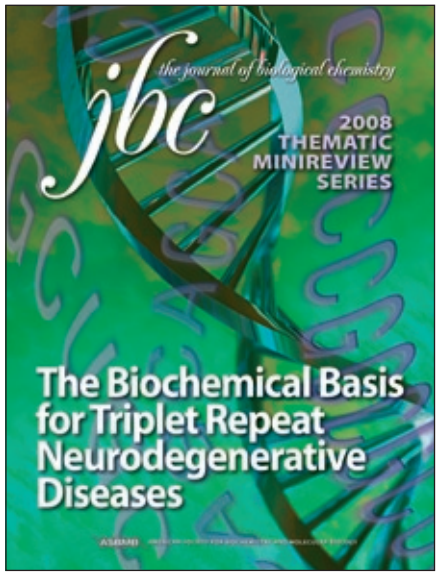
With Emil Smith's passing, we have lost a vast store of memories and as enthusiastic a raconteur as you could ever hope to encounter.

David Eisenberg
Investigator, Howard Hughes Medical Institute
Director UCLA-DOE Institute for Genomics and Proteomics Departments of Biological Chemistry and Chemistry & Biochemistry

Robert L. Hill is James B. Duke Professor of Biochemistry at Duke University and can be reached at hill@biochem.duke.edu. Alexander N. Glazer is professor of the Graduate School Division of Biochemistry and Molecular Biology at the University of California, Berkeley, and can be reached at glazer@berkeley.edu.

JBC Minireview Series: Mechanisms of Triplet Repeat Diseases

BY NICK ZAGORSKI



Three is normally considered to be a lucky number, but in the case of trinucleotide expansion, it definitely isn't. First discovered in the early 1990s, trinucleotide expansion is a mutational mechanism that causes several neurological disorders, ranging from early-onset diseases like some forms of X-linked mental retardation, to late-onset disorders such as Huntington disease. In such disorders, a particular triplet repeat within a gene locus, which may or may not be translated, uncontrollably expands beyond a safe threshold of repetition; the exact number of repeats varies in each instance and this variation correlates with disease phenotype – the larger the expansion, the earlier the onset, and the more severe the disease course.

As a group, trinucleotide expansion disorders provide a rich area of investigation for researchers interested in a wide range of molecular processes. As such, the *Journal of Biological Chemistry* brought together a collection of five minireviews on this emerging mutational mechanism this past March. Coordinated by Joel Gottesfeld of the Scripps Research Institute, "The Biochemical Basis for Triplet Repeat Neurodegenerative Diseases" examines the molecular underpinnings for several of these unstable, disease-causing repeats.

The first three minireviews explore the molecular aspects of repeats that are transcribed but not translated. Robert Wells discusses how the Fragile X Syndrome repeats can mediate deletion mutations in and around the repeat region and shows how studies in bacteria contribute to our understanding of this mutational mechanism. Daman Kumari and Karen Usdin discuss the ability of the repeats at the Fragile X Syndrome locus, as well as the FRAXE and FRA12 mental retardation loci, to promote the formation of heterochromatin, thereby silencing gene expression, through both RNA- and DNA-based mechanisms. And finally, Jason O'Rourke and Maurice Swanson review the RNA-based gain-of-function mechanisms thought to underlie the pathogenesis of myotonic dystrophy, Fragile X tremor ataxia syndrome, and spinocerebellar ataxia type 8. They explore the means by which RNA with an expanded repeat can disrupt alternative mRNA splicing by interacting with key splicing regulators and examine how antisense transcription might contribute to pathogenesis.

The other two minireviews in this series discuss polyglutamine-based disorders, in which the repeat is not only transcribed but also translated into a long stretch of glutamines. Current evidence strongly supports the idea that pathogenesis in these disorders is due to a gain-of-function residing in the mutant polyglutamine protein. Huda Zoghbi and Harry Orr focus their review on polyglutamine expansion within the ataxin-1 protein, which causes spinocerebellar ataxia type 1. Their discussion illustrates the importance of studying the detailed biochemistry of the normal full-length protein to understand pathogenesis. Then, J. Lawrence Marsh, Tamas Lukacsovich, and Leslie Michels Thompson describe the modeling of several polyglutamine disorders in a variety of organisms, including non-mammalian species such as yeast, worms and flies; they also discuss how these models may help identify targets for therapeutic development.

For further information on this series, two podcasts featuring Gottesfeld and Orr can be found at www.asbmb.org/audio.aspx. In addition, as with other series, print copies of "The Biochemical Basis for Triplet Repeat Neurodegenerative Diseases" are available for purchase, so pick up a copy… or three.

Nick Zagorski is a science writer at ASBMB. He can be reached at nzagorski@asbmb.org.

asbmb member spotlight

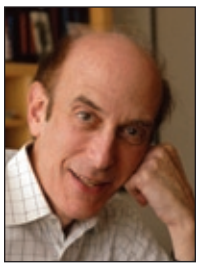
Benkovic Honored with Hirschmann Award

Stephen J. Benkovic, Evan Pugh Professor and Eberly Family Chair in Chemistry at Pennsylvania State University, has been selected to receive the 2010 Ralph F. Hirschmann Award in Peptide Chemistry.

The annual award is given by the American Chemical Society and sponsored by Merck Research Laboratories. It is intended to recognize and encourage outstanding achievements in the chemistry, biochemistry, and biophysics of peptides.

Benkovic's work is considered to be at the forefront of research being done at the interface of chemistry and biology, and he is thought to be among the most prominent mechanistic enzymologists in the world. His studies include the development and application of innovative kinetic methods and the invention of novel biological protocols for investigating the chemical sequence and structural basis of enzyme activity. With these techniques, he has studied many different enzyme systems and has aided in the design of cancer drugs and antibiotics.

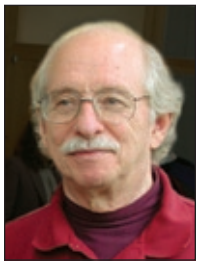
Lippard Receives Breslow Award



Stephen J. Lippard, Arthur Amos Noyes Professor of Chemistry at the Massachusetts Institute of Technology, is the recipient of the 2010 Ronald Breslow Award for Achievement in Biomimetic Chemistry. The award, given annually by the American Chemical Society and sponsored by the Ronald Breslow Endowment, recognizes outstanding contributions to the field of biomimetic chemistry.

Lippard's laboratory discovered and named the first metallointercalators, platinum terpyridine complexes that insert between the DNA base pairs and unwind the duplex. This research was followed by extensive studies of the covalent interactions of cisplatin and related anti-cancer drugs with DNA and an understanding of many of the features of the molecular mechanism of action. Lippard has also characterized proteins that form the soluble methane monooxygenase (MMO) and related systems in bacteria and has also solved the x-ray crystal structures of the hydroxylase enzymes from MMO, toluene monooxygenase, and phenol hydroxylase. Through extensive spectroscopic and theoretical analyses and with the participation of several collaborators, many aspects of the molecular mechanism of dioxygen activation and alkane/arene hydroxylation were established by Lippard. In parallel work, synthetic models of the carboxylate-bridged diiron center in the hydroxylase were prepared as both structural and functional mimics of the enzyme active sites.

Englander Receives Founders Award



S. Walter Englander, Jacob Gershon-Cohen Professor of Medical Science and professor of bochemistry and biophysics at the University of Pennsylvania, will receive the Biophysical Society Founders Award. He is being honored "for pioneering the development of hydrogen exchange techniques for exploring the stability, interactions, and dynamics of macromolecules and their folding." He will receive the award at the 2010 meeting of the Biophysical Society in San Francisco in February.

Englander studies macromolecular structure, dynamics, and function. Work in his lab has explained the chemistry of protein and nucleic acid hydrogen exchange processes and has formulated the physical models that appear to explain the ways in which internal motions in proteins and nucleic acids determine the hydrogen exchange rates of their individual protons. The lab has developed and is using special hydrogen exchange methods that can measure the specific parts of any protein involved in any function, the protein folding process as it occurs on a subsecond time scale, the energetic stability of individual bonding interactions, and structure change.

Hendrix Reappointed to NCI Board of Scientific Advisors

Mary J. C. Hendrix, professor of pediatrics at the Northwestern University Feinberg School of Medicine, has been appointed to serve on the National Cancer Institute (NCI) Board of Scientific Advisors for a second term, which began in July 2009. Hendrix was first appointed to the board in December 2004.

The Board of Scientific Advisors was established in 1996 to assist and advise the director of the National Cancer Institute on all aspects of the extramural program, and it is charged with oversight of the full portfolio of extramural programs of the National Cancer Institute; advising Extramural Division Directors on scientific policies, both present and future; and concept review of research and resource activities supported by the Extramural Divisions.

Hendrix, who is also the president and scientific director of the Children's Memorial Research Center, is working to identify cancer metastasis-causing genes. Her lab's major scientific goals are to define important structure/function relationships, which provide the biological basis for new therapeutic strategies. Recent studies have generated molecular classification(s) of specific tumors and have provided new prognostic markers and novel targets for therapeutic intervention. Hendrix, a former FASEB president, also served ASBMB as chair of its Public Affairs Advisory Committee.

Valentine Wins Alfred Bader Award

Joan Selverstone Valentine, professor of chemistry and biochemistry at the University of California, Los Angeles, will receive the 2010 Alfred Bader Award in Bioinorganic or Bioorganic Chemistry. The award is given annually by the American Chemical Society and is sponsored by the Alfred R. Bader Fund. It recognizes outstanding contributions to bioorganic or bioinorganic chemistry.

Valentine's research centers on transition metals, metalloenzymes, and oxidative stress. She is currently looking at the properties and biological functions of wild-type copper-zinc superoxide dismutases (CuZn-SOD) in hopes of understanding why mutant human CuZn-SOD proteins cause familial amyotrophic lateral sclerosis (ALS, Lou Gehrig disease). She is also studying the roles of superoxide, hydrogen peroxide, metal ions, and small molecule antioxidants in *Saccharomyces cerevisiae* in order to learn how redox balance is maintained in healthy eukaryotic cells.

Costello Garners Mass Spec Award

Catherine E. Costello, director of the Boston University School of Medicine Mass Spectrometry Resource, was named the recipient of the 2010 Frank H. Field & Joe L. Franklin Award for Outstanding Achievement in Mass Spectrometry.

The award, given by the American Chemical Society and sponsored by Waters Corp., recognizes outstanding achievement in the development or application of mass spectrometry. In odd-numbered years, the award is presented for advances in techniques or fundamental processes in mass spectrometry. In even-numbered years, recognition is given to development of the applications of mass spectrometry.

Costello is a leader in glycomics and glycoconjugate analysis. Her research focuses on developing the initial techniques and applications of high-performance tandem mass spectrometry for glycan and glycolipid analysis. She was the first to apply matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF MS) for site-specific profiling of glycoprotein glycans and for the direct analysis of glycolipids from thin-layer chromatographic plates. To address the problems caused by metastable decomposition of MALDI-generated ions, she and her colleagues developed the high-pressure MALDI source for FTMS and applied it to the analysis of thin-layer chromatography (TLC)-separated glycolipids and protein digests. She has also made contributions to the structural elucidation of glycolipids and lipids and of protein post-translational modifications that are involved in the onset and progress of infectious and parasitic diseases, protein misfolding disorders, and cardiovascular disease.

Schatz Presented with Prize for Culture in Science

Gottfried Schatz, former head of the Biozentrum and professor emeritus of biochemistry at the University of Basel, has been awarded the "Europäischer Preis für Wissenschaftskultur" (European Prize for Culture in Science). The award is presented annually by the European Foundation for Culture PRO EUROPA to people or projects that have had outstanding cultural impact on Europe. Schatz was selected for "his dedicated service to culture in science and its impact reaching far beyond the country's borders."

This past spring, Schatz also received the Austrian Decoration of Honor for Science and Art. The order of merit is exclusively awarded to scientists and artists from Austria and abroad who "have distinguished themselves and earned general acclaim through especially superior creative and commendable services in the areas of the sciences or the arts." The award is the highest of its kind in Austria.

Schatz, who was secretary general of the European Molecular Biology Organization (EMBO) as well as president of the Swiss Science and Technology Council, played a leading role in elucidating the biogenesis of mitochondria and was a co-discoverer of mitochondrial DNA.

Spies to Share Margaret Oakley Dayhoff Award

Maria Spies, assistant professor of biochemistry and biophysics in the School of Molecular and Cellular Biology at the University of Illinois at Urbana-Champaign, has been named co-recipient of the Biophysical Society's 2010 Margaret Oakley Dayhoff Award. Spies shares the award with Crina Nimigean of Weill Medical College, Cornell University.

The award honors Spies' achievements in biophysical research at the early stages of her academic career and recognizes her promise as an emerging leader in the scientific community. According to the Biophysical Society, Spies was selected for "her exemplary research into the mechanisms of DNA repair and the cell cycle maintenance machinery."

Spies' lab studies DNA helicases and how they function in DNA repair. Specifically, she focuses on how different helicases perform a diverse set of activities, how they utilize unique structural features incorporated into otherwise conserved motor cores, and how other players in the genome maintenance pathways modulate activities of selected helicases adapting them to desired cellular tasks.

SPIES PHOTO: L. BRIAN STAUFFER, UIUC NEWS BUREAU

Student-Centered Education in Molecular Life Sciences

BY NEENA GROVER AND MARILEE BENORE PARSONS

The enthusiasm was contagious as 70 biochemists hailing from Kuwait to California gathered at Colorado College this past August to discuss education in molecular life sciences. The ASBMB-sponsored conference included plenary sessions and workshops on a variety of topics as well as plenty of time for forming collaborations, having informal discussions, and taking a tour of the Garden of the Gods. The days began early with stimulating conversations over breakfast in Rastall Hall and ended with attendees gathering in small groups in view of stunning sunsets over the mountains.

The workshop began with a plenary talk by Peter Bruns (Howard Hughes Medical Institute) who described various HHMI-supported programs, including the Science Education Alliance program, and talked about the potential for future changes in medical school entrance requirements (see article in the August 2009 issue of *ASBMB Today*). Audience members were very engaged in Bruns' talk and suggested that national societies be involved in further discussions to provide a wider audience before changes are proposed or implemented.

The next day, Adele Wolfson (Wellesley College) presented the results of ASBMB's Teagle Foundation funded white paper on the role of liberal learning in life sciences, which raised questions about skills and responsibilities beyond the content of the major (see box). Later that afternoon, Kathleen Cornely (Providence College) talked about methods of incorporating research-based active learning into classrooms, including problem-based learning, case studies, service learning, and process-oriented guided-inquiry learning (POGIL).

On the third day of the workshop, Lia Margolin (Marymount Manhattan College) discussed how she integrates students' disciplinary interests into her mathematics courses, and Peter Kennelly (Virginia Tech) spoke of his approach to mentoring junior faculty through the tenure process without squelching their enthusiasm or creativity.

The closing plenary was given by Neena Grover (Colorado College). She talked about the need to participate in education using the same tools as research and emphasized that research in education and learning must be incorporated as we move toward developing effective teaching methods.

Workshops, styled after those of the Project Kaleidoscope meeting, where experts guide participants in small groups to discuss various aspects of a topic, were held between the six plenary sessions. In a workshop on undergraduate research, Lisa Gentile (University of Richmond) and Carla Mattos (North Carolina State University) discussed various strategies for successful undergraduate involvement in research. The participants discussed hurdles to undergraduate research at various types of institutions and noted that undergraduate research is not fully appreciated at a majority of schools, whether they are small undergraduate or R01 institutions.

The two sessions on grant writing run by Parag Chitnis (National Science Foundation), J. Ellis Bell (University of Richmond), and Margaret Johnson (University of Alabama) were immensely popular. The participants at these workshops heard about grant opportunities and successful strategies for grant writing and were also exposed to a mock panel.

A molecular visualization and protein database workshop included talks by Tim Herman (Milwaukee School of Engineering), David Macey (California Lutheran University), and Eran Hodis (Weizmann Institute of Science). The workshop attendees got to play with models—both physical and online. Graduate student Hodis' Protopedia wiki training won the hearts of many participants. He taught them wiki tools and provided examples they could incorporate in to their classes.

Erin Dolan (Virginia Tech) gave a workshop on the scholarship of teaching and learning, and POGIL sessions run by Vicky Minderhout and Jenny Loertscher (Seattle University) demonstrated activities that they developed for biochemistry courses. Benjamin Caldwell (Missouri Western State University) and Ann Aguanno (Marymount Manhattan College) provided a venue for sharing laboratory activities. Marilee Benore Parsons (University of Michigan) and Neena Grover discussed various science outreach activities and service learning in their workshop.

And finally, on the last morning, Neena Grover led the

participants through some components of group work. The rest of the morning was devoted to developing individual action plans and discussing these with a small group.

As is often the case, most important conversations took place over wine and cheese in the evening hours. Participants huddled in small and large groups to discuss collaborations or to compare notes on sessions. There was a surprisingly large diversity of experience at such a small meeting. Although there were plenty of familiar faces in the crowd, many participants commented that this was their first meeting on such a topic. The "old guard" was generally welcoming to those just starting their adventure. Additional networking opportunities presented themselves late at night in spontaneous gatherings in the apartments or during walks to the downtown bars.

Several presentations from the workshop, including the six plenary sessions, are available online at http://bit.ly/RWKPs.

Neena Grover is an associate professor of biochemistry and chair of chemistry and biochemistry at Colorado College. She can be reached at ngrover@coloradocollege.edu. Marilee Benore Parsons is a professor of biology and biochemistry and a professor of women and gender studies at the University of Michigan-Dearborn. She can be reached at mparsons@umd.umich.edu.

Broad Goals for the BMB Major

BY ADELE WOLFSON

The recent Colorado education workshop was sponsored in part by the Teagle Foundation as part of its commitment to disseminate and extend the recommendations of last year's white paper, "Biochemistry/Molecular Biology and Liberal Education," produced by a working group of ASBMB members (available at http://bit.ly/9dR8X).

The white paper was one of several reports from disciplinary societies featured in the journal *Liberal Education* (spring 2009). In a commentary introducing the issue, Bob Connor, president of the Teagle Foundation, made the point that "departments often fail to specify how the requirements for the major contribute to students' intellectual and personal growth." This may be particularly true in the sciences, where students take such a large percentage of their college courses in the major, and courses are so content-driven. However, the desired outcomes for all students, in terms of intellectual and practical skills, integrative and applied learning, and personal and social responsibility, can all be placed into the context of a biochemistry and molecular biology (BMB) major and reinforced through coursework and other experiences, such as undergraduate research. The American Association of Colleges and Universities (AAC&U) has shown that high-impact practices lead to significant gains in integrative learning and in practical and personal outcomes and have the added benefit of compensating for a less advantageous background (www.aacu.org/LEAP/hip.cfm). Many of these practices identified by AAC&U fit naturally into a BMB program.

Among the conclusions of the white paper were that ASBMB's recommended curriculum (http://bit.ly/I05SJ) is strong on practical skills but lacking in skills for personal and social responsibility. Given the societal implications of much BMB research, it is particularly important that students develop competence in ethical and moral reasoning and cultivate personal and academic integrity, two of the elements of AAC&U's description of personal and social responsibility.

Other findings were that pedagogy in biochemistry is not reflective of research on student learning and that there is a deep divide between those who view themselves primarily as researchers and those who view themselves primarily as teachers. These are both important issues for the Society to confront.

To enhance student learning in BMB content and to broaden the practical and personal skills that BMB graduates bring to their further education or employment, the Society should take a more active role in undergraduate education. This means doing more than the important work that the Educational and Professional Development (EPD) Committee already undertakes in terms of recommendations for undergraduate curricula and models for successful programs. It means stressing the importance of teaching and learning at large, research-focused institutions, providing opportunities for graduate students to learn about effective pedagogies and the meaningful assessment of student learning, sponsoring meetings or other fora for discussing how best to reward faculty for effective teaching, and bringing faculty from different types of institutions and from industry together to discuss what graduate and professional programs and employers expect from undergraduate majors. This is an especially apt moment to engage these issues, when medical school education is being reconsidered and all of higher education is being scrutinized for its value.

Adele Wolfson is professor of chemistry and associate dean of the College at Wellesley University. She can be reached at awolfson@wellesley.edu

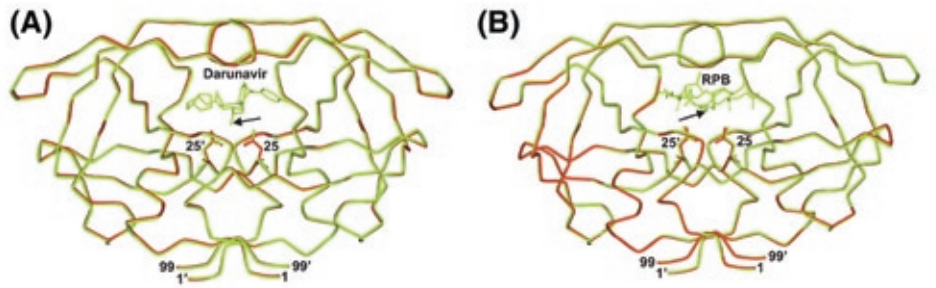
Using *JBC* in the Classroom

BY TAKITA SUMTER

During my first couple years of teaching first-semester biochemistry, I really struggled with helping my students make the connections between protein structure and function. For instance, do the students really understand that adding inhibitor X to protein Y disrupts the hydrogen bond that is essential for catalysis while maintaining other interactions? After a few years of struggling, I think that I've finally found a reasonable solution to this problem!

In an effort to pull all of the protein biochemistry into a single fold, I now use at least one medically relevant article in the *Journal of Biological Chemistry* that demonstrates the interdependence of protein structure and function using kinetic, thermodynamic, and structural findings. While my choice of topics varies from one year to the next, this year's example used HIV protease and a paper published by John M. Louis (1). In the paper, Louis and his colleagues evaluate the effects of converting a highly conserved aspartic acid residue (commonly found in this class of proteins) to asparagine on dimerization and inhibition of HIV protease.

To have my students appreciate this, I use a molecular modeling exercise that requires them to download the structures of HIV protease and the mutant created by the Louis group from the Protein Data Bank (PDB) Repository. They then use the public domain software DeepView to view and manipulate HIV protease based on methods developed by Ship and Zamble (2). In addition to evaluating the secondary structures, viewing Ramachandran plots, and comparing the binding of different inhibitors, these students create the aspartic acid to asparagine mutation. They then align their theoretical structure to that obtained by the Louis group and account for discrepancies using their knowledge of protein structure and inhibition. At the end of the exercise, students are asked to write a summary. In their summary, they include a detailed tutorial for the use of DeepView and a critical analysis of the structures, including explanations for discrepancies between the virtual and actual structural alignments.



Comparison of the structures of wild-type (*A*) and mutant (*B*) HIV-1 protease-inhibitor complexes.

This article uses various methods and allows the instructor to restate the importance of thermodynamics and noncovalent interactions not only in maintaining protein structure, but in enzyme kinetics and inhibition. As a result, this could also be incorporated into the biochemistry lab as a molecular modeling exercise that would be followed by a laboratory experiment comparing the catalytic activity of the wild-type and mutant enzymes in the absence and presence of various HIV protease inhibitors.

My limited assessment of this exercise shows that students gain an appreciation for the connection between structure and function. They are also exposed to many of the public domain tools available for accessing and analyzing protein structures. For many, this exercise is their first exposure to this information. Moreover, the approach is easily adapted to any enzyme featured in *JBC,* which gives them first hand exposure to primary literature references.

Takita Sumter is a biochemistry professor at Winthrop University. She can be reached at sumtert@winthrop.edu.

REFERENCES

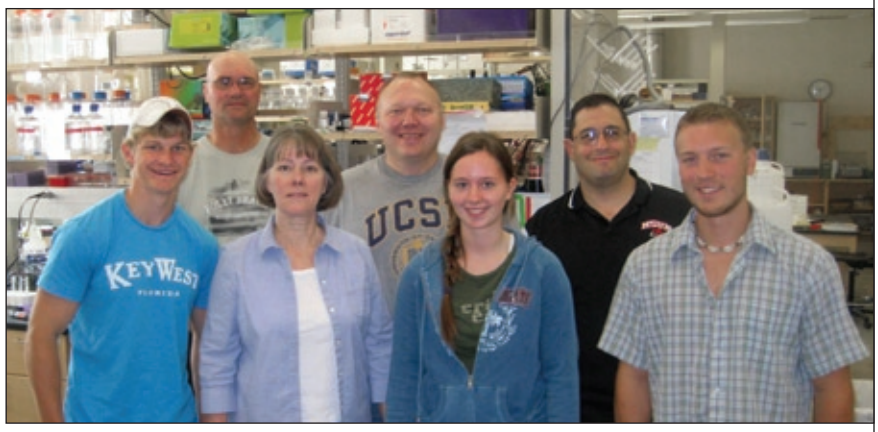
1. Sayer, J. M., Liu, F., Ishima, R., Weber, I. T., and Louis, J. M. (2008) Effect of the Active Site D25N Mutation on the Structure, Stability, and Ligand Binding of the Mature HIV-1 Protease. *J. Biol. Chem.* **283**, 13459–13470.
2. Ship, N. J., and Zamble, D. B. (2005) Analyzing the 3-D Structure of Human Carbonic Anhydrase II and Its Mutants Using DeepView and the Protein Data Bank. *J. Chem. Ed.* **82**, 1805–1808.

Integrating High School Teachers and Students into Summer Research

BY NEENA GROVER

By teaching science from textbooks, we emphasize what is already known and don't give students a chance to explore their curiosity and engage in building knowledge. The best way to bring students into science is to give them opportunities to explore scientific questions and allow them to experience being scientists.

ASBMB funded a 2-year pilot program to promote research-based educational activities that build connections between teachers and students in secondary schools and colleges. The Undergraduate Affiliate Network (UAN) Committee, a subcommittee of the Educational and Professional Development (EPD) Committee, was responsible for giving out these awards. Five undergraduate professors were selected: Ellis Bell (University of Richmond), Joseph Provost (Minnesota State University Moorhead), Mark Wallert (Minnesota State University Moorhead), Neena Grover (Colorado College), and Todd Weaver (University of Wisconsin-La Crosse).



Students and teachers from Detroit Lakes High School spent the summer in the Wallert and Provost Lab at Minnesota State University Moorhead studying how cells move. From *left* to *right*: David Jonason, Stan Richter, Vicki Welke, Mark Wallert, Kelsey Melgaard, Joseph Provost, and Dan Hammes.

The professors assembled a team of researchers that consisted of undergraduate students, high school teachers, and high school students to work on a research project. One of the project's aims was to introduce high school students and teachers to research. Another goal was developing course-linked research activities for high school students. In Bell's laboratory, Rachel Gruner (teacher) and Rachel M. Jones (student) investigated the role of select amino acids in structure-function relationships in watermelon glyoxasomal malate dehydrogenase (MDH). The project involved bioinformatics analysis of MDH sequences to select a residue to mutate, designing primers, QuikChange mutagenesis, and finally, mutant protein expression, purification, and characterization. The kinetic parameters showed a significant impact of the mutations examined.

In Grover's laboratory, John Spengler (teacher), Joe Carver (student) and Rachel A. Jones (student) of Pine Creek High School worked on the thermodynamic characterization of RNA motifs. They began their project by isolating and purifying a histidine-tagged T7 polymerase using nickel affinity chromatography. The T7 polymerase was then used to transcribe a small RNA motif that is being investigated via thermodynamic analysis. The students researched and tested methods for protein isolation and purification and learned the basics of RNA transcription and purification.

Kelsey Melgaard (student), David Jonason (student), Stan Richter (teacher), and Vicki Welke (teacher) from Detroit Lakes High School participated in research in Provost and Wallert's laboratory to study how cells move. They learned about the phosphorylation sites in sodium hydrogen exchangers. They mutated several serine/threonine residues to alanine and also learned protein purification and characterization. The students studied the phosphorylation of these mutants using the RhoA-directed protein kinase, Rock.

The students and teachers will continue to interact with their laboratories during the year and will return next summer to continue their projects.

Neena Grover is an associate professor of biochemistry and chair of chemistry and biochemistry at Colorado College. She can be reached at ngrover@coloradocollege.edu.

From Pen to Pipette

Summer program at Woods Hole brings scientists and science journalists together

BY NICK ZAGORSKI

As a writer and associate editor for Harvard Health Publications, Christine Junge interacts with the world of medical research on a daily basis, interviewing scientists and writing up news stories on the latest exciting discoveries. This day, though, as she cradles a small sea urchin in her hand to examine its intricate spiny exterior, Junge is getting a lot closer to research than she probably ever imagined.

And she's not alone; several other journalists and editors who cover science in their work have gathered from around the world on the campus of the Marine Biological Laboratory (MBL) in the small town of Woods Hole, MA to learn more about what basic biomedical research is really all about. Over the next eight days, these science writers will take part in MBL's Logan Science Journalism Program, temporarily exchanging their reporter's hats for lab coats and getting a true "hands-on" look into the life of a laboratory scientist.

Of course, bringing diverse people together is nothing new for the MBL; since its founding in 1888, this institution has been a scientific focal point during the summer months (though scientific visitors do come year-round). Initially, it was an opportunity for researchers to work with MBL's extensive marine resources, but as the institute has shed the label of conducting marine-only research (which is why it prefers to be known as "MBL" rather than "Marine Biological Laboratory"), scientists of all types have converged here. Summer education is also a long-standing tradition; science students have flocked to MBL for years to take one of its well-known graduate and special topics courses.

The Logan Science Journalism Program (SJP), however, is a different sort of adult education; the participants enter with very little, if any, firsthand scientific background. So, during the short, but intensive, program—think of it as a basic science "boot camp"—the participating fellows will get crash-course lectures on fundamental principles in biochemistry, molecular biology, cell biology, genetics, and development; observe and conduct laboratory experiments like PCR and selective yeast plating; meet MBL scientists and learn about their ongoing research; and even get an opportunity to go out in the field, which in this past session included a tour of Martha's Vineyard's unique ecosystem and a trip aboard the MBL's marine organism collection vessel *RV Gemma*.

SJP scientific co-director Brad Shuster (*left*) demonstrates the use of centrifugation to separate cellular components to journalism fellows Christine Junge (*center*) and Juliana Tiraboschi.

It's not all business, however, and along the way the fellows can partake in plenty of social activities, whether it's chatting with newfound colleagues over dinner or taking a stroll through the quaint waterfront town before retiring to their dorms (the SJP does offer a "true" education experience) until the next day's work.

By week's end, the SJP hopes the fellows can return to their offices with a better understanding of the kind of work researchers do, as well as what kind of people scientists are. It may seem like a small thing, but the relationship between scientists and the journalists/public information officers who publicize them is a symbiotic one that is vital for continued scientific literacy and progress. Yet frequently, representatives on either side may not truly appreciate their counterpart, which can cause some friction. The SJP, which has been conducted every May since 1986, is a fine example of an educational effort to remedy this gap, making use of the old saying "If you can walk a mile in another man's shoes."

Alumna Andrea Early, who participated in the SJP back in 1993, can attest to that. "It may sound a little cliché, but I had the time of my life when I participated in the program," she says, "and it definitely gave me a new outlook into my role as a science writer." Early loved it so much, in fact, that she couldn't stay away; she came back to serve as MBL's director of communications and administrative director of the SJP. She notes that the program has received such praise from all parties involved that it has recently expanded; in addition to the biomedical program at Woods Hole, MBL now offers a polar program at its field station in Alaska.

Enthusiasm at the 2009 program was equally on display. "It was great seeing these journalists take such a keen interest in the science," says David Burgess, a professor in the Department of Biology at Boston College who, along with his former postdoc Brad Shuster (currently an assistant professor at New Mexico State University), took over this year as the SJP scientific co-directors. (Burgess, who uses sea urchins as models in his studies of cytokinesis, has been a frequent MBL summer visitor and saw the position as a chance to give back to a place that has helped him tremendously.) "They asked a lot of questions, often took the planned discussions in a different direction, and even proposed some of their own experiments; it was just like they were graduate students."

In fact, just like graduate students, the fellows spent much of their free time each night in the lab, hanging out informally with the instructors and getting to learn a little more about science and themselves. Before the end, they even helped put together a movie night featuring some of their videos of sea urchin fertilization and embryogenesis, which was one of the SJP's major experimental topics.

And by the time the fellows were ready to go home, they managed to take a whole wealth of knowledge back with them. Naturally, the fellows developed new connections with their classmates and some MBL scientists and also picked up some potential story ideas from the exciting local research they had heard about. However, the biggest take-home message, as intended, was an increased appreciation of science.

Kimani Chege, for example, who came to the MBL right after completing a Knight Journalism Fellowship at the Massachusetts Institute of Technology (MIT), was extremely intrigued by the lecture explaining the basics of genetic engineering, as this topic is quite relevant in his home country of Kenya in regards to genetically modified agriculture. Meanwhile, Massimo Roncati, who runs a small magazine devoted to science hobbyists with his wife back in Italy, was fascinated by the technical details of science and eager to learn more about all things microscopy. As for Junge, the trip ended up helping both her work and her hobby. "I like to write fiction in my spare time," she says, "and now I feel I can have a scientist in one of my stories and make him feel more believable as a character."

To learn more about the MBL's Logan Science Journalism Program (of which ASBMB is a sponsor), please visit www.mbl.edu/sjp/index.html.

For a more in-depth look at the recently concluded 2009 program, featuring photos, videos, and blogs by some of the participants, visit http://logansciencejournalism.wordpress.com/2009/08.

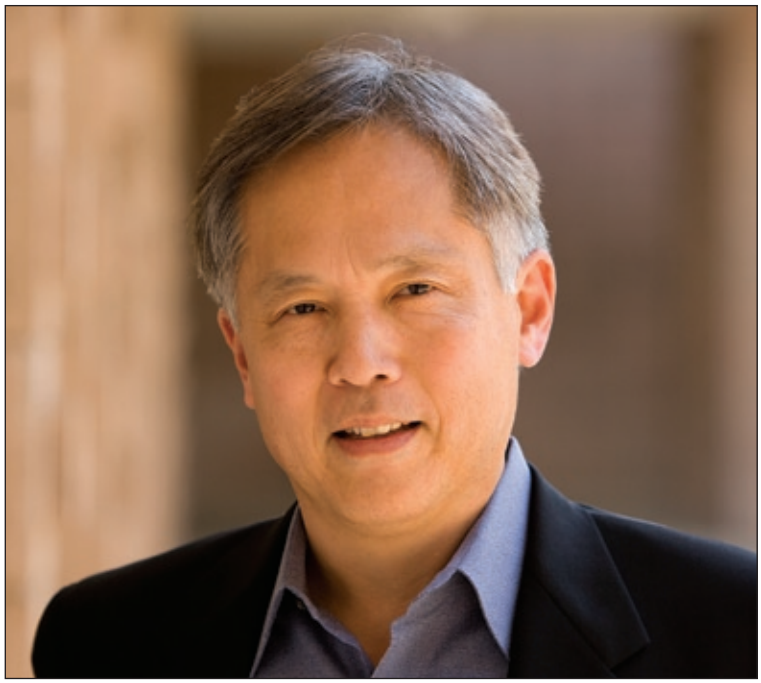
2009 Logan Science Journalism Program attendees

Kimani Chege, Science and Development Network
Julia Kumari Drapkin, stringer, PRI's "The World"
Christine Junge, Harvard Health Publications
Massimo Roncati, *L'Hobby Della Scienza e Della Technica*
Juliana Tiraboschi, *Galileu Magazine*
Nick Zagorski, *ASBMB Today*

Nick Zagorski is a science writer at ASBMB. He can be contacted at nzagorski@asbmb.org.

ASBMB Roundtable: David Asai

BY NICK ZAGORSKI



Elegantly illustrated by the numerous Science Focus subjects who possess the title of Howard Hughes Medical Institute (HHMI) Investigator, the Howard Hughes Medical Institute is known around science circles as being synonymous with excellent research. However, somewhat overshadowed by HHMI's funding of today's elite scientists is its role in supporting future generations of researchers through numerous education initiatives. Over the last 20 years, in fact, some 70,000 students have been supported by HHMI science education grants—certainly not a pittance. Over that period, ASBMB member David Asai has worked closely with many of those students as an HHMI program director at both Purdue University and Harvey Mudd College, and he knows full well the difference that supporting student research can make. Since August 2008, Asai has continued his efforts from a different perch, that of HHMI's director of pre-college and undergraduate science education. He sat down with ASBMB to provide a sense of HHMI's educational mission.

ASBMB: ***For those who may not be familiar with the operation, would you provide a brief overview of HHMI's efforts in promoting science education among undergraduate and K-12 students?***

ASAI: Certainly; our section of the education division encompasses four major areas. The first is our education grants to both small liberal arts colleges and larger research universities to provide student research funding as well as improve curricula and perform community outreach; we currently support 98 institutes with these 4-year awards. We also have 31 precollege science education grants, which we award to biomedical research institutes, as well as five local grants that we provide to schools in Maryland and northern Virginia in conjunction with NIH and Janelia Farm. Next, there's the HHMI professors program, which funds creative researchers so they can pursue innovative models of teaching undergraduates at their home institutions; it's like an educational version of an HHMI investigator. Finally, we're extremely proud of the Exceptional Research Opportunities Program (EXROP), which provides research experience to underrepresented minorities.

Now, my area is just one part of a whole. We have another section devoted to graduate level science education, directed by Bill Galey, and the Educational Resources group, run by Dennis Liu, that produces the annual HHMI Holiday Lectures. HHMI just last year launched a nationwide program, headed by Tuajuanda Jordan, called the Science Education Alliance (SEA)* that's been really taking off. Basically, freshmen at partner colleges and universities go out in the environment to collect and characterize bacteriophage. According to HHMI professor Graham Hatfull, the results from the SEA students have directly contributed to the verification of new clades of phage.

ASBMB: ***How did you get drawn away from your lab and into this new administrative role?***

ASAI: Well, I had known (former HHMI President) Tom Cech and Peter Bruns (HHMI's vice president for grants and special programs) for a while since we all studied *Tetrahymena*, and in early 2008, they presented me with this opportunity. Now, it was a very difficult decision; after running a lab for 27 years, it became like a second home to me, and I would have to shut it down to take the appointment. But I saw this as a great challenge because I've long advocated the importance of scientific literacy; as a nation, we cannot maintain any scientific power unless we have scientific

understanding. This area was also close to my heart because I had personally experienced different aspects of undergraduate research education; at Purdue I witnessed the problem faced by many big universities, in that undergraduates aren't the focus of the school's research enterprise. Then at Harvey Mudd, whose entire student body is smaller than Purdue's biology department, I found that you can conduct excellent research with undergraduates, but realized small academic institutions face their own limitations as well.

Of course, as soon as I arrived I found out that Tom was stepping down as HHMI president to return to his lab; I hope I didn't have anything to do with that!

ASBMB: ***Now, in your own career, you've had a couple of personal experiences that highlight how valuable research experience at an early age can be.***

ASAI: True, I started doing research during high school through an NSF summer program and that experience got me hooked on science. So, when I enrolled at Stanford, I already knew my passion and that let me begin laboratory research as a freshman, which helped get me a leg up.

Later, when I began my own independent research at the University of California-Santa Barbara in 1982, I remembered my experiences and encouraged undergraduate work in my lab; and the very first student to join was a young woman named Carol Greider. As you may know, a few years later, Greider would go on to discover telomerase while a graduate student, leading to a long and distinguished career. As Carol likes to remind me, I was instrumental in her development because I gave her advice about graduate school, and she chose to ignore my advice and instead went to Berkeley to work with Liz Blackburn.

ASBMB: ***So would it be fair to say one of HHMI's pre-graduate educational goals would be to maximize research opportunities for students?***

ASAI: Well, I think it's vital to stress that while HHMI believes undergraduate and precollege research can be tremendous, our mission is not simply to help groom future A-list scientists. One of the people we work closely with, David Lopatto at Grinnell College, has been studying this. David is a psychology professor who really understands kids, and he notes that at 18–21 years of age, this critical intersection between child and adult, individuals are really trying to find what they're good at. And that is what HHMI is trying to achieve: helping students find their passion, whether it's in a lab or not.

ASBMB: ***In our previous conversation with Tom Cech, he had hinted that re-energizing HHMI's education efforts had been one of his goals in office. And, I believe recently you had put forth one of these new ideas, a sort of challenge to conventional thinking?***

EXROP students Jabari Miller (*right*) and Alexandra Boye-Doe (*left*) share stories with EXROP alum Ana Cristancho (*center*) at a program meeting at HHMI headquarters. PAUL FETTERS, 2009

ASAI: Yes, for this round of educational grants to research universities, we've added some special supplemental awards to universities that are willing to think outside the box. In the past, HHMI grants supported activities in four key areas: student research, faculty development, curriculum development, and community outreach. This time around, the schools have an option to include a fifth component, which we call "Experiments in Science Education." We're inviting faculty at research universities to think of an educational problem we don't know the answer to and come up with bold and even outrageous ways to tackle it; maybe it will fail, but sometimes you have to encourage people to take risks.

ASBMB: ***Do you have any examples of what some of these problems and solutions might look like?***

ASAI: I try to refrain from suggesting what I think are interesting problems because I expect that the faculty who are proposing experiments will have much better ideas than mine. If you want some idea though, you can definitely take a look at our HHMI professors; they are great examples of what scientists can do if they get a little creative. The applications are due this month, so I'm very excited to start looking them over and seeing what ideas people came up with.

Harvey Mudd professor Eliot Bush oversees students in his class, "Computational Approaches to the Genome." Created with help from an HHMI grant, this class combines bioinformatics with practical problems in genome biology. KEVIN MAPP.

ASBMB: ***And what about the future? What other bold initiatives lie around the corner?***

ASAI: Well, normally I never try to look too far ahead; I've generally tried to live my life in 5-year chunks. That being said, I can tell you we do have a lot of exciting items on the HHMI plate. One of our first goals is building on the terrific success of the EXROP program, by expanding and increasing the size of the applicant pool. Another agenda item is revamping the structure of our HHMI professors program; in the next cycle, we plan on re-appointing just a small number of current professors so we can really change it up, and right now we're analyzing what direction the next generation of professors should take. Third, though this project is way down the road, I'd like to take a step back and look at undergraduate science education from a holistic perspective and use that perspective to help us identify key areas to target.

ASBMB: ***People often joke about just how much money HHMI has, but even so, you receive far more grant applications from schools than you could ever possibly fund. So, for teachers or students who are eager and willing to be creative and try new approaches, are there some other options they can pursue if they aren't an award recipient?***

ASAI: Yes, as much as we would like to, even HHMI doesn't have the resources to support all the worthwhile applications we've received. So, one of the other areas we're looking at expanding is our online resources. After all, information is free, and as I mentioned increasing scientific literacy—and not just in universities, but among the general public as well—is one of the nation's most important challenges. Look at the issues of the day—global warming, alternative energies, improving healthcare; it's all science. So, HHMI recently set up a new section on the website called Cool Science (www.hhmi.org/coolscience) that we think will be extremely valuable. It features items for teachers, such as lab modules or syllabus ideas, as well as sections for kids of all ages, including some fun and interactive material. And anyone can access this, and we hope a lot of people will make use of it.

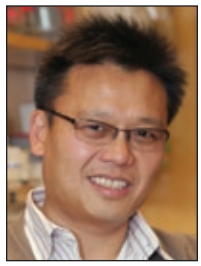
* Be sure to check out ASBMB audiophiles to listen to a podcast with SEA Director Tuajuanda Jordan and learn more about the Science Education Alliance.

Nick Zagorski is a science writer at ASBMB. He can be reached at nzagorski@asbmb.org.

Developments in Quantitative Biology

BY JAMES E. FERRELL, JR. AND WENDELL A. LIM

FERRELL



LIM

If the last few decades have been the halcyon days of qualitative biology, quantitative biology is now on the upswing. There is a growing realization that the complexity of biological systems demands quantitative experimental, computational, and theoretical approaches. The importance of being quantitative has long been appreciated by ASBMB and its members—for example, G. S. Adair's classic 1925 treatment of the binding of oxygen to hemoglobin was published in the sixth of six back-to-back papers in the Society's *Journal of Biological Chemistry*. The 2010 ASBMB Annual Meeting will highlight some of the recent excitement in quantitative biology in four symposia under the rubric of "Systems Biology, Synthetic Biology, and Signal Transduction."

One of the driving forces behind the current explosion of quantitative biology has been the development of new technologies for obtaining huge amounts of data—deep sequencing, microarrays, mass spectroscopy, and the various other "omics" approaches. The first symposium under the systems biology theme takes on the challenge of "Making Sense of Whole Genome Data." One of the most promising approaches comes out of 18th century probability theory and 21st century computer science—Bayesian analysis. Daphne Koller (Stanford University) has been a pioneer in developing machine learning approaches and applying them to the analysis of complex biological processes. Koller will be joined by Roy Kishony (Harvard Medical School), who focuses on how various perturbations—mutations, stresses, drug treatments, and combinations thereof—affect complex networks. Rounding out the session is Jonathan Eisen (University of California, Davis), whose lab studies how new functions and processes evolve in microorganisms. Eisen is also the academic editor-in-chief of *PLoS Biology* and is an author of the textbook "Evolution."

This segues into a symposium on "Evolution and Development." Speakers in this session include Michael Lynch (Indiana University), whose lab studies the mechanisms of evolution—the roles of mutation, genetic drift, recombination, and so on—in a variety of standard (*Caenorhabditis elegans*, *Drosophila*) and less-standard (*Daphnia*, *Paramecium*) model organisms. The symposium continues with Marian Walhout (University of Massachusetts), who focuses on the topology and evolution of transcription factor networks in the nematode *C. elegans*. Ultimately, the hope is that as such networks are more mapped out, the substructures of the network and the basic algorithms of development will begin to be better understood. Toward that end, Arthur Lander's group (University of California, Irvine) has been carrying out not only high-throughput, omics-style studies, but also low-throughput live-cell imaging and mathematical modeling aimed at understanding the engineering principles at the heart of development, focusing on feedback loops, and intercellular interactions.

> **"The 2010 ASBMB Annual Meeting will highlight some of the recent excitement in quantitative biology in four symposia under the rubric of 'Systems Biology, Synthetic Biology, and Signal Transduction.'"**

Reductionistic systems biology—the systems biology of modest-sized subsets of the omics-level whole—continues in the symposium on "Signaling Modules." James E. Ferrell, Jr. (Stanford University) will be presenting studies of

cellular switches and oscillators that draw on quantitative experiments and non-linear dynamics. Mary N. Teruel (Stanford University) has been using single cell microscopy as well as bioinformatics approaches to investigate the evolution of specificity in the PIP3 signaling module. And Chao Tang (University of California, San Francisco) will present an exciting, intuitively appealing computational approach aimed at understanding what types of biological circuits work best in homeostasis, comparing the performances of tens of thousands of circuits with each other (just as a microarray experiment compares the behavior tens of thousands of mRNAs with each other).

Biochemists have long recognized that if you understand a biochemical machine you should not only be able to take it apart, but also put it back together. Ultimately, this higher level of understanding may guide the engineering of cells with useful, precisely designed functions. In this spirit, the fourth symposium focuses on "Synthetic Biology." Wendell Lim (University of California, San Francisco) will present his work on re-engineered signaling proteins and networks, studies that test our basic understanding of how diverse signaling responses can be built through simple evolutionary steps. Peter Pryciak (University of Massachusetts Medical School) will discuss how synthetic biology approaches can be used to elucidate the importance of subcellular localization in regulating the signaling properties of MAP kinase cascades. Finally, Drew Endy (Stanford University) will present his vision of how standardized biological parts could be used to build broadly useful functional modules, such as scaleable genetic memory.

These 12 speakers anchor the four symposia. In addition, 12 short talks will be chosen from the abstracts submitted to provide new voices with the chance to be heard and to allow us all to stay on top of this exciting, dynamic field. We look forward to seeing you in Anaheim!

James E. Ferrell, Jr. is professor and chair of chemical and systems biology and a professor of biochemistry at the Stanford University School of Medicine. He can be contacted at james.ferrell@stanford.edu. Wendell A. Lim is a professor of cellular and molecular pharmacology, a professor of biochemistry and biophysics, and an investigator of the Howard Hughes Medical Institute. He is also director of the UCSF/UCB NIH Nanomedicine Development Center and deputy director of the National Science Foundation Synthetic Biology Engineering Research Center. Lim can be contacted at lim@cmp.ucsf.edu.

Systems Biology, Synthetic Biology, and Signal Transduction

SYMPOSIUM: MAKING SENSE OF WHOLE GENOME DATA

Phylogenomics, Evolvability, and the Origin of Novelty in Microbes, *Jonathan Eisen, University of California, Davis*

Drug Interactions and Resistance, *Roy Kishony, Harvard Medical School*

Gene Regulatory: From Networks to Mechanisms, *Daphne Koller, Stanford University*

SYMPOSIUM: SIGNALING MODULES

Experimental and Computational Dissection of the Cell Cycle Oscillator, *James E. Ferrell, Jr., Stanford University*

Design Principles in Biochemical Adaptation, *Chao Tang, University of California, San Francisco*

Insulin/PI3K Signaling Network Control of Fat Cell Function, *Mary N. Teruel, Stanford University*

SYMPOSIUM: EVOLUTION AND DEVELOPMENT

The Engineering of Developmental Regulation, *Arthur D. Lander, University of California, Irvine*

Evolution, Population Dynamics, and Genomics, *Michael Lynch, Indiana University*

Transcriptional Regulatory Circuits in *C. elegans*, *Marian Walhout, University of Massachusetts*

SYMPOSIUM: SYNTHETIC BIOLOGY

Scaleable Synthetic Genetic Memory, *Drew Endy, Stanford University*

The Evolution and Engineering of Signaling Pathways, *Wendell A. Lim, University of California, San Francisco*

Regulating MAP Kinase Cascade Signaling by Subcellular Localization, *Peter Pryciak, University of Massachusetts Medical School*

Education and Professional Development: Diversifying Our Repertoire

BY PETER J. KENNELLY

KENNELLY

X-ray crystallography, SDS-PAGE, cloning, recombinant protein expression, site-directed mutagenesis, transgenic animals, genomics, proteomics, metabolomics... the past 50 years have witnessed a steady succession of quantum leaps in our ability to explore, understand, and manipulate the chemistry of life. These revolutionary changes have transformed biochemistry and molecular biology (BMB) from a largely academic enterprise into a major player in the world economy, one whose importance will only increase with calls for the development of sustainable energy and environmental, agricultural, and healthcare strategies. Consequently, employment in the commercial/industrial sector now far outstrips that in academia. Whereas college biochemistry majors once uniformly aspired to pursue an advanced degree, today BMB majors transition directly into the workforce upon receipt of their B.S. Increased commercialization has spawned a surfeit of careers "beyond the bench" and fueled a burgeoning demand for training in complementary skills.

The Education and Professional Development theme will focus on the opportunities and challenges presented by today's dynamic career environment. The sessions grouped under the rubric of professional development highlight some of the important, but oftentimes unfamiliar, career options open to students with BMB degrees. These careers constitute more than an additional source of jobs. They offer an opportunity for individuals of diverse skills and interests to identify a rewarding career. After the Undergraduate Affiliate Network's undergraduate poster session on Saturday afternoon, participating students and faculty are invited to a workshop on career options moderated by Cynthia M. Barber (PBM Products LLC) and myself. On Sunday, this theme will be continued and expanded in a session entitled "The Biochemistry and Molecular Biology Career Spectrum." Lisa M. Balbes (Balbes Consultants) will provide an overview of careers beyond the bench. Subsequent speakers will discuss non-stereotypical careers from a personal perspective. Joan Kwong (Pfizer Inc.) will speak on "Careers in Regulatory Affairs," and Evelyn Jabri (American Chemical Society) will discuss "Careers in Publishing."

"These careers constitute more than an additional source of jobs. They offer an opportunity for individuals of diverse skills and interests to identify a rewarding career."

While scientific competency constitutes the foundation of career success, people lacking complementary skills increasingly find themselves at a disadvantage in the job market and workplace. In a session entitled "Complementary Skills: What Are Employers Looking For?", Susan Ainsworth (Chemical & Engineering News) will discuss the types of complementary skills employers are looking for and Cynthia Barber (PBM Products LLC) will offer suggestions on how to become a well-rounded job candidate.

The sessions grouped under the rubric of education will focus on addressing the needs of students seeking complementary skills and multidisciplinary training. The session entitled "Classroom of the Future I: Models for Multidisciplinary Training" will focus on professional master's programs as vehicles by which B.S. students wishing to enter the work force can diversify their skills. Sheila Tobias (science-teaching-as-a-profession.com) will discuss the role and structure of professional master's programs. Next, Dale Sevier (San Diego State University) will talk about his school's highly successful M.S. in regulatory affairs program. Edward Caner (Case Western Reserve University) will speak on

his university's award winning science and technology entrepeneurship program.

A second session, "Classroom of the Future II: Professional Training for B.S. Students," will be devoted to models for providing professional and multidisciplinary training within the context of a bachelor's degree program. Li Zhang (University of Texas at Dallas) will discuss her department's popular B.S. in molecular biology and business administration. Next, Jonathan Monroe (James Madison University) will speak on JMU's successful interdisciplinary B.S. program in biotechnology, and Dorothy Deremer (Montclair State University) will discuss her school's innovative science informatics major.

It is my hope that these sessions will help raise the career awareness of both students and their advisors and stimulate thinking on innovative ways to meet the needs of the growing number of students seeking complementary and multidisciplinary training.

Peter J. Kennelly is professor and head of the Department of Biochemistry at Virginia Polytechnic Institute and State University. He can be reached at pjkennel@vt.edu.

Careers in Biochemistry and Molecular Biology: A World of Options, a Variety of Skills

CAREER WORKSHOP FOR UNDERGRADUATES

Peter J. Kennelly, *Virginia Polytechnic Institute and State University*

Cynthia M. Barber, *PBM Products LLC*

THE BIOCHEMISTRY AND MOLECULAR BIOLOGY CAREER SPECTRUM

Careers for BMB Majors, *Looking Beyond the Bench, Lisa M. Balbes, Balbes Consultants*

Careers in Publishing, *Evelyn Jabri, American Chemical Society*

Careers in Regulatory Affairs, *Joan Kwong, Pfizer, Inc.*

CAREER ENVY: THE ROAD TO A SUCCESSFUL PUI POSITION PANEL DISCUSSION

(Panel is part of the Career Spectrum session)

Ryan Mehl, *Franklin & Marshall College*

Myriam Cotten, *Hamilton College*

Sean Decatur, *Oberlin College*

Joseph Provost, *Minnesota State University Moorhead*

Kathleen Parson, *Macalester College*

COMPLEMENTARY SKILLS: WHAT ARE EMPLOYERS LOOKING FOR?

Talk Title to Be Announced, *Susan Ainsworth, Chemical & Engineering News*

Becoming a Well-rounded Job Candidate, *Cynthia M. Barber, PBM Products LLC*

CLASSROOM OF THE FUTURE I: MODELS FOR MULTIDISCIPLINARY TRAINING

Entrepreneurial Biotechnology & Other Masters Programs in Innovation at Case Western Reserve University, *Edward Caner, Case Western Reserve University*

The M.S. in Regulatory Affairs Program at San Diego State, *E. Dale Sevier, San Diego State University*

Professional Master's Degrees for Biochemistry and Molecular Biology Students, *Sheila Tobias, science-teaching-as-a-profession.com*

CLASSROOM OF THE FUTURE II: PROFESSIONAL TRAINING FOR B.S. STUDENTS

Embracing the Information Age: The Science Informatics Major at Montclair State University, *Dorothy Deremer, Montclair State University*

An Interdisciplinary B.S. Program in Biotechnology, *Jonathan Monroe, James Madison University*

The B.S. in Molecular Biology and Business Administration at UT Dallas, *Li Zhang, University of Texas at Dallas*

UNDERGRADUATE SMART TEAMS

Exposing Students to the Process of Science through Physical Modeling, *Tim Herman, Milwaukee School of Engineering*

SAY WHAT YOU MEAN: TIPS FOR GRANT WRITING

Know Your Audience, *Peter J. Kennelly, Virginia Polytechnic Institute and State University*

What Makes a Grant Application Competitive, *George M. Carman, Rutgers University*

What to Put In, and Where, *Lisa Gentile, University of Richmond*

How to Work WITH Your Program Officer, *Parag Chitnis, National Science Foundation*

A Brave New Virtual World of Science

BY WEIYI ZHAO

Have you ever had an argument with a friend, a question about a natural phenomenon, or simply needed a recipe while away from the internet and vehemently wished that Google or Wikipedia was close at hand? Like it or not, many of us spend a large amount of our time each day in front of the computer. We have come to depend on the Web in many ways. Whether it's learning how to bake an apple pie or looking up a piece of obscure historical information, the internet rarely fails to give an answer to your question. What about when it comes to subjects in biochemistry and molecular biology? What types of information are out there, and how accurate and reliable are they? Where can a high school student turn to learn about DNA, a science teacher for information about photosynthesis, or an undergraduate biology student for a refresher on gluconeogenesis?

As it turns out, when it comes to biology and chemistry, there are some spectacular online resources dedicated to educating both the layperson and the erudite. They span the spectrum from online encyclopedias to websites that are both visually stimulating and interactive. On the more didactic end is University of Arizona's **The Biology Project** (BP), which covers a wide range of topics from biochemistry to cell biology to immunology. The materials are presented in a fashion similar to a textbook organized by chapters accompanied by diagrams and illustrations. Visitors to the site are expected to do a fair amount of reading. Some lessons come with interactive materials in the form of mini-quizzes. Navigating though the site is fairly easy and straightforward. According to BP's developers, their materials have been tested on thousands of students and are suitable for "high school students, medical students, physicians, science writers, and all types of interested people."

"As it turns out, when it comes to biology and chemistry, there are some spectacular online resources dedicated to educating both the layperson and the erudite."

In a similar vein to the Biology Project, is the **Medical Biochemistry Page** developed by Indiana University School of Medicine. This site offers information on a wide range of biochemistry concepts such as thermodynamics, metabolism, and protein synthesis.

If you're motivated to learn or teach principles of genetics, the University of Utah's **Learn Genetics** website is a great online resource for information on DNA, heredity, and gene manipulation. The website itself is visually appealing, and the information is well categorized. Materials come in different formats: Flash graphics with voiceover, photographs, illustrations, videos, and point-and-click interactive animations. As an example, when one clicks on "DNA Extraction" under the Virtual Labs section of the website, a series of Flash videos guide a person through the process of DNA extraction in a virtual laboratory setting complete with virtual pipetting and centrifugation. A home DNA-extraction protocol is provided at the bottom of the page, where aspiring young scientists (or those who have never done this before) can extract DNA from fruit and vegetables using a blender and some common household reagents in their own kitchens. More advanced topics such as epigenetics, genetic disorders, and stem cells are also explored on Learn Genetics. Not only can visitors to the site gather basic information on nucleic acids and gene manipulation, they are also taught why genetic research is important and learn about its applications in medicine.

The website **Action Bioscience**, sponsored by the American Institute of Biological Sciences, is an excellent resource for showing that science can be entertaining and relevant. The developers' goal is to promote bioscience literacy among the general public, and the website places heavy emphasis on demonstrating how biological sciences affect everyday life. By covering topics such as biodiversity, bioterrorism, and evolution, Action Bioscience provides a broad perspective on how science is helping us understand and tackle issues in modern society such as disease epidemics and climate change.

Science educators looking for innovative teaching tools to capture students' imagination can turn to **Molecular Movies**. The site offers a collection of three-dimensional, computer-generated movies that simulate the

A virtual laboratory on the Learn Genetics website lets the user practice their DNA extraction techniques.

molecular and cellular world. For example, a student can watch a movie called *The Inner Life of the Cell* by Harvard BioVisions to help solidify the concepts he/she learned in class. There are also videos on apoptosis, embryonic development, and multiple sclerosis. One of Molecular Movies' greatest features is that the website devotes an entire section to three-dimensional modeling tutorials so that any scientist can learn to make three-dimensional movies of his own favorite molecule or cellular process. Read the ASBMB UAN online newsletter, *Enzymatic*, for regular reviews of existing molecular movies.

Not content to simply sit and watch? Check out **Foldit**, an online video game where players help researchers determine the three-dimensional structure of proteins. Although still in a beta version, Foldit represents a new generation of online learning tools that tap into the younger generation's obsession with video games.

The websites described above represent a small fraction of the science learning resources available online. Not meant to replace classroom or laboratory learning, online learning can be used to supplement the classroom and laboratory experience. More importantly, the internet can help expand the reach of science, increase science literacy among the general population, dispel the misconception that science is difficult or boring, and inspire young people to pursue careers in science.

Links to the websites discussed in this article can be found at www.asbmb.org/educationresources.

Weiyi Zhao is the ASBMB manager of education and professional development. She can be reached at wzhao@asbmb.org.

Cheap and Easy Ways to Help Students Become Scientists

BY SYDELLA BLATCH

There are a growing number of concerns about the low numbers of U.S. students who will be well prepared to enter research careers and the scientific work force in the future. There is even more concern regarding a lack of minority scientists, called underrepresented minorities (URM) in these settings. As researchers and teachers, college professors seem to take a central role in filling this gap. But this is no small task, and professors typically have a mountain of other things to do. Most well-known efforts to expand this future work force have been successful. Some examples are undergraduate research programs like the National Institutes for Health-Funded Minority Access to Research Careers or grant supplements to hire undergraduate researchers, like the National Science Foundation's Research Experiences for Undergraduates (NSF REU). However, these approaches can require large amounts of time and money, which limit their broad usage. Perhaps this is the reason that it seems like only a fraction of science professors are purposely working to prepare URM and all undergraduates for biomedical careers. If there were evident and easily accessible ways to increase the number of undergraduates involved in research, more students (especially URMs) might seek these paths.

> **"Why not offer a short tour of your lab to students in your classes?"**

What follows are suggestions for free (or inexpensive) and relatively simple ways professors (and graduate students and postdocs) can help increase undergraduate research and professional development, with special notations for URM students.

Free, 5-Minute Fixes

If you teach a class, there are several quick ways in which you can help more students stick with science careers. You can use the last few minutes of class time to tell students things that we often assume they already know:

- **Explain why research experience will benefit them.** A lot of students are not fully aware that research experience is needed to be a competitive applicant for medical school, graduate school, and the science work force in general.
- **Tell students how they can get research experience.** List websites for summer research programs and make suggestions for how students can ask professors about volunteering in their labs. Most students do not know that volunteering is often the easiest way to get a foot in the door, and the few who do know this may feel unsure of how to ask professors.
- **Profile different scientific careers and scientists from different backgrounds.** In many of my lectures, the first slide contains biographical information and a list of accomplishments for a past or present scientist of color. I also incorporate scientific accomplishments from African civilizations, for instance, into the historical tidbits already covered within the course material. This has encouraged some students to share their own knowledge of scientific accomplishments from non-Western cultures, and one student even asked for more information once the course was over. It is helpful for students, especially URM and women, to be able to see themselves as scientists. These profiles can also help students choose research careers as they become more aware of the breadth of actual options. Many students want to be doctors because they like biology and simply do not know of other rewarding biological careers.

Free, 15-Minute Fixes

Now that you have spent 5 minutes convincing students they should get involved in research, you can use 15 minutes to help get them physically in the door. Why not offer a short tour of your lab to students in your classes? There, you can explain your research goals and show students how you answer these questions. These connections are often hard to imagine for students beginning their biological education. And hopefully, the tour will spark interest in

some students who have been turned off by traditional or cookbook laboratory exercises.

To further encourage undergraduate research, my dissertation chair, Jon F. Harrison, invited any student earning an "A" in his class to assist graduate students in the lab for course credit or as a volunteer. This pulled in excellent researchers who said they never would have thought to volunteer in a lab and/or did not even feel they were qualified to do so. An added bonus is that your research can benefit from having cost-free researchers! By extending these kinds of invitations to students, these approaches reduce the chance that students shy away from research because of feeling unwelcome in the lab or intimidated. This can be an even stronger barrier for URM students who may already feel like outsiders.

Teaming up with Graduate Students and Postdocs

You are very busy, and so are graduate students and postdoctoral researchers. But often these trainees are very eager to work with students and "give back" because it can provide more balance to their lives and help prepare them for their own careers. In little time, graduate students and postdocs can do a lot to encourage undergraduate research and professional development in different ways. One way is through structured mentoring programs. These go beyond informal mentoring by building communities of young scientists. These are especially lacking among URM students who are often isolated because they are underrepresented.

For example, a program I began at Arizona State University called the *Shades Multicultural Mentoring Program* (2) allows graduate students to mentor undergraduate students of color with similar career interests. Students were easily recruited to participate at campus-wide events and then matched via career goals or areas of study. Mentors can contact their mentees by phone or e-mail, and all students convene over lunch twice a semester to socialize and learn from guest speakers about professional development in the sciences. Mentees who spoke to me said they learned a lot about navigating careers and felt encouraged by the fact that an older peer wanted to help them with their future.

"Mentees who spoke to me said they learned a lot about navigating careers and felt encouraged by the fact that an older peer wanted to help them with their future."

A second way to tap into graduate students and postdocs is with those who have interests in teaching and are seeking teaching experiences outside of traditional teaching assistantships. Two different programs designed by education staff have worked well at the National Institutes of Health. In one such program, postdocs offer a seminar series to post-baccalaureate researchers called *Becoming an Effective Scientist* (3). Sort of a hybrid journal club, postdocs show the post-baccalaureates how to design experiments and keep lab notebooks and also teach introductions to various sub-specialties in biology with accompanying journal clubs. The other program was designed to enhance the experience of summer interns, who range from the high school to graduate school level. Interns were invited to eat lunch with two postdocs to informally discuss topics such as working in a lab, how to create poster presentations, and career options in biology. Some of the interns commented that they were happy to meet others like themselves, since they were at the "bottom" of the lab hierarchy with respect to both education level and age. Many participants came with questions about workplace dynamics with co-workers, how to keep up with research projects, and career and academic planning. We certainly got the sense that the students were harboring these questions but had no other comfortable place to ask them.

Having more undergraduates involved in research and aware of good career planning strategies benefits all of us. Even if as a professor or trainee you do not want to devote a large chunk of your career directly to this cause, you can still make great contributions toward it. XOXO

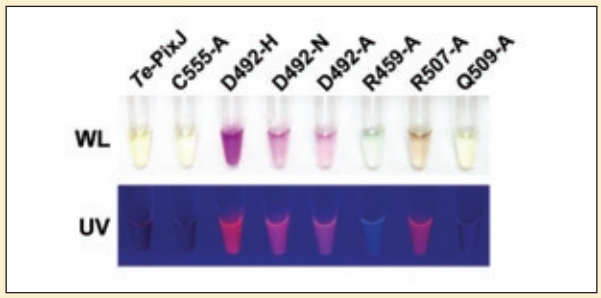
Sydella Blatch is a postdoctoral fellow at the National Institutes of Health and a member of the ASBMB Minority Affairs Committee. She can be reached at blatchsy@mail.nih.gov.

FOOTNOTES

1. A great text for more information on this is *Blacks in Science: Ancient and Modern*, Edited by Ivan Van Sertima, available from Amazon.com.
2. http://graduate.asu.edu/diversity/shades.html
3. http://dir.nichd.nih.gov/dirweb/postbac.html

A Rainbow of Chromophores

Phytochromes are a large family of photoreceptors that interconvert between a red light-absorbing, biologically inactive form (Pr) and a far-red light-absorbing, biologically active form (Pfr) to regulate a diverse array of processes in microorganisms and plants. Many phytochrome-like photoreceptors have recently been discovered, including a novel set of cyanobacterial proteins called cyanochromes that photoconvert between stable blue- and green-light absorbing forms (Pb and Pg). In this study, the researchers apply several physiochemical approaches to characterize the architecture and absorption properties of the cyanochrome chromophore, phycocyanobilin (PCB), using the *Thermosynechococcus elongatus* PixJ receptor as a model. They found the cyanochromes are similar in many aspects to canonical phytochromes but bind their bilin using two stable thioether linkages. The researchers also identified a set of amino acids crucial for photochemistry and mutated them to generate red and yellow chromoproteins that may be useful in biological applications.



Purified *Te*-PixJ cyanochrome mutants in solution under white light or UV light, highlighting the dramatic effects of simple amino acid changes.

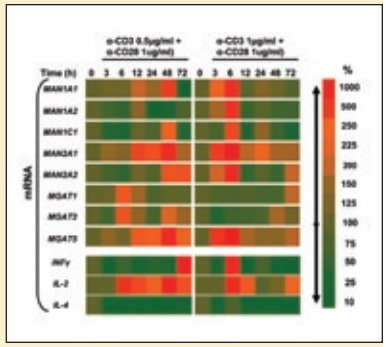
The Cyanochromes: Blue-Green Photoreversible Photoreceptors Defined by a Stable Double Cysteine Linkage to a Phycoviolobilin-type Chromophore

Andrew T. Ulijasz, Gabriel Cornilescu, David von Stetten, Claudia Cornilescu, Francisco Velazquez Escobar, Junrui Zhang, Robert J. Stankey, Mario Rivera, Peter Hildebrandt, and Richard D. Vierstra

J. Biol. Chem., published online August 17, 2009

jbc

Overseeing T-cell Glycan Branching



Quantitative real-time PCR of *N*-glycan pathway and cytokine genes in Jurkat T-cells stimulated with T-cell-activating anti-CD3 and anti-CD28.

T-cell activation results in enhanced branching of surface *N*-glycans, creating a molecular lattice that promotes growth arrest and inhibits autoimmunity. T-cell receptor (TCR) signaling is believed to be a key regulator of *N*-glycan branching, and in this study, the researchers took a detailed look at TCR signaling-mediated enzymatic activity. They found that TCR signaling differentially regulates the mRNA expression of multiple genes involved in *N*-glycan processing; the affected enzymes are all upstream of *N*-acetylglucosaminyl transferase V (*MGAT5*), which mediates β1,6GlcNAc-branching by transferring *N*-acetylglucosamine (GlcNAc) from UDP-GlcNAc to various *N*-glycan substrates. TCR signaling enhanced the levels of Golgi α1,2-mannosidase I (MI) and α1,2-mannosidase II (MII), while reducing the levels of *MGAT1* and *MGAT2*; blocking the increased MI or MII activity with drugs limited β1,6GlcNAc branching, suggesting both enzymes are required for the phenotype, while increasing *MGAT1* expression inhibited branching by limiting the supply of UDP-GlcNAc to *MGAT5.* Together, these alterations at the mRNA level cooperatively promote β1,6GlcNAc branching and subsequent T- cell growth arrest and self-tolerance.

T-cell Receptor Signaling Co-regulates Multiple Golgi Genes to Enhance *N*-Glycan Branching

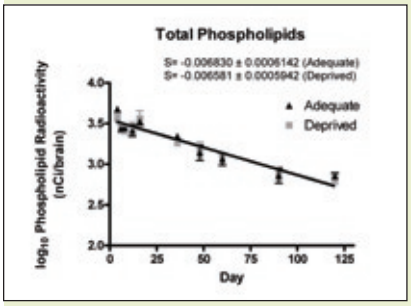
Hung-Lin Chen, Carey Fei Li, Ani Grigorian, Wenqiang Tian, and Michael Demetriou

J. Biol. Chem., published online August 25, 2009

jbc

The Kinetics of Arachidonic Acid in the Brain

The polyunsaturated fatty acid (PUFA) arachidonic acid (AA) has been recognized as a biochemically potent dietary compound due to its important role in the nervous system, both as a component of the cell membrane and a player in signaling cascades. Therefore, it is vital to understand the dynamics of AA entry and turnover in the brain. In this study, the researchers fed young rats either an n-3 PUFA adequate or deprived diet for 15 weeks and then injected them with ^{3}H-labeled AA before resuming their dietary treatment; 4 to 120 days after ^{3}H-labeled AA administration, brain samples were chemically analyzed. The half-life of AA in rat brain phospholipids was around 44 days for the n-3 PUFA adequate group and 46 days for the deprived group, which closely approximates a previously predicted half-life. Importantly, though, unlike a previous study in which the half-life of docosahexaenoic acid (DHA) was increased in n-3 PUFA-deprived rats, n-3 PUFA deprivation did not significantly alter the AA half-life, suggesting different mechanisms exist to maintain brain concentrations of the important brain fatty acids AA and DHA.



Radioactivity of ^{3}H-labeled arachidonic acid among total brain phospholipids in both PUFA-adequate and -deprived rat models.

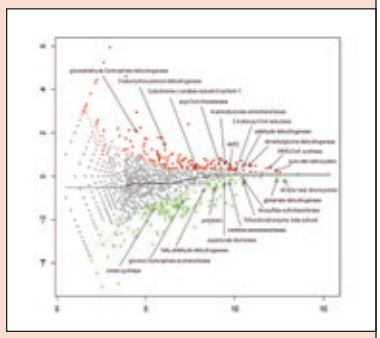
Brain Phospholipid Arachidonic Acid Half-lives Are Not Altered following 15 Weeks of N-3 Polyunsaturated Fatty Acid-Adequate or -Deprived Diet

Joshua T. Green, Zhen Liu, and Richard P. Bazinet

J. Lipid Res., published online August 6, 2009

Diabetes and Mitochondrial Activity

Type 2 diabetes (T2D) is a heterogeneous disease in which many underlying factors are involved in disease pathogenesis. Recently, evidence has suggested that mitochondrial dysfunction might be causally linked to T2D, so in this paper, researchers performed a multiplexed proteomics study on liver mitochondria isolated from a spontaneous diabetic rat model. They identified 1091 mitochondrial proteins, 228 phosphoproteins, and 355 hydroxyproteins and compared protein expression before and after the rats were rendered diabetic. Mitochondrial protein expression changed in a highly correlated fashion during T2D development; proteins involved in several bioenergetic processes were coordinately up-regulated, suggesting that in response to T2D, liver cells increase energy expenditure to rid themselves of the increased flux of glucose and lipid. Notably, oxidative phosphorylation levels increased, resulting in the overproduction of reactive oxygen species and subsequent oxidative stress as evidenced by heavier protein hydroxylation. The researchers also observed a depression of anti-apoptosis and anti-oxidative stress proteins, which might reflect higher apoptotic index during diabetes.



Changes in protein expression during the early development of T2D (up-regulated proteins in *red* and down-regulated proteins in *green*); genes already reported to be associated with T2D are highlighted.

Proteome, Phosphoproteome, and Hydroxyproteome of Liver Mitochondria in Diabetic Rats at Early Pathogenic Stages

Wen-Jun Deng, Song Nie, Jie Dai, Jia-Rui Wu, and Rong Zeng

Mol. Cell. Proteomics, published online August 23, 2009

A Life in the Museum

BY ERIKA SHUGART

From my youngest days, there was never any doubt in my mind that I would be a research scientist. In elementary school, I literally thought that everyone wanted to be a scientist, but some people didn't quite make it. I had this stilted worldview because I spent my first 13 years in Oak Ridge, TN, which is home to a national laboratory. This meant that most of the adults that I met were scientists. Today, I am a little less naïve. I didn't become a research scientist, however, because I found that a life at the bench didn't suit my personality. Nevertheless, I can't imagine a life without science in it. As deputy director of the Marian Koshland Science Museum in Washington, D.C., I have a position that allows me to explore cutting-edge research and keeps me satisfied.

My decision to pursue a non-research science career started with a shock. Midway through my graduate career, I was attending one of my first scientific conferences when I found out I had been scooped by a postdoc from my advisor's postdoctoral laboratory. I was already feeling dissatisfied with research, and this discovery pushed me into crisis mode. Because I had never imagined being anything but a research scientist, it took quite a bit of soul-searching before I was willing to admit to myself that I wanted to leave the bench. I completed my Ph.D. with the intention of using it in a non-research career, but the question was, what type of career?

There were very few resources available on "alternative science careers" in the mid-1990s, when I first started exploring my options. There was also very little support in my department, where even a career in industry was considered alternative. As I learned more about science writing, patent law, science policy, technology transfer, and other potential careers, I wanted to share what I learned with others. My exploration coincided with the initial spread of the World Wide Web. I decided to create a website on alternative science careers. My site was one of the first to gather information about a variety of careers in one place. I gathered my content from other websites and from informational interviews with professionals in fields of interest. The creation of the website gave me experience in non-academic writing, Web design, and html; it also helped to differentiate me from other graduate students. Ultimately, it was this website that helped me get an internship that eventually led to my first job.

I was drawn to science policy because it offered an opportunity to keep up with science while using my knowledge for public good. As I sought out people in the field for informational interviews, I was fortunate enough to cold call Janet Joy at the National Research Council's Board on Biology. She suggested I attend a session on alternative careers in science at the upcoming AAAS meeting that was to be held in Baltimore, MD. We met and talked. She needed someone to work on a website for a project and offered me a summer internship. I was about to graduate and decided to pursue that opportunity instead of a traditional postdoc. My advisor was supportive, but I was told by other faculty in the department that I was making a huge mistake. In the mid-1990s, there was a significant stigma in the academic community to leave research, and I felt it acutely. I am fortunate to have a supportive spouse who encouraged me to find work that I could love.

Erika Shugart

Erika Shugart, deputy director, oversees the development of new exhibits for the museum as well as the museum's web site. Prior to joining the museum staff, Erika directed the National Academy of Sciences Office on Public Understanding of Science, managing several projects including the article series Beyond Discovery. Erika began her career at the National Academies as an intern with the Board on Biology. Erika also worked at the Office of Policy Analysis at the National Institute of Allergy and Infectious Diseases, NIH. She received her Ph.D. in biology from the University of Virginia.

Additionally, the Washington, D.C. area offers many opportunities for couples with dual science careers.

It didn't take long in my new internship for me to realize that the naysayers were wrong and that I was finally finding a path to a career I could enjoy. I spent the summer helping to prepare for a large conference on biodiversity. I loved working on a project with a set completion date, and it was rewarding to work closely with a group to achieve a goal. When the conference finally occurred, I was busy but relished the opportunity to learn about a new subject from some of the best minds in the field. When my internship was about to end, I was offered a position at the National Academy of Science's Office on Public Understanding of Science (OPUS), which had helped with the outreach for the conference. I had gotten to know the office's director, Donna Gerardi, and she was looking for someone with a science background to add to her staff.

> **"In the mid-1990s, there was a significant stigma in the academic community to leave research, and I felt it acutely."**

Although I originally intended to work in policy, the availability of the position at the right time and place moved me into science outreach. I was happy about the opportunity because I still felt as if I was helping the community and had the opportunity to learn about a wide range of interesting science. I worked primarily on a project called "Beyond Discovery," a series of articles describing the basic science behind applications, such as GPS or leukemia drugs. As the articles expanded from print to the Web and even television shorts, I learned different approaches and strategies for reaching audiences to communicate science. Over the next 6 years, I worked my way up to become the director of OPUS.

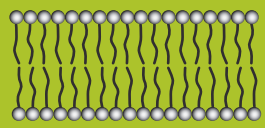
At that point, the major project that had been the focus of OPUS was winding down. To work through my next steps, I hired a career coach. She helped me to recognize what I liked and didn't like about my job. As I began to explore possible options, I knew that there was a project starting up just down the hall that was of real interest to me. The NAS had received a generous gift from Daniel Koshland to start a museum in memory of his wife, Marian Koshland. The museum was scheduled to open in 2004, and it was expanding its staff.

I joined the museum to direct its Web efforts and assist in the development of an exhibit on DNA technology in 2003. The next year was a wild ride as we created a museum from scratch. I had the opportunity to work with amazing scientists, museum designers, and multimedia specialists to create a one-of-a-kind museum focused on the work of the National Research Council, the Institute of Medicine, and the National Academy of Engineering. Our opening day in April 2004 was one of the proudest of my life.

> **"I had the opportunity to work with amazing scientists, museum designers, and multimedia specialists..."**

I am now the deputy director of the museum. My day-to-day work is varied, but my primary focus is to serve as project manager for teams of scientists and museum and web professionals to create exhibits, websites, and other products that help teens and adults understand how they can use science in their daily lives. To do this effectively, I need to understand enough of the science to ask good questions, identify possible sources of data, and oversee scientific review. It also means that I need to be familiar with the latest multimedia technology and communication theory. I love that I have the opportunity to be creative and learn about science.

In addition to the behind-the-scenes work creating exhibits, I have the opportunity to work in the "front of the house" as well. I give tours and interviews to reporters in order to promote the museum. I have even had the chance to do some live television with the local news. I also provide tours for VIPs, such as policymakers from federal agencies and dignitaries who come through the State Department. I like the balance between working at my desk on an intellectual challenge and being with people sharing the museum. I feel fortunate to have found work for which I have a passion.



Flip-flop Season

BY TODD R. GRAHAM

For most people in the general population, the term "flip-flop" conjures up images of the ubiquitous footwear and lazy summer days at the beach. The more politically inclined may recall how the chants of "flip-flop" helped torpedo John Kerry's presidential aspirations. But those of us who study lipid molecules for a living are not like most people. Many lipid biologist readers of this column will see the term "flip-flop," and visions of lipid molecules somersaulting back and forth between leaflets of a membrane bilayer will pop into our heads. We may also recall that the frequency of this flip-flop behavior depends a lot on the nature of the lipid head group. Lipids with small and weakly polar headgroups will visit both sides of the membrane quite frequently. But addition of a larger polar group to the head will mostly prevent the rapid flip-flopping and keep the lipid molecule on its own side of the hydrophobic fence, at least in artificial membranes.

"Many lipid biologist readers of this column will see the term "flip-flop," and visions of lipid molecules somersaulting back and forth between leaflets of a membrane bilayer will pop into our heads."

However, in biological membranes, a group of phospholipid transporters, generically called flippases, can mediate rapid translocation of phospholipid molecules with large polar headgroups across the bilayer. These transporters come in a few different varieties—energy-independent flippases that mediate bidirectional transport and ATP-coupled pumps that translocate phospholipid unidirectionally to either the exofacial leaflet or cytosolic leaflet. An important predicted role of an energy-independent flippase is to allow balanced growth of both leaflets during membrane biogenesis at the endoplasmic reticulum (ER). The proteins responsible for this ER flippase activity as well as an energy-independent, Ca++-dependent "scramblase" activity in the plasma membrane are still unknown. In contrast, a number of ATP-coupled pumps in ABC transporter and P-type ATPase superfamilies have been implicated in directional lipid transport. The ABC transporters primarily drive "outward" transport of lipids and for this reason are sometimes called floppases, while type IV P-type ATPases appear to drive "inward" transport to the cytosolic leaflet, a flippase activity. These ATP-powered transporters play important roles in membrane asymmetry, cholesterol transport, bile secretion, steroid synthesis, drug resistance, protein trafficking, vision, signal transduction, and many other aspects of membrane biogenesis. While this is an exciting and active area of research, the precise cellular function and mechanism of lipid translocation for many of the lipid transporters is still poorly understood.

Progress in the study of lipid transport was presented last fall at an ASBMB-sponsored meeting titled "Cellular Lipid Transport–Connecting Fundamental Membrane Assembly Processes to Human Disease" and organized by Dennis Voelker with help from Jean Vance and myself. This meeting provided a forum for an exciting exchange of ideas on how lipid molecules move across and between membranes within cells and the relationship of these processes to human health. A meeting that took place last October may not be particularly newsworthy. However, the meeting begot a collection of 15 review articles that was published this past July in a special issue of *Biochimica et Biophysica Acta: Molecular and Cell Biology of Lipids* (1). In addition to reviews on the phospholipid flippases and floppases mentioned above, the special issue contained excellent reviews on proteins proposed to mediate movement of cholesterol, lipopolysaccharides, and other lipids. Although summer has drawn to a close, and it may be too late to put on your flip-flops and head to the beach, reading up on lipid flip-flop never goes out of season!

Todd R. Graham is a professor in the Department of Biological Sciences at Vanderbilt University. He can be reached at tr.graham@vanderbilt.edu.

REFERENCE

1. Cockcroft, S., and Frohman, M. (2009) Special Issue on Phospholipase D. *Biochimica et Biophysica Acta (BBA): Molecular and Cell Biology of Lipids* 1791, 837—838.

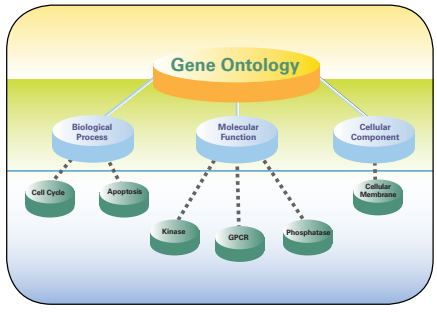
Get the cDNA and ORF price the other guys can't clone!

The Thermo Scientific Open Biosystems gene expression technologies include the Mammalian Gene Collection, the world's largest fully-sequenced collection covering over 93% of curated genes in Refseq. Save yourself the time and effort of cloning and order your cDNA or ORF from the value leader. Full-length, sequence-verified cDNA clones are available for the industry leading price of $85. Additional unique coverage includes cDNAs, ORFs, promoters and strains from more than 22 species!

- Full-length, sequence-guaranteed clones
- Over 17 million clones in stock
- Pre-assembled, expression-ready gene families
- Industry leading technical service

Call toll free or visit our website today to discover why we're the fastest growing clone provider in the industry.

To learn more, visit **www.thermo.com/GeneExpression**



Save Time and Money
Screen an entire gene family or pathway with predefined cDNA or ORF gene family sets. We can also create your custom gene set.

Moving science forward

Thermo SCIENTIFIC
Part of Thermo Fisher Scientific

scientific meeting calendar

OCTOBER 2009

3rd Central and Eastern European Proteomics Conference
OCTOBER 6–9, 2009
BUDAPEST, HUNGARY
www.chemres.hu

SACNAS National Conference: Improving the Human Condition: Challenges for Interdisciplinary Science
OCTOBER 15–18, 2009
DALLAS, TX
www.sacnas.org/confnew/confclient

7th Euro Fed Lipid Congress
OCTOBER 18–21, 2009
GRAZ, AUSTRIA
www.eurofedlipid.org/meetings/graz/

36th Federation of Analytical Chemistry and Spectroscopy Societies (FACSS)
OCTOBER 18–22, 2009
LOUISVILLE, KY
www.facss.org

Systems Biology for Biochemists
OCTOBER 22–25, 2009
TAHOE CITY, CA
Organizer: Arcady Mushegian, Stowers Institute for Medical Research
www.asbmb.org/meetings

Bioactive Lipids in Cancer, Inflammation, and Related Diseases (11th International Conference)
OCTOBER 25–28, 2009
CANCUN, MEXICO
www.bioactivelipidsconf.wayne.edu

2009 Swiss Group for Mass Spectrometry Meeting
OCTOBER 28–29, 2009
BEATENBERG, SWITZERLAND
www.sgms.ch

NOVEMBER 2009

Annual Biomedical Research Conference for Minority Students
NOVEMBER 4–7, 2009
PHOENIX, AZ
www.abrcms.org

Mass Spec Europe
NOVEMBER 5–6, 2009
BARCELONA, SPAIN
www.selectbiosciences.com

7th Annual World Congress on Insulin Resistance
NOVEMBER 5–7, 2009
SAN FRANCISCO, CA
www.insulinresistance.us

Annual Meeting of the Society for Glycobiology
NOVEMBER 12–15, 2009
SAN DIEGO, CA
www.glycobiology.org

American Heart Association Scientific Sessions 2009
NOVEMBER 14–18, 2009
ORLANDO, FL
www.scientificsessions.org

2nd International Conference on Biodiesel
NOVEMBER 15–17, 2009
MUNICH, GERMANY
www.aocs.org

4th Barossa Meeting: Cell Signaling in Cancer and Development
NOVEMBER 18–21, 2009
BAROSSA VALLEY, SOUTH AUSTRALIA
sapmea.asn.au/conventions/signalling09/index.html

20th International Symposium on Glycoconjugates
NOVEMBER 29–DECEMBER 4, 2009
SAN JUAN, PR
www.glyco20.org

DECEMBER 2009

49th Annual Meeting of the American Society for Cell Biology
DECEMBER 5–9, 2009
SAN DIEGO, CA
www.ascb.org/meetings

JANUARY 2010

Keystone Symposium—Adipose Tissue Biology
JANUARY 24–29, 2010
KEYSTONE, CO
www.keystonesymposia.org

5th Human and Medical Genetics Meeting
JANUARY 28–30, 2010
STRASBOURG, FRANCE
www.assises-genetique.org/fr

FEBRUARY 2010

15th Annual Proteomics Symposium
FEBRUARY 4–7, 2010
LORNE, AUSTRALIA
www.australasianproteomics.org

Gordon Research Conference—Glycolipid and Sphingolipid Biology
FEBRUARY 7–12, 2010
VENTURA, CA
www.grc.org

AAAS Annual Meeting
FEBRUARY 18–22, 2010
SAN DIEGO, CA
www.aaas.org/meetings

Biophysical Society 53rd Annual Meeting
FEBRUARY 28–MARCH 4, 2009
BOSTON, MA
www.biophysics.org/2009meeting

MARCH 2010

Keystone Symposium–Biomolecular Interaction Networks: Function and Disease
MARCH 7–12, 2010
QUEBEC CITY, CANADA
www.keystonesymposia.org

APRIL 2010

Keystone Symposium—Diabetes
APRIL 12–17, 2010
WHISTLER, CANADA

4th ESF Functional Genomics Conference
APRIL 14–17, 2010
DRESDEN, GERMANY
www.esffg2010.org

ASBMB Annual Meeting
APRIL 24–28, 2010
ANAHEIM, CA
www.asbmb.org/meetings.aspx

MAY 2010

Euro Fed Lipid International Symposium on Microbial Lipids
MAY 13–15, 2010
VIENNA, AUSTRIA
www.eurofedlipid.org

2010 American Thoracic Society International Conference
MAY 14–19, 2010
NEW ORLEANS, LA
www.thoracic.org

6th International Atherosclerosis Society Workshop on High Density Lipoproteins
MAY 17–21, 2010
WHISTLER, CANADA
www.athero.org

JUNE 2010

3rd European Workshop on Lipid Mediators
JUNE 3–4, 2010
PARIS, FRANCE
www.workshop-lipid.eu

8th International Conference on Hyaluronan of the International Society for Hyaluronan Sciences
JUNE 6–11, 2010
KYOTO, JAPAN
www.ISHAS.org

Keystone Symposium—Bioactive Lipids: Biochemistry and Diseases
JUNE 6–11, 2010
KYOTO, JAPAN
www.keystonesymposia.org

78th European Atherosclerosis Society Congress
JUNE 20–23, 2010
HAMBURG, GERMANY
www.kenes.com/eas

11th International Symposium on the Genetics of Industrial Microorganisms
JUNE 28–JULY 1, 2010
MELBOURNE, AUSTRALIA
www.gim2010.org

SEB Annual Main Meeting
JUNE 30–JULY 3, 2010
PRAGUE, CZECH REPUBLIC
www.sebiology.org/meetings

AUGUST 2010

9th International Mycological Congress (IMC9): The Biology of Fungi
AUGUST 1–6, 2010
EDINBURGH, UNITED KINGDOM
www.imc9.info

14th International Congress of Immunology
AUGUST 22–27, 2010
KOBE, JAPAN
www.ici2010.org

SEPTEMBER 2010

British Mass Spectrometry Society Meeting
SEPTEMBER 5–8, 2010
CARDIFF, WALES
www.bmss.org.uk

HUPO 9th Annual World Congress
SEPTEMBER 19–24, 2010
SYDNEY, AUSTRALIA
www.hupo.org

OzBio2010
SEPTEMBER 26–OCTOBER 1, 2010
MELBOURNE, AUSTRALIA
www.asbmb.org.au/ozbio2010

Transcriptional Regulation by Chromatin and RNA Polymerase II
SEPTEMBER 30–OCTOBER 4, 2010
TAHOE CITY, CA
www.asbmb.org/meetings.aspx

OCTOBER 2010

Biochemistry and Cell Biology of ESCRTs in Health and Disease
OCTOBER 14–17, 2010
SNOWBIRD, UT
www.asbmb.org/meetings.aspx

Post Translational Modifications: Detection and Physiological Evaluation
OCTOBER 21–24, 2010
TAHOE CITY, CA
www.asbmb.org/meetings.aspx

Biochemistry of Membrane Traffic: Secretory and Endocytic Pathways
OCTOBER 29–31, 2010
TAHOE CITY, CA
www.asbmb.org/meetings.aspx