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**ASPB 2015 Award
Winners**

ASPB honors plant scientists for their excellence in research, education, outreach, and service



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SURF 2015

A new wave of undergraduate research coming this summer



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Obituary

Albert W. Frenkel
1919–2015

ASPB News



THE NEWSLETTER OF THE AMERICAN SOCIETY OF PLANT BIOLOGISTS

Plant Biology 2015

See You in
Minneapolis!

July 26–30!



Online registration
open until July 12

President's Letter

Time to PhD—Time to Publish

JULIAN SCHROEDER
University of California, San Diego

In this letter I would like to address two interlinked problems and offer possible solutions to both of them: (1) the relatively long duration of PhD graduate studies in many countries and (2) the increasing time it can take from research advance to publication. In the latter case, I will also address innovations that are being implemented toward reducing the time to publication by *The Plant Cell's* new editor-in-chief, Sabeeha Merchant, and her editorial team. Additionally, recent procedures in *Plant Physiology* are geared to shortening time to publication as well.

The plant sciences—and indeed all scientific disciplines—rely on new directions of research and new perspectives. Because young scientists often generate these new ideas, it is essential to provide opportunities for them to grow and succeed in their disciplines.

Unfortunately, on the downside, in the United States and many other countries, it can often take over six years to complete the work



Julian Schroeder

necessary to generate a PhD thesis in the life sciences. This very long training period and the limited number of academic job openings can discourage talented young scientists from pursuing PhDs and their careers in the plant sciences.

On the upside, recent analyses have highlighted the need for trained PhD plant scientists (<http://bit.ly/ZsHLrj>), and

a report from the STEM Connector Food and Ag Council (<http://bit.ly/1EMiGEO>) projects substantial job growth in plant- and agriculture-related industries, with a combination of net new positions and looming retirements generating over 160,000 vacancies in the United States alone over the next 10 years. There are many careers that trained plant scientists can embark on in addition to academia, including industry, biotechnology, the business side within companies, education, plant-linked information technology, instrumentation, big data-related jobs, envi-

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ASPB staff are dedicated to serving our members. We welcome your questions and feedback.

For quick response, e-mail us at info@aspb.org or visit our FAQ at www.aspb.org/faq.

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The *ASPB News* is distributed to all ASPB members and is also available online. It is published six times annually in odd-numbered months. Its purposes are to keep membership informed of ASPB activities and to reinforce the value of membership. The *ASPB News* is edited and produced by ASPB staff from material provided by members and other interested parties.

Copy deadline is the 5th day of the preceding even-numbered month (for example, December 5 for January/February publication).

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Plant Biology 2015

JULY 26–30 MINNEAPOLIS, MINNESOTA
PLANTBIOLOGY.ASPB.ORG

Online registration
open until July 12

Come for the science, come for the posters, and come to spend quality and fun time with colleagues!

U.S. Federal Funding Agencies Up Their Presence at PB2015

This year there are four workshops that highlight the work and contributions of U.S. government agencies.

- The conversation kicks off on Monday, July 27, with a noon-hour grantsmanship workshop with officials from the U.S. Department of Agriculture (USDA), the Department of Energy, and the National Science Foundation (NSF).
- That evening NSF takes the podium again from 7:00 to 9:00 to explain the criteria its decision makers use to assess the ~50,000 research proposals they review each year—and to select the ~11,000 they are able to fund.
- At noon on Tuesday, July 28, a panel representing USDA, the Environmental Protection Agency, and the Food and Drug Administration will review the regulatory environment for genetically engineered plants in the United States.
- And at noon on Wednesday, July 29, ASPB's Science Policy Committee (http://my.aspb.org/?G_Leadership#policy) hosts a session on the millions of dollars that the newly formed Foundation for Food and Agriculture Research (FFAR) will funnel into plant science under the 2014 Farm Bill. FFAR's mandate to support research, innovation, and partnerships for America's agricultural economy makes this an exciting time for plant biology, and this session will help you figure out what it all means for your own research program.

Bioinformatics Resources for Plant Biology Research

Two workshops will feature presentations from Araport, Bio-Analytic Resource, KBase, Legume Federation, MaizeGDB, Plant Reactome, and TAIR describing the resources and tools at their respective sites.

Make New Connections and Have Some Fun!

- At 5:30 p.m. on Wednesday, July 29, join the editors of *Plant Physiology* and *The Plant Cell* and Society leadership for light refreshments and a serious dialogue about the issues facing *your* profession and *your* professional society.
- At 6:30 p.m. on Wednesday, July 29, the Environmental and Ecological Plant Physiology Section holds an open meeting.
- **AND FINALLY—back by popular demand**—we're delighted to announce that *The Nines will rock our Final Party* at 8:30 p.m. Wednesday, July 29. They were a favorite during ASPB's 2014 closing party at the World Forestry Center in Portland, and they're joining us in Minneapolis for a repeat performance. If you missed the show the first time, or it's just been too long since you've heard them, check out this fabulous video (<http://www.lovethenines.com/video/>). And don't forget to come early to take part in the first annual ping-pong and foosball tournament!

Ready to register?

Take a comprehensive look at all that Plant Biology 2015 has to offer—including the full listing of minisymposia—at plantbiology.aspb.org.

PRESIDENT'S LETTER *continued from page 1*

ronmental work, patent law, and communications to name just a few. So how can we ensure that we are training young talent in ways that enable them to meet the challenges and needs of the future?

The plant sciences community has come together and proposed its first decadal vision, with among other goals, to significantly shorten the time from the beginning of undergraduate studies to completion of the PhD degree to about seven years (i.e., three to four years PhD duration) and has proposed approaches for broadening the professional preparation of graduate students. An abbreviated background on the decadal vision: Plant sciences communities (<http://bit.ly/1IGhyrq>) in the United States have worked to develop the decadal vision for innovation in plant science for 2015 to 2025 (<http://bit.ly/1Fj1IC3>). Several societies, including ASPB with leadership provided by Sally Mackenzie and David Stern, are working to promote this vision. This forward-looking document is providing plant scientists with a platform to speak with a common voice and communicate common goals with elected representatives (see page 23 of the September/October 2013 issue of the *ASPB News* [<http://bit.ly/1cEItAR>]).

It is to a large degree up to us to shorten the time to PhD to a more reasonable time of, for example, four years. You might ask “Is this at all possible?” In England, the recommended time to PhD has been three years for a long time, with four years usually being the absolute maximum. The Bologna agreement in Europe recommended the duration of a PhD to be

from about three to four years, and some countries are seeing a trend in reducing PhD durations closer to four years or less. Thus, it is clearly possible; however, there is a big fly in the ointment—but one that we as a community can also fix. This brings me to the second subject of this letter:

Time to Publication...

Reducing the time to PhD sounds great to many young scientists. And if you have made a discovery or important advance in your PhD research, you would of course like to publish it, preferably as a first-authored paper. However, the trend in the life sciences over the past dozen years has been that publications, and in particular supplemental data, have ballooned to indigestible lengths. How can a graduate student who has made a discovery or a relevant advance possibly complete all of those experiments? The same question applies to postdoctoral associates who also need to report their advances. Undeniably, publication is an important “currency” by which young scientists are evaluated for their next career steps.

If we step back from the early career investigators for a minute, the delayed publication of solid research advances is also detrimental to the scientific community. These days it is not unusual for publication to take one to over two years longer than it did 15 years ago. This lag also delays the ability of the community to use this information in their research and to test the validity and boundaries of new models. As graduate research is, by and large, funded by governments, this delay also postpones the return on public investment toward

advancing knowledge and scientific discourse. You might argue that mentors may actually benefit from publication delays, because the research advances in their labs can continue without competition for, say, another year or two before this advance becomes publicly available. I have yet to hear this opinion from mentors, who also bemoan the lengthy times to publication themselves, just like students and postdocs.

So what went wrong on the way to publication? What has led to these delays? One factor might be our tendency to inadvertently embrace lengthy supplementary data files. Does publication of behemoth papers really lead to more solid advances in the literature? Is it worth delaying community access to new advances by a year or two? I have not heard any true benefits being proclaimed by the community. From my own experience as a young scientist, I was taught that if you make a scientific advance and are fortunate to publish it, it is upon you (or perhaps the lab that you will be leaving with your degree in hand) to pursue “follow-up” studies. Thus, what is today’s supplementary data, in the past often appeared in follow-up publications rather than in supplements. Undoubtedly, supplements carry an important value in the age of “big data,” but their definition may have slowly expanded to include a parking place for reviewers’ most favored experiments.

Ironically, anecdotal evidence suggests that young scientists are not immune to requesting many new experiments when reviewing manuscripts. It can be a young scientist who brings up a shopping list of new experiments when reviewing or co-reviewing a

submitted manuscript with their mentor. In such cases it is up to the mentor to ask the key question of their co-reviewer: “If a reviewer requested this many interesting but perhaps not immediately required experiments for your manuscript, would you want to have to work through a long list of often difficult experiments before you can publish your finding or complete your degree? Or would you rather be given the opportunity to pursue a follow-up study focusing on your interests?”

Some journals (meaning us—the reviewers and editors) have inadvertently pushed for longer and longer publications, with the rationale that long papers would represent “complete” studies. But is there really such a thing as a “complete study,” and are longer papers more reliable than an initial publication and follow-up research within roughly the same time frame? There is also the issue that journal editors may seek the higher impact factor as their holy grail, and this may inadvertently lead to longer publications. It is arguable whether longer papers aid in this goal. There might also be a conflict of interest for mentors who may not want to “let go” of their students and postdocs once they have been trained. But helping trained scientists advance their career goals is the nature of a faculty mentor’s job.

I don’t want to belabor a problem without also offering a solution. So what’s the solution? Some journals, including *eLife* and *The Plant Cell*, are now instituting quite simple solutions. In these journals reviewers and handling editors are being asked to determine: (1) Is the manuscript suit-

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ASPB Announces 2015 Awards

Each year, ASPB honors plant scientists for their excellence in research, education, outreach, and service, conferring numerous awards to those who promote the mission of our Society. We are proud to announce this year's recipients.

ASPB Innovation Prize for Agricultural Technology

Sherri Brown

Monsanto

David Fischhoff

The Climate Corporation

Mike Koziel

Athenix

Fred Perlak

Monsanto

The inaugural 2015 ASPB Innovation Prize for Agricultural Technology is awarded jointly to Sherri Brown (Monsanto), David Fischhoff (The Climate Corporation), Mike Koziel (Athenix), and Fred Perlak (Monsanto). Their leadership of pioneering research and development teams led to the engineering of commercially viable varieties of cotton and corn that express derivatives of insecticidal proteins from *Bacillus thuringiensis*. The insect-resistant crops that they developed, and subsequent generations of improved varieties, have had a major impact on crop yields in both developed and developing countries. These crops have also had significant environmental benefits by reducing the use of chemical pesticides.



Sherri Brown



David Fischhoff



Fred Perlak



Cyril Zipfel



Wendy Boss

Charles Albert Shull Award

Cyril Zipfel

Cambridge University

Cyril Zipfel, who heads The Sainsbury Laboratory, is the 2015 recipient of the Charles Albert Shull Award. Cyril played a leading role in the discovery of pattern-triggered immunity in plants, which included characterizing the bacterial peptides flagellin (flg22) and EF-Tu (elf18) as pattern-associated molecular markers that activate signaling by the receptor-like kinases FLS2 and EFR, respectively, leading to plant immunity. He found that the BAK1 brassinosteroid coreceptor also cooperates with FLS2 and EFR, and he identified residues of BAK1 that are key to specifying coreceptor output toward brassinosteroid signaling, cell death control, or innate immunity. Cyril also made the major practical discovery that transgenic expression of Arabidopsis EFR in solanaceous species, which normally do not recognize the bacterial ligand EF-Tu, con-



Mike Koziel

fers immunity to a broad range of bacteria, and he has extended this approach to cereals.

Charles Reid Barnes Life Membership Award

Wendy F. Boss

North Carolina State University

This year's Charles Reid Barnes Life Membership Award for life-long service in plant biology goes to Wendy F. Boss, the William Neal Reynolds Distinguished Professor Emeritus at North

Carolina State University's Department of Plant Biology. ASPB recognizes Wendy for her trailblazing three decades of

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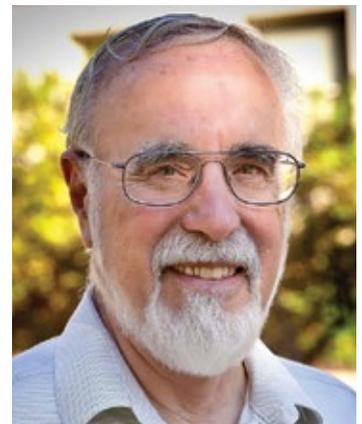
Maria Harrison



Daniel Chitwood



Joe Louis



Stanley Roux

ASPB AWARDS continued from page 5

work in the particularly challenging fields of phosphoinositide biochemistry and inositol phosphate signaling pathways; for her outstanding roles in education, mentorship, and international outreach; and for her graceful and tireless work for the Society—in Washington, D.C., and around the world—promoting plant science and encouraging people who are interested or involved in the discipline.

Dennis R. Hoagland Award

Maria Harrison
Cornell University

In recognition of her outstanding contributions to plant mineral nutrition, ASPB honors Maria Harrison with the Dennis R. Hoagland Award. Maria is the William H. Crocker Professor at Cornell University's Boyce Thompson Institute for Plant Research. She has pioneered studies of phosphate acquisition in arbuscular mycorrhizal (AM) symbioses using the model legume *Medicago truncatula*. In particular, her findings that

phosphate transport is linked to maintenance of symbiosis and that plants use classic hormone signaling pathways for regulation of the AM symbiosis have ushered the field of fungal-plant interactions in new directions, and they provide opportunities for the future manipulation of phosphate acquisition in crop species. Maria has identified key gene products required for phosphate transport and uptake, and she has shown that redirected plant protein secretion mechanisms target transporters to symbiotic membranes. Maria has also developed cell biology resources for in vivo cellular imaging at *Medicago*, expanding research capabilities for further unraveling the nutritional function of the AM symbiosis.

Early Career Award

Daniel Chitwood
Danforth Plant Science Center

The ASPB Early Career Award acknowledges outstanding research by a scientist generally not more than seven years post-PhD. This year's Early Career Award recipient is Daniel Chitwood, whom the Society recognizes for

his extraordinary contributions to the systems analysis of large, diverse, and complex data sets that encompass morphological and molecular traits. Dan is the head of the Chitwood Lab and an assistant member at the Danforth Plant Science Center. The methods that he has developed will be broadly applied to questions related to plant development and beyond.

Eric E. Conn Young Investigator Award

Joe Louis
University of Nebraska-Lincoln

Joe Louis, assistant professor of entomology at the University of Nebraska-Lincoln, is awarded the Eric E. Conn Young Investigator Award in recognition of his significant contributions to the field of plant-insect interactions, as well as his demonstrated excellence in outreach, public service, mentoring, and teaching. Joe's research work has shown that plants recognize specific insect-delivered elicitors that induce innate defense mechanisms. His research has been published in high-impact journals, garnering

excellent citation records. Joe has trained and mentored many students, from high school through PhD level, and he has taken multiple leadership roles in outreach activities. He has been very active in scientific society activities, and he has organized many symposia at several national and regional meetings. For his significant contributions at different stages of his career, he has received many awards from different organizations.

Excellence in Education Award

Stanley Roux
University of Texas at Austin

The 2015 Excellence in Education Award acknowledges the outstanding contributions of Stanley Roux, professor of molecular cell and developmental biology and University Distinguished Teaching Professor at the University of Texas at Austin. During a career spanning more than 30 years, Stan has made a considerable impact at his institution by expanding the curriculum while developing and adopting innovative pedagogical methods.



Craig Pikaard

Both in the classroom and in his laboratory, Stan has emphasized meaningful hands-on research for students. The recipient of several past teaching awards, Stan was one of the first to challenge the notion that freshmen cannot conduct “real” research. The results of his efforts have been manifest in the form of peer-reviewed publications with many student coauthors, as well as conference awards and further modeling of this paradigm. Stan has offered innovative courses in the realm of plant biology while mentoring numerous undergraduate and graduate students and participating in various science outreach organizations, thereby making lasting impacts in the field.

Martin Gibbs Medal

Craig Pikaard

Indiana University

The Martin Gibbs Medal, established in 1993, honors individuals who pioneered advances that have served to establish new directions of investigation in the plant sciences. The 2015 recipient, Craig Pikaard, is the Carlos O. Miller Professor of Plant Growth and



Bob Goldberg

Development and head of the Pikaard Lab at Indiana University. Craig is honored for his seminal work and important discoveries in the fields of nucleolar dominance, gene silencing, and the role and function of the atypical polymerases IV and V. Craig will convene the Martin Gibbs Medal Symposium at Plant Biology 2016.

Stephen Hales Prize

Bob Goldberg

University of California, Los Angeles

Bob Goldberg is well known for his research contributions to plant biology, particularly in the area of reproductive development. He has generated fundamental discoveries that have also resulted in applications in industry, such as the development of the Barnase-Barstar male sterility system, together with PGS in Belgium. Bob later served as cofounder and director of Ceres, Inc., a plant biotechnology company. A major contribution to the community was his role as the founding editor-in-chief of *The Plant Cell*. Bob is a leader in educating the public about plant biotechnology. He championed ASPB's effort



Renate Scheibe

to make the documentary film *History's Harvest*, and he often speaks in public forums to promote science-based discussions about the utility and safety of genetically modified foods. Bob has received several prizes for his excellent teaching at UCLA.

Corresponding Membership Nominees

Corresponding Member status is conferred by election on the annual ballot. This honor, initially given in 1932, provides life membership and Society publications to distinguished plant biologists outside the United States.

Renate Scheibe

University of Osnabrueck

Renate Scheibe is a leading contributor to our understanding of redox regulation in plants, extending from metabolic control to transportable reductant, to rapid environmental responses by plant cells. As professor of biology at the University of Osnabrueck, she has pioneered studies defining the impact of redox regulation on enzymes central to inter-organelle communication, sens-

ing, and signaling in response to environmental cues and stress. Her groundbreaking “malate valve” hypothesis (operated by an NADP-dependent malate dehydrogenase) is now a widely accepted mechanism for controlling export of reducing equivalents from illuminated chloroplasts. Renate quickly followed this early work with her discovery of a contrasting system for malate transfer in the dark (this one NAD-dependent) that is essential for deriving ATP from plastidial glycolysis. These advances led her to focus on redox-dependent processes in the cytoplasm, specifically those that affect the cytoskeleton, the outer mitochondrial membrane, and the nucleus. She remains concurrently active in outreach, teaching, administration, and service to national and international societies, and her efforts have immensely aided the popularization of plants among students and the public. Renate has served as dean of the faculty of biology and chemistry at the University of Osnabrueck, director of the Botanical Garden (currently active on the board), national delegate and treasurer for the Federation of the European Societies of Plant Biology, and member of the editorial board of *Plant Physiology*. Renate has also engaged in numerous other ASPB activities since 1979. She continues to make impressive contributions to our collective outreach efforts, as well as to our knowledge of cellular energy metabolism and the redox-poising systems in plant cell compartments in response to environmental cues and stress.

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ASPB AWARDS
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Kazuo Shinozaki

RIKEN Center for Sustainable Resource Science

Kazuo Shinozaki is director of the RIKEN Center for Sustainable Resource Science in Japan. He is recognized internationally for his pioneering work on signal transduction in stress responses and plant genome science. In 1986, he elucidated the first complete nucleotide sequence of the chloroplast genome (in tobacco). Later, as a pioneer of plant functional genomics, he collected full-length cDNAs, not only from Arabidopsis, but also from various crop, tree, and weed species. He has also provided valuable service in distributing these genomics resources from the RIKEN BioResource Center. Kazuo's main interest has been in the response of higher plants to abiotic stress, including gene expression, cellular signal transduction pathways, and in the molecular process of tolerance using transgenic plants. He and his wife, Kazuko Yamaguchi-Shinozaki, have analyzed gene expression networks that regulate stress responses and have identified many important genes associated with tolerance to various stresses. He has demonstrated the presence of both ABA-independent and ABA-dependent regulatory systems governing drought-inducible gene expression. He also discovered the *cis*-acting and *trans*-acting regulatory elements DRE and DREB, which function in ABA-independent gene expression. Importantly, Kazuo applied these



Kazuo Shinozaki

discoveries to the molecular breeding of drought-tolerant plants. Two papers on this subject (DREB transcriptional factors and the *cis* element) are listed among the 10 most frequently cited papers in *The Plant Cell*. Kazuo and his colleagues have published 437 papers; he is among the most-cited plant scientists. He has been an ASPB member since 1990 and has been invited many times to the ASPB annual meetings. Kazuo has also been president (2010–2011) of the Japanese Society of Plant Physiologists, and in this capacity he has contributed to the Global Plant Council.

2015 ASPB Fellow Awards

Established in 2007 and granted to no more than 0.2% of the current membership, the Fellow of ASPB Award may be given in recognition of distinguished and long-term contributions to plant biology and service to the Society by current members in areas that include research, education, mentoring, outreach, and professional



Caren Chang

and public service. Current members of ASPB who have contributed to the Society for at least 10 years are eligible for nomination.

Caren Chang

University of Maryland

Caren is well known for her pioneering work in ethylene signaling, and she has continued to contribute significantly in this area by elucidating signaling mechanisms and physical connections among the different players in the ethylene-signaling pathway. By helping to fill major long-standing gaps in the pathway, Caren's work has provided new advances in our understanding of ethylene perception and ethylene biology in general. In addition to her research contributions, Caren has also served ASPB and the plant biology community through her work on the editorial boards of several Society publications and as a member of ASPB's Publications Committee.



Keiko Torii

Keiko Torii

Howard Hughes Medical Institute and University of Washington, Seattle

For the past 15 years, Keiko has been studying the role of receptor-like kinases in plant development and the mechanisms controlling stomata formation. Her research on stomata formation has greatly improved our understanding of how plant cells coordinate proliferation and differentiation to generate specific patterns during organ morphogenesis. In addition to her research accomplishments, she is a monitoring editor for *Plant Physiology* and editor-in-chief of *The Arabidopsis Book* (TAB). Keiko is also currently serving on the ASPB Early Career Award Committee.

Congratulations to all the 2015 awardees, and many thanks to their nominators and the committees who evaluated nominees for each award. ■

ASPB's 2015 Women's Young Investigator Travel Award Winners Announced

Each year, ASPB and its Women in Plant Biology Committee award travel grants enabling early-career women investigators to attend the Plant Biology annual meeting. The Women's Young Investigator Travel Award (WYITA) is a competitive program that aims to increase meeting attendance by female investigators who are within the first five years of their appointment in academic faculty-level positions, government research positions, or industry research scientist positions, as well as experienced postdocs. Selection is based on (1) the science and quality of the abstract submitted relative to the amount of time as an early-career investigator, (2) a statement describing why travel should be supported, and (3) financial need.

Seven women were selected this year, and each will receive a \$1,000 award to support her attendance at Plant Biology 2015 in Minneapolis. Several awardees will present a minisymposium talk. A list of the recipients and their abstract titles follows.

Congratulations to each of the 2015 WYITA winners.

Carla Antonio

Instituto Tecnologia Quimica Biologica (ITQB-UNL), Oeiras, Portugal

Regulation of primary metabolism in response to flooding stress as revealed by stable isotope redistribution. (Minisymposium 1: Abiotic: Water)



Carla Antonio



Anna Dobritsa



Andrea Eveland



Emily Indriolo



Aruna Kilaru



Lucia Strader



Sowmya Subramanian

Anna Dobritsa

Ohio State University, Columbus

Aperture formation on *Arabidopsis* pollen surface is regulated through a ploidy-dependent mechanism and is guided by the INP1 protein. (Minisymposium 13: Pollen)

Andrea Eveland

Daniel Danforth Plant Science Center, St. Louis, Missouri

Inflorescence architecture traits in panicoid grasses: regulatory networks and comparative genomics. (Minisymposium 29: Transaction Networks in Development)

Emily Indriolo

New Mexico State University, Las Cruces

ARC1 is a downstream signaling component of SRK in the self-incompatibility pathway in *Arabidopsis* spp. (Minisymposium 13: Pollen)

Aruna Kilaru

East Tennessee State University, Johnson City

Elucidation of endocannabinoid pathway in *Physcomitrella patens*.

Lucia Strader

Washington University in St. Louis, Missouri

Molecular basis for protein interaction and the control of auxin response repression.

Sowmya Subramanian

New Mexico Consortium and Los Alamos National Laboratory, Los Alamos

Engineering carbon concentration mechanisms (CCM) in C3 plants. (Minisymposium 7: Biochem: Bioenergy) ■

ASPB's New Meetings Business Unit Supports a Broader Plant Science Dialogue

ASPB has set up a new meetings and events business unit to support plant science researchers in ways that align closely with the Society's vision of a unified global plant science community.

Historically, ASPB has supported scientific meetings other than the annual plant biology meeting whenever they arise. Beginning this year, though, ASPB will provide à la carte meeting management services, as well as full service conference management. The Society will also launch a series of topical meetings, workshops, and satellite meetings following the annual meeting.

An advisory board will provide the overall direction for the new business unit. Some of primary purposes of the board are to

- provide guidance on the overall direction of the meetings and events business
- assist in identifying the community's most pressing needs for meeting management services
- identify target meetings or potential customers
- assist in the development of progressive and viable pricing models
- help identify emerging areas to consider for focused topical meetings
- assist in the evaluation and improvement of products and services
- help establish best practices to serve the community



Rick Amasino



Sally Assmann



Julia Bailey-Serres



Siobhan Brady



Michael Metzloff



A.S.N. Reddy



Rowan Sage



Julian Schroeder

The inaugural eight-member board, which held its first meeting on March 15 in Denver, Colorado, includes representatives from both academia and industry; all have served leadership roles within the plant science community. Members include Rick Amasino (chair), Sally Assmann, Julia Bailey-Serres, Siobhan Brady, Michael Metzloff, A.S.N. Reddy, Rowan Sage, and Julian Schroeder.

All of the new unit's services will feature a personalized

approach to meeting management support, high-quality technology, and well-informed scientific oversight, ensuring that each meeting delivers consistent value to the plant science community. ASPB's new unit will also be available to run events that are collocated but unaffiliated with other organizations or meetings, such as satellite meetings held in association with international congresses.

For more details please contact Jean Rosenberg (jean@aspb.org). ■

Midwestern Section Holds Successful Meeting

BY DARRON LUESSE

Southern Illinois University Edwardsville

The Midwestern Section of the ASPB held its annual meeting on Saturday, March 21, and Sunday, March 22, at the Donald Danforth Plant Science Center in St. Louis, Missouri. More than 150 attendees from 37 institutions across the Midwest were present for 32 oral presentations and over 70 posters.

The presentations were primarily given by undergraduate and graduate students, but also included two talks from postdoctoral associates and one representative from industry. The keynote address was delivered by Scott Peck from the University of Missouri–Columbia, who spoke on Using Proteomics to Study Signaling and Secretion During Responses to Biotic and Abiotic Stresses.

The meeting also included a featured talk from Sona Pandey from the Donald Danforth Plant Science Center. Susan Cato and Shoshana Kronfeld from ASPB were on hand to deliver information about new membership initiatives and to solicit feedback from members of the section.

In addition to oral presentations, the meeting offered several opportunities for informal scientific interactions and catching up with friends. The poster session on Saturday afternoon was a great chance to see examples of the cool science being done across the section. Several coffee breaks allowed participants to catch up with friends, and there were tours of the impressive Donald Danforth Plant Science

Center. Saturday was capped off by the traditional banquet, where everyone relaxed after a long day.

One highlight of the meeting was the presentation of student awards. While all of the oral presentations and posters were very high quality, the section recognized those that stood out above their peers. Awards for Best Undergraduate Oral Presentation were given to

First place

Dennis X. Zhu

University of Missouri–Columbia

Characterization of Vegetative and Reproductive Defects in the Maize Tassel-less 4 Mutant

Second place

Charles A. Cook

Ohio University

Gene Expression Microarray of the GPS Treatment Reveals Novel Genes Involved in Early Gravitropic Signal Transduction

Third place

Spencer Schreier

South Dakota State University

MicroRNA160 Regulation of Auxin-Cytokinin Balance During Soybean Root Nodule Development

Awards for Best Graduate Student Oral Presentation were given to

First place

Carina Collins

University of Missouri–Columbia

A Vesicular Trafficking ENTH-domain Protein Functions in

Plasma Membrane Localization of the Receptor Kinase FLS2

Second place

Xiaolong Lu

Saint Louis University

The Membrane-anchored Ubiquitin-fold (MUB) Protein Family Regulates Ubiquitylation in Arabidopsis

Third place, tie

Tami Coursey

Ohio State University

Putative Histone Readers EML1 and EML3 Differentially Impact Geminivirus Infection

Third place, tie

Enkhtuul Tsogtbaatar

Ohio State University

Metabolic Characterization of Pennycress (*Thlaspi arvense L.*) for the Production of Valuable Fatty Acids

Awards were also given for poster presentations. The Best Undergraduate Poster winners were given to

First place, tie

Marissa Fabbri

Truman State University

First place, tie

Jordyn Williams

Truman State University

Second place, tie

Helen Liu

University of Illinois at Urbana-Champaign

Second place, tie

Roberto Alers-Velazquez

Ohio State University

Best Graduate Student Poster Presentation awards were given to

First place, tie

Sarah Hutchinson

Southern Illinois University Edwardsville

First place, tie

Nadeesha Rajapaksha

Saint Louis University

Second place, tie

Lingyan Jiang

University of Missouri–Columbia

Second place, tie

Tyler Dowd

University of Missouri–Columbia

Third place

Nicholas Heller

University of Illinois at Urbana-Champaign

Participants at the business meeting on Sunday determined that the next meeting would likely be held in the western portion of the section, possibly in South Dakota, and organized by the ascending section chair, vice chair Aaron Wyman. Section chair Darron Luesse closed the meeting on Sunday afternoon after thanking everyone who made organizing the meeting possible, including Aaron and local organizer Dmitri Nusinow. We hope everyone will join us again next spring in South Dakota for another great meeting. ■

SS-ASPB 2015 Meeting Report

The 2015 annual meeting of the Southern Section (SS-ASPB) was held at the Dauphin Island Sea Lab, Alabama, at the edge of Mobile Bay, March 28–30. Over 130 plant biologists from 35 institutions enjoyed discussing plant science in a scenic and relaxing setting at the Sea Lab. We fit a lot of science into the two-day meeting, with 61 poster presentations and 33 talks, in addition to the Kriton-Hatzios Symposium on incorporating bioinformatics into plant biology. The annual student competitions were as strong as ever, with 22 graduate students competing for awards with oral presentations and 28 undergraduate poster competitors. Students made up two-thirds of the total number of attendees. The meeting was chaired by Ashlee McCaskill, and

Rick Turley organized the Kriton-Hatzios Symposium. Events were organized by Ken Korth and local organizers Tim Sherman, Kelly Major, and Molly Miller. A special thank-you goes out to all who helped with planning, judging, presenting, stepping up as needed, and asking insightful questions of the presenters.

About the Meeting...

Tim, Kelly, and Molly got the meeting off to a perfect start on Saturday evening with a Gulf Coast tradition, a shrimp and crawfish boil. Participants met under a beautiful sunny sky and dug into piles of spicy crustaceans, vegetables, and sausage, all washed down with beverages of their choice. The festive mood and excellent food put everyone

into the right frame of mind for the talks that began early on Sunday morning. The crew from the University of South Alabama (Tim, Kelly, and Molly) deserve a huge thank-you from everyone, as they hauled and prepared copious amounts of food and drink.

Most of the meeting attendees stayed on-site at the Sea Lab, and participants filled all rooms in the 86-bed dormitory. We were fortunate that the meeting this year was very affordable, with total costs for students being \$125 for meals, lodging at the dorm, registration, and the banquet. Breakfasts and lunches were held at the cafeteria adjoining the dorm. It was agreed that the food was very good and that having communal meals really helped to promote vigorous discussions and networking among the scientists.

Following breakfast on Sunday morning, Ashlee opened the meeting, and we started into a full slate of talks. At mid-morning, we divided into concurrent sessions to accommodate all speakers. Following oral presentations by faculty and postdocs, graduate student talks began and continued throughout the afternoon. Starting after lunch, small groups of undergraduate poster presenters met with judges to allow for adequate time to interact. Students returned to their posters to further discuss their work in the general session along with all poster presenters from 4:30 to 6:30 p.m.

Both the quality and quantity of work by all presenters impressed the judges and made their decisions especially difficult.

continued on page 14

PRESIDENT'S LETTER *continued from page 4*

able for the given journal? (2) If the answer to (1) is yes, then what are the essential data that may be needed to allow the authors to publish their advance soon? Needless to say, this approach may lead to a rapid decline of some highly worthy manuscripts. However, at least the duration of the response facilitates a shorter and less arduous path to publication, leading authors to

move on to submitting elsewhere after considering the reviewer comments. In addition to this simple solution, *The Plant Cell* is instituting additional new review measures that will help young investigators more rapidly move from submission to publication, enabling visibility of their new laboratories within the scientific community (for those interested in more details, please see: <http://bit.ly/1bVgpj1>). *The Plant Cell* and *Plant Physiology*, along with *Nature*, *Science*, and PNAS, now

also permit making manuscripts publicly available any time prior to publication on preprint servers such as the bioRxiv at Cold Spring Harbor Laboratory, thus enabling early access by the community, a practice spearheaded by the physics and mathematics communities. And Mike Blatt and the editorial board of *Plant Physiology* have instituted Research Reports—short papers intended to accelerate the time from experimental concept to final publication.

In closing, if we as plant biologists can institute simple innovations as described above, then we could lead the way for other life scientists toward bringing the time to PhD, the time to completing successful postdoctoral research, and the time to publication back to more reasonable norms. We owe it to our discipline to support young scientists, not least because they are the ones who will ensure a strong future for plant biology. ■

ASPB members share a common goal of promoting the growth, development, and outreach of plant biology as a pure and applied science. This column features some of the dedicated and innovative members of ASPB who believe that membership in our Society is crucial to the future of plant biology. If you are interested in contributing to this feature, please contact ASPB Membership at info@aspb.org.

Ian Street

Professional Title: Research Associate

Member Since: 2002

Place of Work or School: Dartmouth College

Research Area: Root development, hormones, signaling



the annual meeting, but I maintained my membership because I believe that the more members in the Society, the more influential it can be.

Why has being a member of ASPB been important?

It's given me something to get involved in, a place to contribute to, and has helped me get my voice out into the world.

How has being a member of ASPB helped you in your career?

I've helped ASPB adopt social media at the annual meeting the past few years and have been rewarded with so many great interactions because of it. (To anyone reading this, I'm @IHStreet; come say hi.) It's really helped me develop my interests in terms of plant science and teaching, and it's a privilege to get to know so many talented and thoughtful scientists.

What advice would you give to a plant scientist just starting out?

Take care of yourself, too. It's easy to get wrapped up in experiments, data, doing things for colleagues, and working toward the end

goal of "Once I'm successful (PI, bigwig in industry, etc.), I can do _____." However, it's important along the way to do things you enjoy or want to do, too. Don't leave yourself out of your life plans.

What person, living or deceased, do you most admire? Why?

Keeping it within plant science and ASPB, Pam Ronald (@pcronald) is a scientist I have enormous respect for. She's done good work, running from basic science to applying her work; done the hard thing of correcting her published work (and doing so openly); and is engaged in the discussion of feeding the world. It's an impressive combination of what many scientists hope for: curiosity-based research, applications deriving from it, and public engagement beyond the university walls.

What are you reading these days?

Lots of plant science papers relating to hormones, root development, and meristem function, but I'll talk about three books: *The Signature of All Things* (about a 19th-century plant scientist), *Game of Thrones, Book 5* (not plant-science related, but weirwoods seem like a fascinating species), and *Essentials of Biomedical Writing*.

What are your hobbies?

My biggest hobby is probably blogging; I write about plant science at thequietbranches.com

and have a personal blog at postdocstreet.wordpress.com. I am also a runner and a hiker and always seem to be reading things.

Do you still read print journals?

I still get a hard copy of *Science* I look at occasionally. And I do like to print out individual articles so I can doodle on them and make margin notes as I read. Digital solutions to writing on paper just aren't as satisfying. I love reading in coffee shops and libraries. It's even better when it's raining outside.

What do you think is the most important discovery in plant biology over the past year and why?

I just read the Cutler and Volkman group's paper in *Nature* on the modified ABA receptors that allow on-demand drought tolerance (Park et al., 2015). That's one of the important stories I've run across recently.

What do you think is the next "big thing" in plant biology?

It may be obvious, but with high-throughput technologies (RNAseq, proteomics, etc.), more different plants than ever can be experimented on and molecular data gained with less of requirements needed to develop tools standard to model organisms like *Arabidopsis* (which is still a valuable plant for research). These technologies also enhance research possibilities at primarily

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What would you tell colleagues to encourage them to join ASPB?

Community matters. Being a part of an organization like ASPB is part of that. Connecting with colleagues, even in small ways, enhances your own experience in the plant science world.

Was someone instrumental in getting you to join ASPB?

My plant physiology professor at Willamette University, Gary Tallman, made me aware of the Society. The reason I joined in grad school was partly to attend

Eric Hamilton Awarded ASPB/AAAS Mass Media Fellowship

Eric Hamilton, from Washington University in St. Louis (WUSTL), has been awarded the 2015 ASPB/AAAS Mass Media Science & Engineering Fellowship. He will spend 10 weeks this summer training as a science journalist at the Milwaukee *Journal Sentinel* in Milwaukee, Wisconsin.

Eric is a PhD candidate in the Plant and Microbial Biosciences program at WUSTL, where he researches plant mechanosen-

sation in the lab of Elizabeth Haswell, particularly the role mechanosensitive ion channels play in pollen's response to stress. He received a BS in biology and a BA in chemistry from Case Western Reserve University, where he was drawn to the plant world through his time with the university's produce program at its farm.

In graduate school, Eric has focused on bringing the plant science and urban gardening communities together through

garden events and presentations on the biology behind domestication, gardening, and home brewing. He is also an assistant organizer for the Science on Tap monthly science café series at a local brewery, which discusses WUSTL research with the public. His research is supported by the Monsanto Excellence Fund Fellowship.

Eric plans to pursue a career in science communication after graduating and is thrilled to have



Eric Hamilton

this opportunity to hone his skills in this field through the ASPB/AAAS Fellowship. He thanks ASPB for the support and is eager to report back after a summer of science reporting. ■

SS-ASPB MEETING REPORT *continued from page 12*

Thanks to the judges, who all worked very hard and were an asset to the student competitors and their mentors. The judges this year were Caryl Chlan, Nihal Dharmasiri, Becca Dickstein, Steve Grace, Nathan Hancock, Beth Hood, Mautusi Mitra, Mustafa Morsy, Shane Sanders, Jay Shockey, Meg Staton, and Rick Turley.

The Kriton-Hatzios Symposium was held on Sunday morning. The topic this year was

“Incorporating Bioinformatics into Plant Biology Research.” Our first speaker was Meg Staton from the University of Tennessee, who spoke about her research using bioinformatics for American chestnut restoration. Next, Joshua Udall from Brigham Young University discussed genome evolution of allotetraploid cotton. Finally, Shane Sanders from Mississippi State University presented on genome assembly and analysis.

The general business meeting completed the weekend events. ■

MEMBERSHIP CORNER *continued from page 13*

undergraduate institutions, since the data generated only require computing power for analysis and a lot of the method is outsourced. It's a good way to engage undergrads in research.

What do you still have to learn?

So many things.

Have you enhanced your career using ASPB job postings or through networking at an ASPB function?

Yes, I certainly have. Through networking and Twitter, I've been a guest author for the ASPB

blog, become part of the ASPB Digital Futures User Group, and have gotten new ideas for my own research. And I have hope that continued networking will lead to my next job, too.

What do you see as the most important role for scientific societies such as ASPB?

Ideally, a society creates an umbrella to spark new ideas and collaborations and to get more (plant) science done and funded. Societies are also key for getting the content generated by scientists out to the world, or at least being a platform to get the message out even further than it might otherwise go. ■

Policy Update

BY LAUREN BROCCOLI
Lewis-Burke Associates, LLC

House and Senate Pass Budget Resolutions

In March, the House and Senate adopted their own versions of the fiscal year 2016 budget resolution that establishes a budget blueprint for the government. Both chambers then moved to conference their respective budget resolutions into one final package by a target deadline of April 15. While the budget resolution is nonbinding and does not have the force of law, it does set binding top-line spending caps for the House and Senate Appropriations Committees for FY2016. In seeking to balance the budget within the next 10 years, both the House and Senate resolutions currently commit to adhering to the budget caps set in the Budget Control Act of 2011, which would mean significant budget cuts over the next few years.

The House resolution praises the work of science agencies, but it does not provide additional funding. Unlike the House resolution, which would support basic research and cut applied research programs, the Senate resolution prioritizes applied research such as energy research and development for renewable forms of energy.

A conference agreement would serve as a statement of House and Senate Republican priorities, but action would end there, as the budget resolution triggers authority for the Appropriations Committees to determine FY2016 appropriations bills.

House Appropriations Subcommittee on Agriculture Holds Hearing on FY2016 USDA Research Budgets

On March 24, plant science-related issues were among the topics addressed during a hearing held by the House Appropriations Subcommittee on Agriculture, Rural Development, Food and Drug Administration, and Related Agencies to consider FY2016 budget proposals for U.S. Department of Agriculture (USDA) research agencies. Witnesses included

- Catherine Woteki, undersecretary for Research, Education, and Economics, USDA
- Chavonda Jacobs-Young, administrator, Agricultural Research Service (ARS)
- Sonny Ramaswamy, director, National Institute of Food and Agriculture (NIFA)
- Mary Bohman, administrator, Economic Research Service
- Joe Reilly, administrator, National Agriculture Statistics Service
- Mike Young, director, USDA Office of Budget and Policy Analysis

In his opening remarks, Subcommittee Chairman Robert Aderholt (R-Alabama) noted the “very constrained funding environment” in which the Appropriations Committee is operating during FY2016. The testimony of the witnesses outlined the president’s FY2016

budget request for each agency and highlighted a wide range of USDA research priorities.

While much of the question-and-answer portion of the hearing focused on concerns about animal research at a specific U.S. Meat Animal Research Center in Nebraska, members of the subcommittee also highlighted issues of interest to plant biologists. In response to a question from Representative Kevin Yoder (R-Kansas), Ramaswamy mentioned NIFA’s support for new discoveries in plant genetics, including investments in research to develop drought-tolerant crops. Subcommittee Ranking Member Sam Farr (D-California) voiced concern about the Agriculture and Food Research Initiative’s (AFRI’s) low success rates and urged agency officials to look at research on the whole, rather than in silos. Woteki agreed with Farr, highlighting plant genetics and genomics, as well as the new antimicrobial resistance initiative, as examples of activities undertaken through a departmentwide approach.

Sources and Additional Information

- Information about the hearing is available at <http://1.usa.gov/1DmYObd>.

Bipartisan Engineering Biology Legislation Introduced in the House

On January 29, Representative Eddie Bernice Johnson (D-Texas), ranking member

of the House Committee on Science, Space, and Technology, and Representative James Sensenbrenner (R-Wisconsin) introduced the Engineering Biology Research and Development Act of 2015. The legislation would create a National Engineering Biology Research and Development Program to oversee federal research and development in engineering biology. In addition, the bill would develop a framework for coordinating federal investments in engineering biology, develop a national strategy, increase public-private partnerships, bolster education and training efforts for future engineering biology researchers, and “address any potential ethical, legal, environmental, and societal issues associated with engineering biology research.” The bill has been referred to the House Committee on Science, Space, and Technology, where it has not yet been considered.

Sources and Additional Information

- The full text of the Engineering Biology Research and Development Act of 2015 is available at <http://1.usa.gov/161cu25>.
- A press release announcing the introduction of the bill is available at <http://1.usa.gov/1yQ7vbR>.

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POLICY UPDATE
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**USDA NIFA Releases
FY2015 AFRI RFAs**

In February, the USDA NIFA released a series of Requests for Applications (RFA) through the Agriculture and Food Research

Initiative (AFRI), including solicitations on Food Security, Childhood Obesity Prevention, Water for Agriculture, Climate Variability and Change, Food Safety, and the Foundational Program. As reported in December, AFRI announced an RFA for the newly titled “Food,

Agriculture, Natural Resources, and Human Sciences Education and Literacy Initiative” (previously the “Fellowship Grants”), which will accept proposals to support undergraduates, graduate students, and postdocs. Each solicitation also contains details about Centers of Excellence crite-

ria, responding to a provision in the 2014 Farm Bill and building off of July 2014 NIFA stakeholder listening sessions.

Sources and Additional Information

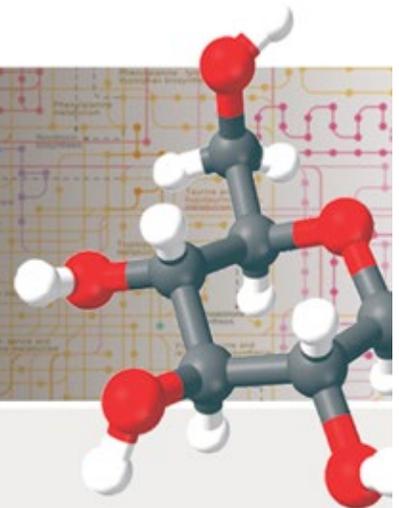
The RFAs can be accessed at <http://1.usa.gov/1b4Rjy1>. ■

Call for Papers

Plant Physiology[®]

Focus Issue on Metabolism

Deadline
for Submission
Extended!



Deadline for Submission: July 8, 2015

To submit an article, please go to <http://pphys.msubmit.net/>

Advances in next-generation sequencing, gene and genome engineering, and sampling have had an immense impact on our understanding of metabolism. This Focus Issue on Metabolism will address these advances including, but not limited to, state-of-the-art approaches in the study of plant metabolic pathways and interactions from the molecule to the whole-plant level, and the evolution of these processes. Special attention will be paid to emerging technologies and advances that promise to accelerate our understanding of metabolism, its control, the signals that regulate metabolism, its integration within organismal signaling and response in the face of biotic and abiotic stress, its contributions to plant structure, function, and its diversity and importance within modern society.

Authors interested in contributing should indicate this in the cover letter when submitting papers online at <http://pphys.msubmit.net/>. Please select “Metabolism (October 2015)” from the Focus Issue list in the online submission system. Articles published in *Plant Physiology* on this topic within 2 years before and after the Focus Issue publication date will be collected in an online Focus Collection on Metabolism.

Please contact Alisdair Fernie (Fernie@mpimp-golm.mpg.de) or Eran Pichersky (lelx@umich.edu) for more information.

Science Policy Committee Meets in Washington, D.C.

BY TYRONE SPADY

ASPB Legislative and Public Affairs Director

On March 16, 2015, the ASPB Science Policy Committee met in Washington, D.C., when the fiscal year 2016 appropriations process was under way. We met with members of Congress to discuss the importance of sustained annual investment in the federal agencies that support plant science research, as well as the importance of plant science to the economic well-being of those members' states and districts. We pointed out that plant biology provides the foundation for advancement in agriculture and the bio-economy, mitigation of the impacts of climate change, and development of new medicinal compounds involved in the treatment and prevention of diseases (see *Decadal Vision*, <http://bit.ly/1kNedsW>).

ASPB calls for sustained funding growth at federal agencies, which will allow researchers to work toward revolutionary breakthroughs, such as producing nutritious foods, sustainable energy, new medicines, and medical treatments; protecting our environment; and advancing our fundamental understanding of plant biology.

ASPB recognizes the tight fiscal environment facing the United States and appreciates congressional support for federal research agencies. Robust investments in the agencies and programs detailed below are vital to ensuring the nation's ability to meet critical challenges: attaining energy independence, increas-

ing crop production sustainably in a changing environment, training the next generation of scientists and engineers to lead the 21st-century global economy, and improving science education. These investments also will help drive future economic success and job growth.

National Science Foundation (NSF)

ASPB supports the requested level of \$7.724 billion for NSF in FY2016 and encourages the greatest possible support for the Directorate of Biological Sciences (BIO). This includes the Plant Genome Research Program (PGRP), which not only furthers fundamental knowledge, but also enables us to enhance agricultural productivity, grow nutritious foods, and diminish the effects of devastating plant parasites. Sustained funding growth over multiple years for PGRP will be critical to address many challenges of the 21st century.

Department of Energy's Office of Science

ASPB supports the requested level of \$5.34 billion for DOE's Office of Science in FY2016. ASPB supports the FY2016 request for the Office of Basic Energy Sciences at \$1.849 billion and the Office of Biological and Environmental Research at \$612.4 million. These offices support dynamic research at the interface of plant biology and other scientific disciplines.



Jane Silverthorne, deputy assistant director for the NSF Directorate of Biological Sciences, provides an update on agency activities to the ASPB Science Policy Committee.

Department of Agriculture

ASPB supports the FY2016 requested level of \$450 million for the Agriculture and Food Research Initiative (AFRI), which administers competitive funding for innovative research on issues such as food security, global health, and renewable energy. ASPB also supports the FY2016 requested level of \$1.398 billion for the Agricultural Research Service.

National Institutes of Health

ASPB supports sustained funding growth for NIH and advocates for increased support for plant science research within NIH's Centers and Institutes to help fight disease and obesity.

As part of our Congressional Visit Day, ASPB held 31 congressional meetings with offices representing Iowa, North Carolina, New York, Nebraska, Minnesota, Missouri, Mississippi, California, and

Florida. Within most congressional offices, our funding recommendations were well received. Our meetings also included the House Science Committee and Senate Appropriations (Commerce, Justice, and Science Appropriations Subcommittee) and Foreign Relations and Commerce Committees.

Prior to the congressional visits, ASPB's Science Policy Committee received agency updates from representatives of several important funding organizations. Among them were Jane Silverthorne, deputy assistant director for the NSF Directorate of Biological Sciences; Parag Chitnis, deputy director for the USDA Institute of Food Production and Sustainability; and Joe Cornelius, program director for the DOE Advanced Research Projects Agency–Energy. ■

ASPB at the 2015 White House Easter Egg Roll

137th year (est. 1878)



Five Healthy Habits!



At least 1 family from each of the 50 states

35,000
South Lawn visitors

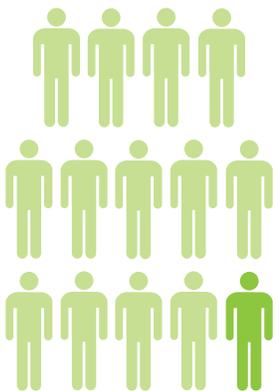
at least
60%
visited the
ASPB booth



10 amazing
morning volunteers!



10 awesome
afternoon volunteers!



1 of 14 special
activity partners



5th anniversary of
the First Lady's
Let's Move Initiative

www.whitehouse.gov/eastereggroll

Thanks for Hopping to It, ASPB Volunteers!

Daniel Czerny, Rachel Binder, Ryan Binder, Justin Kuan, Matthew Yu, Hemayet Ullah, Stacey Slijepcevic, Burkhard Schulz, Rosanne Alstatt, Liesel Alstatt, George Ude, Assumpta Ude, Janet Slovin, Caitie Hanlon, and Molly Hanlon. Molly also blogged about the day. See <http://bit.ly/1ycbGUq>.

And ASPB staff: Melanie Binder, Stephanie Liu-Kuan, and Kim Kimmach



Photos by Melanie Binder.

ASPB Outreach Veteran Janet Slovin Shares Some South Lawn Science Savvy:

"I tried to get the kids to think about where plants come from. I had them shake the seeds into their hand, then put them in the soil in their cup. So many of them were surprised at how small the seeds were, and that the lettuce seed looked different than the carrot seed."

"With the older kids, I asked them where the carrot seeds came from, or what part of the lettuce had seeds.... This usually stumped them, so I had a good chance to talk about where seeds come from in general. No one thought about carrots and lettuce having flowers."

"I also talked about whether we eat seeds or not. Lots of kids had been exposed to pumpkin seeds and sunflower seeds, and one kid knew about popcorn, but everyone was surprised that flour comes from the wheat seed. Having seeds in their hands allowed me to go in many different directions, even though we had very limited time with each kid."

Advice from a Postdoc

Take Advantage of Mentoring Opportunities with the PlantingScience Online Mentoring Program

BY DAWN NAGEL
University of Southern California

One aspect of my research training and career development that I am very passionate about is the opportunity to mentor students. As such, I am always looking for opportunities to get involved with students at earlier stages in their education. So when I discovered PlantingScience.org, an online mentoring resource that was advertised on the ASPB website, my first reaction was, “This is awesome, why haven’t I heard about this before?”

The major appeal for me was the minimal and flexible time commitment, which allows you to make an impact even with a busy schedule, and the opportunity to work with a diversity of students at a middle- and high-school academic level. You are expected to communicate with your assigned group of students about two or three times a week. Since it is an online forum, you can post suggestions and recommendations to your group from any mobile device, perhaps when you are on the bus or waiting to be seated at a restaurant.

The fact that the student groups are diverse both academically and culturally provides an



Photo by Naomi Volain.

enriching experience for me. For example, I had the opportunity to mentor an amazing group of students from a secondary school in the Netherlands. I was impressed by their commitment to the project and by how well the experiments were designed and performed. In addition, you are able to see the conclusions of the projects, because the students do

an excellent job of posting images of the experiments and results at the end of the session.

Overall, I feel that it was a fulfilling experience for me as well as the students. Participating in these types of mentoring activities contributes to the students’ understanding of basic plant biology principles and may foster a new interest in a plant

science career. For the mentor, this opportunity provides a basic foundation that can be integrated into the broader impacts section of your research grants, and, more important, a chance to develop relationships with these students and teachers that can lead to further collaboration.

The benefits and rewards are obvious to me, and once they hear about the program, many of my colleagues are very interested and eager to participate. So I strongly encourage graduate students, postdocs, and faculty members to explore this amazing opportunity, spread the word, and offer ways to further contribute to this program.

Interested in becoming a PlantingScience mentor? Check out www.plantingscience.org/newmentor to learn more and register. The next session will begin in mid-September. See what projects the student teams are working on this spring by browsing the research gallery (<http://bit.ly/1Hn3nFg>). ■

A Children's Workshop: Rooting Around the World of Plants

200 Bilingual Primary School Students Explore Plant Life Cycles and Root Grafting

BY CRISTINA SORIANO
CEBAS-CSIC - Campus Universitario de Espinardo

ROOTOPOWER (<http://www.ROOTOPOWER.eu>) is innovating rootscience research in Europe, gathering top research scientists from a wide array of root-related fields. This Knowledge Based Bio-Economy project, funded under the Seventh Framework Programme (FP7) of the European Union (grant number 289365), comprises 13 partners from Spain, the United Kingdom, Germany, Belgium, the Netherlands, and Turkey.

ROOTOPOWER aims to develop new tools, targeted to roots, to enhance agronomic stability and sustainability of dicotyledonous crops under multiple and combined stress conditions. The project focuses on the tomato as a model species, since its genome sequence is already available and it can be very easily grafted. This surgical technique attaches histologically shoot systems and root systems that are genetically different; the method allows researchers to precisely assess how altering the root genotype affects the grafted variety's crop performance. This project will analyze and exploit the natural genetic variability existing in a recombinant inbred line population (RIL) from a cross between *Solanum lycopersicum* and *S. pimpinellifolium* and other



CEBAS-CSIC team members responsible for organizing and teaching this workshop, March 26, 2015, Murcia, Spain. Photo © by M. A. Muñoz.

selected mutants and functional lines (used as rootstocks) for their performance under multiple abiotic stresses and for their biotic interaction with natural soil microorganisms (mycorrhiza and rhizobacteria). ROOTOPOWER will obtain genetic information and physiological understanding of mechanisms vital for high-performing root systems.

With an initial budget of about €3 million and anti-



Grafting tomato plants with students from the bilingual primary school Maristas, March 26, 2015, Murcia, Spain. Photo © by M. A. Muñoz.

ipated duration of four years, ROOTOPOWER seeks to improve crop stress resistance and develop more resource-efficient crops. This strategy aims to help producers and breeders deal with

the predicted impacts of climate change and to reduce the soil degradation and natural resource depletion that result from unsustainable agricultural practices.

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ROOTOPOWER continued from page 21

As part of its dissemination plan, CEBAS-CSIC (Murcia, Spain), the project's coordinating partner, recently organized a one-day workshop geared toward the broad academic public, particularly the students attending Maristas, a bilingual primary school in Murcia. With this activity, ROOTOPOWER partners intend to provide a better understanding of root-targeted strategies to minimize abiotic stress impacts on horticultural crops and to increase the education of the general public and schoolchildren on the field.

Early education needs to be creative and adaptive in order to motivate children and keep their attention. With this aim, CEBAS-CSIC developed a program combining both theoretical knowledge and practical applications. The first half of the workshop included a presentation titled "The World of Plants," covering the life cycle, parts, and



Students from Maristas participating in the workshop, March 26, 2015, Murcia, Spain. Photo © by M. A. Muñoz.

functions of plants; photosynthesis; and the role of scientists. This presentation included a time-lapse video showing the difference in scion growth of two grafted plants. In order to highlight the importance of roots and the use of grafting as the primary rootstock-evaluation method, the second half of the workshop

focused on showing children how to graft tomato plants. The students viewed an educational video recorded by CEBAS-CSIC, followed by the in situ grafting of plants. The approximately 200 children participating in the workshop were divided into small groups to promote direct participation as they learned about the

roots of different species cultivated hydroponically, plants subject to different stresses (salt stress, light stress, and control conditions), and blue tomato plants.

The workshop was very successful, and the participants enthusiastically collaborated in the activities. Because the children were bilingual in English and Spanish, the workshop was taught mainly in English, enabling CEBAS-CSIC to reinforce their language skills in English while teaching science in a fun way. The workshop designers drew on the educational materials and resources available at the ASPB K-12 Resources webpage, and the students received different ASPB bookmarks. ■

ASPB at NSTA 2015

Reaching Out to Promote Plants in the Science Classroom

BY ANDREW MANNING
University of Chicago

Spring has sprung, and teachers and administrators were out in force at the National Science Teachers Association (NSTA) national conference. From March 11 through 14 in Chicago, thousands of instructors made their way through a vast exhibition hall to seek out resources and advice on how to improve their science education methods. To reach out and promote the importance of considering plants in the science classroom, ASPB once again hosted an Education and Outreach booth during this event.

Highlights of the various activities and resources made available to booth visitors were the outstanding and eye-catching experiments from Scott Woody of the University of Wisconsin–Madison (<http://www.fpssc.wisc.edu>). These included several experiments highlighting recessive or dominant genetic traits, as well as The Mating Game, a great way to playfully engage students in understanding the genetic principles of inheritance and the differences between genotype and phenotype.

Many people stopped by the booth to see Suzanne Cunningham of Purdue University present her module on using plants to teach nutrition. Part of Suzanne's module used several different everyday drinks to illustrate the amounts of sugar that children consume with

Suzanne Cunningham explains her sugar module to Jean Greenberg and another visiting instructor. Photo by Andrew Manning.

Scott Woody's FPsc plants on display at the NSTA National Conference. Photo by Suzanne Cunningham.



A student examines a starch module on display at the ASPB booth. The hands-on activities were a hit with the kids and adults alike! Photo by Suzanne Cunningham.

their beverage choices. Visitors engaged in Suzanne's module by unspooling the five or more feet of sugar packets that could be found in some 24-ounce bottles of soda, comparing this to the much more minimal sugar content of some juices. Participants found the exercise inspiring and a great hands-on tool to teach students about sugar intake.

Joe Austin of the University of Chicago brought tools and images for teachers to do a little model-

ing of 3-D tomogram reconstructions of plant-root tips in the process of dividing. Participants explored some of the completed models to see how they could be integrated into the teaching of science concepts.

The ASPB booth also offered teachers a wide array of ways to engage students with various experiments highlighting the 12 Principles of Plant Biology. The integrated approach with the Next Generation Scientific Standards

(NGSS) was also a hit, delivering different ways to communicate biological principles through the use of plant biology. One of the more popular handouts was a plant fact sheet. It was increasingly apparent that we all do not recognize plants enough for their contributions to the planet and all the modern-day amenities that we have.

As usual, there can never be enough of the *My Life as a Plant* *continued on page 25*





Recognizing Our Authors 2009–2013

At ASPB, we are privileged to publish the work of a range of authors whose scientific experience and academic leadership have helped establish our journals, *Plant Physiology* and *The Plant Cell*, as highly respected sources of knowledge for the advancement of plant science.

In 2009, we analyzed citations to our journals for papers published between 2004 and 2008 to identify our authors from around the world publishing the most influential science. Now, in 2015, we are pleased to once again thank our authors for their role in the ongoing success of *Plant Physiology* and *The Plant Cell* and invite you to celebrate them with us. This new edition of *Recognizing Our Authors* acknowledges authors of our most highly cited papers published between 2009 and 2013. We've begun with researchers working in North America and Europe. Soon we will add plant biologists from Asia, Australasia, Central and South America, the Middle East, and Africa. We are grateful to them, just as we are grateful to all our authors, for making *Plant Physiology* and *The Plant Cell* what they are today.

Interested in submitting your best work to *Plant Physiology* and *The Plant Cell*? Please see our Instructions for Authors for both *The Plant Cell* (<http://www.plantcell.org/misc/ifora.shtml>) and *Plant Physiology* (<http://www.plantphysiol.org/misc/ifora.shtml>).

Read more by downloading the online PDF at
<http://bit.ly/1H1QAvy>

NSTA 2015
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activity books. Many instructors, both classroom teachers and even some forest rangers, found these a great way to reach out to a young audience and engage them with a variety of games and exercises intent on teaching basic plant principles. Many people who saw the books were even more impressed with the wide array of languages that they come in, delivering the interesting biology of plants to a much broader audience. See <http://www.aspb.org/coloringbook> for available translations.

Engaging with teachers and administrators also alerted me to several issues that we may be able to help with in the future. Many

of the teachers who stopped by marveled at Scott's tabletop lighting structure for plant growth. Although Scott is an admitted carpenter hobbyist, the essential parts and pieces for such a growth apparatus are relatively easy for teachers to obtain and put together. Additionally, there are a growing number of teachers with garden plots at their schools. These teachers are looking for a way not only to teach the basics of sowing seeds through plant development, but also to have space to conduct other outdoor plant-based experiments. As the idea of community gardens and active learning catches on, and as schools put more effort into incorporating these gardens into lessons, it would be great for

the plant biology community to design fun and easy experiments with these new resources and then reach out and get involved in the growing interest in plant biology and ecology.

Finally, on behalf of ASPB and its many members who care about public outreach, I want to acknowledge all the volunteers who helped make the ASPB booth such a success for us as collaborators and, of course, for the many science educators with whom we interacted. A big thanks to

Joe Austin, Jean Greenberg, Joanna Jelenska, and Jiyoung Lee
University of Chicago

Louise Anderson and Katherine Warpeha
University of Illinois, Chicago

Joyce Ache Gana, Devi Potluri, and Fred Ruddat
Chicago State University

Suzanne Cunningham
Purdue University

Scott Woody
University of Wisconsin–Madison

Everyone traveled from various nearby institutions to reach out and raise enthusiasm and support for the use of plants in the classroom. The marvelous thing about each volunteer was the differences that each could bring to reaching out to the teachers, offering unique advice and suggestions for engaging young audiences in the diverse and awe-inspiring world of plant biology. ■

Plant Explorations for Youngsters

Now available in Italian!

Thanks to Emanuela Pedrazzini, these two classic primary grade outreach worksheets from ASPB are available in Italian. Beyond her regular research agenda at the Institute of Agricultural Biology and Biotechnology in Italy, Emanuela conducts outreach events in her community. As part of this work, she has translated these basic worksheets to help introduce youngsters to the fascinating world of plants by using items they are familiar with and rely on every day.

Piante nascoste

<http://bit.ly/1DrzkPh>

Plants are everywhere and are important to people in many ways!

Use this form to take a treasure hunt of plants around your house.



Quante piante in un hamburger

(<http://bit.ly/1FIUyM2>)

Hamburger:

Find out just how many plants you eat with your hamburger.



SURF 2015: A New Wave of Undergraduate Research Coming this Summer

BY KATIE ENGEN
ASPB Education Coordinator

Recipients of the ASPB Summer Undergraduate Research Fellowship (SURF; <http://surf.aspb.org>) receive support to conduct 10 consecutive weeks of plant biology research under the mentorship of

an ASPB member. Program participation is worldwide and represents diverse interests. Proposals from undergraduates at doctoral-granting and primarily undergraduate institutions are reviewed separately. The

SURF committee makes awards in proportion to the number of applications received from each group. This year's 15 awards went to 10 applicants from universities that grant PhDs and five from primarily undergraduate institutions. The

2015 SURFers will present their research at the undergraduate and general poster sessions during Plant Biology 2016 in Austin, Texas.

Congratulations to these 2015 SURFers!

Group A Research and Doctoral Universities



Kevin Bird

Kevin Bird, University of Missouri
Mentor: Michael Gore, Cornell University
Project: *Building the genetic foundation for biofortification in Brassica rapa*

This award allows me to both broaden my research experience by working at a new institution and to share my research with a new network of scientists at the ASPB 2016 meeting.



Allison Butt

Allison Butt, Worcester Polytechnic Institute
Mentor: Luis Vidali
Project: *Analysis of the function of conditional loss-of-growth 1 gene in Physcomitrella patens protonemal cell development*

The ASPB SURF grant has given me the ability to have professional lab experience and work with a project that is pivotal to plant biology. The opportunity to work in a lab during the summer of my junior year will allow me to pursue my goal of going on to graduate school to attain a doctorate within the field of biology.



Hailey Cambra

Hailey Cambra, Worcester Polytechnic Institute
Mentor: Pamela Weathers
Project: *Artemisinin biosynthesis: Do roots affect epigenetic changes in leaves?*

This SURF grant allows me to pursue my research interests in elucidating metabolic regulation in plants. I plan to apply to a PhD program following my graduation from Worcester Polytechnic Institute, and I hope to focus my thesis on metabolic engineering of photosynthetic organisms to find solutions to issues of global concern, such as health and renewable energy.



Maxwell Choka

Maxwell Choka, Queen's University
Mentor: William Plaxton
Project: *Functional-genomic analysis of a "curculin-like lectin" in Arabidopsis phosphate acquisition*

I am extremely grateful for the opportunity to be involved with plant science research this summer in the Plaxton lab. Receiving the SURF grant will not only allow me to develop research skills useful for my undergraduate career and beyond, but also give me the chance to make a valuable contribution to the scientific community.



Clayton Dilks



Ronald Fox



Josephine Lee



Abigail Miller

Clayton Dilks, University of Illinois at Urbana-Champaign
Mentor: Amy Marshall-Colon
Project: *Changes in heat and nitrogen stress signaling pathways throughout development of Arabidopsis*

The ASPB SURF award will allow me to focus solely on my summer research by funding me to cover some living expenses and the equipment that I will need to complete my research project. It will further help me achieve my goal of pursuing a PhD in systems biology with a focus in plant biology by giving me the means to start an independent research project and to gain invaluable experience in the field.

Ronald Fox, The Ohio State University
Mentor: Anna Dobritsa
Project: *The creation of organelle markers for characterizing proteins involved in exine formation in Arabidopsis*

The SURF award will give me the opportunity to productively work on my project without the distraction of classes. It will give me experience that will enhance my career as a scientist.

Josephine Lee, Washington University in St. Louis
Mentor: Elizabeth Haswell
Project: *Do plastids and mitochondria communicate through redox state to control plant development?*

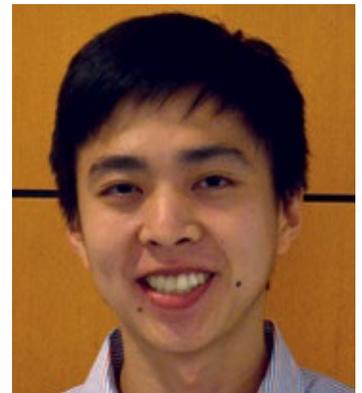
The breadth of exposure that the ASPB SURF award provides me will help me discover my specific interests in plant biology and develop a career in plant biology research.

Abigail Miller, Michigan State University
Mentor: Pengxiang Fan
Project: *Variation in the Acylsucrose biosynthesis pathway in wild tomato species*

I am grateful to be a recipient of the ASPB Summer Undergraduate Research Fellowship because it allows me to continue pursuing my research on the Acylsucrose Acyltransferase enzyme in tomato plants. I am looking forward to another summer filled with intensive research and learning new biochemical techniques to analyze enzyme structure and function. This fellowship will help me immensely in pursuing a future graduate career in biochemistry.



Elizabeth Sarkel



Dennis Zhu

Elizabeth Sarkel, Wake Forest University
Mentor: Gloria Muday
Project: *Investigating the role of reactive oxygen species in root gravity response*

Applying for and receiving the SURF grant has given me a valuable opportunity to prepare, complete, and present a research project this summer. This will be an excellent start to my undergraduate research and will give me a great foundation for continuing my undergraduate research and preparation for graduate studies.

Dennis Zhu, University of Missouri-Columbia
Mentor: Paula McSteen
Project: *Characterization of vegetative and reproductive defects in the maize tassel-less 4 mutant*

After my undergraduate career, my goal is to continue plant science research in graduate school and eventually work as a research scientist. Working with my mentor to write a proposal for the ASPB SURF taught me the challenges of science writing and also gave me experience in independently planning experiments.

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LeMar Callaway III



Sienna Lopez



Karina Morales



Maria Sorkin

SURF 2015
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Group B Primarily Undergraduate Institutions

LeMar Callaway III, Virginia Wesleyan College

Mentor: Eric Johnson

Project: *Aribinogalactan proteins, calcium ion signaling, and their role in plant development*

Applying for this grant has given me exposure to the research process, as well as some of the important considerations involved in deciding an important question to research. Receiving this grant has given me the opportunity to have a productive summer, in which I can delve deeper into an interesting and specified area of plant biology.

Sienna Lopez, Spring Arbor University

Mentor: Aaron Wyman

Project: *Exploring genes and their products for novel impacts on plant growth and development*

With the SURF award, I'll be able to apply and advance the knowledge I've gained through my courses and labs in an inde-

pendent research setting. I feel very blessed and honored to have this opportunity, which I likely wouldn't have had without the SURF grant. Thanks again!

Karina Morales, Azusa Pacific University

Mentor: Charles Chen

Project: *Projecting food sustainability: Identifying varietal differences in the gas exchange and nitrogen distribution of two rice cultivars grown under increased [CO₂] and air temperature*

As I look toward my future, I plan to pursue a PhD in plant physiology and to use this degree to teach and research the impact of climate change on major food crops. By participating in this SURF project, I am given the opportunity to receive hands-on experience in the field of research. I envision myself participating in as a future career.

Maria Sorkin, Kenyon College

Mentor: Karen Hicks

Project: *An evolutionary assessment of how seasonal cues regulate reproductive development using the bryophyte *Physcomitrella patens**

I am incredibly excited to put my funds from the ASPB SURF grant toward the completion of

my summer project, which I hope will offer a meaningful contribution to plant biology research at Kenyon and to the larger plant research community. This fellowship will help set the stage for my senior honors thesis and for my continued involvement in applied plant research beyond Kenyon.

Melissa Traver, Centenary College of Louisiana

Mentor: Rebecca L. Murphy

Project: *Making the switch: The role of protein interactions CONSTANS-mediated floral initiation in sorghum*

Receiving the ASPB SURF grant will allow me to pursue my goal of earning a PhD in the biological sciences and give me the opportunity to perform intensive summer research. Without this grant, I would not have this incredible opportunity.

Honorable Mention

Jennifer Olins, University of Massachusetts Amherst



Melissa Traver

Albert W. Frenkel

1919–2015

BY GOVINDJEE AND SUSANNA FRENKEL

Albert Frenkel was the fourth and youngest child of Selma (Baerwald) and Arthur Frenkel. He was born during the Spartacist rebellion, and the attending doctor had to be guaranteed his safety after Al's birth. Al was raised in an upper-class environment, with visits to the huge house of his grandfather Hermann Frenkel—next door to the family house of one of the fathers of rocket science, Werner von Braun. From Germany, the family moved to Switzerland in the 1920s to escape the rise of the Nazis. Al began collecting wildflowers in Switzerland and pressing them; this collection is now part of the Jepson Herbaria at the University of California (UC), Berkeley.

Al graduated from the Bismarck Gymnasium in Berlin in 1936, but he had a rough time at the Nazi-controlled elite high school. As a Jew, he was pushed around at school. To avoid being picked up, he would ride his bike to get around instead of taking public transportation.

In April 1937, at age 17, Al left Germany. Eager to leave behind the rigidity of German life, he eventually made his way to New York City and then San Francisco. He applied to UC Berkeley and wrote his admission essay on Marie Curie. He received two years of college credit for his Gymnasium education and received his BA in plant physiology with highest



A photograph of Albert Frenkel in Berlin. Source: Archives of the Frenkel family.

honors in 1939. His senior and PhD theses were on studies of enzyme systems in photosynthesis by means of radioactive tracers, carbon monoxide, and ultraviolet light. Al obtained his PhD in botany in 1942, at the age of 23 (see <http://ucjeps.berkeley.edu/history/botanyatberkeley/>). His degrees from UC Berkeley were under his original name, Wolfgang Hans Albert Frenkel, which he changed to Albert W. Frenkel upon becoming a U.S. citizen in 1944.

As a graduate student, Al worked with Martin Kamen and Samuel Ruben when they were working at the Cyclotron in the Radiation Lab at Berkeley. The era of “Big Science” was being ushered in by Ernest Lawrence at



Albert Frenkel at the University of Minnesota. Source: Archives of the Frenkel family.

Berkeley (see Kamen, 1985). In addition to Andrew A. Benson, of Calvin-Benson cycle fame, Al was one of the first to learn of Kamen and Ruben's discovery of carbon-14; he remained a friend of Kamen's all his life and attended the function at the State Department when Kamen was awarded the Fermi Prize in 1996.

After graduation, Al went to work with Robert Emerson at Caltech, studying “artificial rubber.” He was then drafted into the U.S. Army, first stationed at Fort Hood and then sent to Oak Ridge National Laboratory, where he worked for the Army Corps of Engineers. During this period, he worked at Rochester, New York, for the Manhattan Project as a technical sergeant. In addition,

he worked for the U.S. Atomic Energy Commission.

In 1947, Al was hired as an assistant professor in the Department of Botany at the University of Minnesota, and in 1948 he met his wife, Goldie (Schwartz); they were married in Grand Forks, North Dakota.

Al was a member of the University of Minnesota faculty until retiring as a professor of botany and plant physiology in 1988. He served as chair of the Botany Department from 1971 to 1975. The Albert Frenkel Reading Room in the Biological Sciences Building was named in recognition of his many contributions to the life sciences and his support of university libraries. At the dedication of this room, he was lauded as a “much-loved teacher, scholar, and adviser.”

It was in 1954 that Albert Frenkel did research with 1953 Nobel Prize winner Fritz Lipmann at Harvard Medical School and Massachusetts General Hospital. And it is this work that led to the discovery of photophosphorylation in photosynthetic bacteria (Frenkel, 1954).

In addition, Al did research at the Hopkins Marine Station (working with the greatest microbiologist of his time, Cornelis van Niel), Stanford University (1967–1968), and the Marine Biology Laboratory at Woods Hole National Laboratory (first in 1948, then again in 1957).

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FRENKEL

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In his 1993 “Recollections” in the journal *Photosynthesis Research*, Al did a fantastic job in bringing before us his research life, his discoveries, and his associations, showing how and when he did what. We refer the reader to this wonderful story. Here, we present a glimpse of his research areas in chronological order to show his journey in science from graduate student in the 1940s until retirement in the 1980s.

1940s

Path of carbon in photosynthesis

Long before anyone else, Frenkel (1941) and Ruben et al. (1942) presented one of the earliest measurements on intermediates in plant cells using radioactive tracers. This was followed by looking at what uranium did on the surface of cells (Rothstein et al., 1948), perhaps a follow-up of what went on during World War II.

1950s

Photoreduction in algae

Hans Gaffron had discovered photoreduction in some algae; Al soon thereafter discovered it in several other algae and extended this area of research, which is now becoming quite important for biofuel and bioenergy (see Frenkel et al., 1950; Frenkel and Rieger, 1951; Frenkel, 1952; and Frenkel and Lewin, 1954).

Major review

In 1953, Al coauthored a major and highly authoritative review on photosynthesis with Allan Brown, editor-in-chief of *Plant Physiology* from 1958 to 1963 (see Brown and Frenkel, 1953a,b).

Discovery of photophosphorylation

As mentioned earlier, Al discovered photophosphorylation in bacterial photosynthesis (Frenkel, 1954; see his full detailed paper, Frenkel, 1956; also see Gest and Blankenship, 2004; 2005).

Light-induced reduction of nucleotides in photosynthetic bacteria

Just as ATP is important, reducing power is equally important for photosynthetic bacteria. Frenkel (1958; 1959a) made one of the first measurements in this area. Soon thereafter he was invited to write a review on this topic (Frenkel, 1959b).

Structural aspects

Al began looking at structural aspects of photosynthesis with Donald D. Hickman; this opened a new way of thinking for him (see Frenkel and Hickman, 1959; Hickman and Frenkel, 1959).

Nitrogen fixation

Getting deeper into biochemistry and metabolism of photosynthetic bacteria, he studied nitrogen fixation (see Pratt and Frenkel, 1959).

1960s

Structural aspects (*continued*)

Hickman and Frenkel (1965a,b) continued their detailed structural studies on photosynthetic bacteria, extending them to several species.

New interest in a chlorophyll b mutant of barley

Highkin and Frenkel (1962) published their physiological studies on a barley mutant that would be used by others later for understanding the mechanism of protection against excess light by plants (see, e.g., Gilmore et al., 2000).

Review of photophosphorylation

The discoveries in the 1950s were reviewed after a decade with a new unique perspective (Frenkel and Cost, 1966).

Free radicals

With Jim Bolton, Al described free radicals in both chromatophores and chloroplasts (Cost et al., 1969).

1970s–1980s

Electron transport in bacterial chromatophores

Frenkel (1970) discussed the multiplicity of electron transport in bacterial photosynthesis and reviewed, in great depth, all that was then known about chromatophores (Frenkel and Nelson, 1971).

Mechanism of superoxide production

Jahnke and Frenkel (1975, 1978) and Frenkel et al. (1981) studied the mechanism of superoxide production in *in vitro* systems.

The finale

Al ended his writing career by covering Fritz Lipman's contributions (Frenkel, 1985) as well as his own (Frenkel, 1993).

Personal attributes

Al Frenkel was a good-natured and kind person. He would spend hours telling stories of the past, including the controversy between the 1931 Nobel laureate Otto Warburg and Robert Emerson about the minimum quantum requirement of oxygen evolution (see Hill and Govindjee, 2014).

Al was not only a dedicated scientist, but he was also a very good father. Often on weekends, he would take his children

(including the author SF) to work with him, and they would wander around the old Botany Department building at the University of Minnesota and the adjacent student union and the hospital.

Albert Frenkel was preceded in death by his sisters Doro Odenheimer and Susanne Goltz and his brother Paul Frenkel. He is survived by his wife, Goldie Frenkel, and by daughter Susanna Frenkel (coauthor of this tribute), sons David and Joseph Frenkel, and four grandchildren.

This article is adapted with permission from Govindjee and S. Frenkel, Albert W. Frenkel (1919–2015): Photosynthesis research pioneer, much-loved teacher, and scholar. Photosynthesis Research. doi 10.1007/s11120-015-0109-x.

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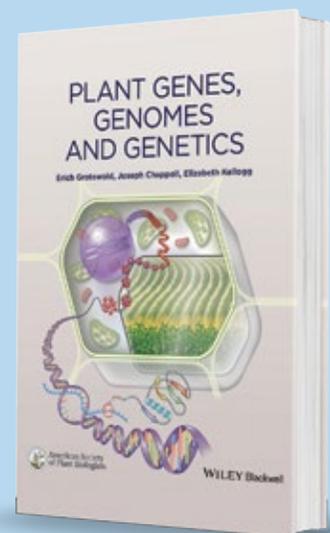
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Plant Genes, Genomes and Genetics

By Erich Grotewold, Joseph Chappell and Elizabeth A. Kellogg

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