

National Science Foundation
Directorate for Biological Sciences

BIO ADVISORY COMMITTEE
Room 1235, Stafford I
March 17 and 18, 2010

Summary Minutes

Wednesday, March 17, 2010

Welcome and Approval of Minutes

Note: Drs. Michael Mares and Daniel Wubah joined via teleconference

Dr. Barbara Schaal, Chair of the Advisory Committee for Biological Sciences (BIO AC), convened the Spring 2010 meeting at 8:30 am with a request for introductions. Dr. Joann Roskoski, Acting Assistant Director (AD) for the Biological Sciences (BIO) Directorate, greeted the guests, welcomed the BIO AC members, and discussed logistics for the meeting. The minutes from the Fall 2009 BIO AC meeting were unanimously approved by the Committee.

Request for BIO AC Liaisons for BIO Reviews

BIO AC liaisons were requested for the Division of Biological Infrastructure (DBI) Committee of Visitors (COV) review July 12-14, 2010, the Plant Genome Research Program (PGRP) COV review August 31-September 2, 2010, and the Long-Term Ecological Research (LTER) 30 Year Review. Dr. Roskoski provided a brief background to the decadal reviews of LTER. The LTER 30 Year Review is to address the direction the LTER program should head in the next 5-10 years. The review committee will be led by Allison (Sonny) Powers and Anthony Michaels. The LTER program has been incorporating the recommendations of the 10-year and 20-year reviews by ensuring the sites become more of a network and attempting to incorporate the social sciences (humans) in the program. The BIO AC members who volunteered to serve as liaisons are Dr. Robert Robbins – DBI COV, Dr. David Stern – PGRP COV, and Dr. Robert Robbins (interested) – LTER 30 Year Review.

2011 Budget Report – Dr. Joann Roskoski, Acting AD, BIO

Dr. Roskoski reported on staffing changes in the Foundation and in BIO, 60 years of NSF, BIO's ARRA funding, BIO's FY 2010 budget, BIO's FY 2011 budget request, and BIO priorities. The openings at NSF includes the Director (June 1), the BIO AD, and the Division Director (DD) of Integrated Organismal Systems (IOS). Dr. Roskoski presented the ARRA Portfolio, which includes 555 awards totaling \$260M and spread across 47 states. Awarding of grants was driven by guidance by the White House to focus on certain target areas (energy, climate, early career, etc.). This elevated the award success rate to 28%. She also highlighted several of

BIO's FY 2010 new activities: Climate Research Investments (part of the focus of BIO's efforts for the US Global Change Research Program), the National Ecological Observatory Network, Transforming undergraduate Biology Education, Research Resources- Digitization, and Experiments in Innovation. Dr. Roskoski noted the BIO budget request was increased by 7.5 % (\$53.27M) for FY 2011 and the FY 2011 priorities for BIO have been aligned with some of the Administration's priorities. These priorities include the FY 2010 new activities and add Bio-economy, the intersection of biological and physical sciences, and Science, Engineering, and Education for Sustainability (SEES).

Most of the discussion with the BIO AC members focused on ARRA funding and reporting and the proposal submission, review, and recommendation process. Concern was expressed regarding the potential PI answers to questions about the impact about job creation with ARRA funds. It was suggested that NSF send guidelines or "bullet points" to advise Principal Investigators (PIs) of the criteria for awarding ARRA funds and answers to potential job creation questions. One PI was troubled by the concept of a "soft-landing" for the ARRA funding. Dr. Roskoski spoke of BIO's management of the funding creatively by using FY 2009 funds to pay down mortgages for 2010. Reduced mortgages give you more money to pick up additional awards. Discussions then focused on the proposal submission and merit review processes. Most of the committee feels they should be evaluated: Is the use of pre-proposals a viable method? Should there be a limited number of times a PI can submit a proposal? What is the best working model in the US? How does the funding profile map to the PIs/institutions who are submitting proposals?

Undergraduate Biology Education (UBE) Update – Dr. Bill Zamer, Acting Deputy Division Director (DDD), IOS

Dr. Bill Zamer started his presentation with a request for advice about institutional change. He posed two questions: 1) What issues should be considered in the development of support and 2) What elements would attract the BIO AC members to apply to the program? He then presented a historical timeline of undergraduate education as an area of focus at NSF and the FY 2010 activities geared towards this area, such as Research Coordination Networks (RCN)-UBE, Course Curriculum and Laboratory Instruction (CCLI), the STEM Talent Expansion Program (STEP) Center, Vision & Change, the Baseline Assessment, and the Institutional Change initiative. Dr. Zamer announced the decision to have an external review of existing UBE activities in FY 2010 to provide guidance for the future of the UBE portfolio by completing an analysis of current investments and pointing to the development of metrics to be used in the future for assessment and evaluation of activities.

The discussion that followed centered on the topic of institutional change. The benefits of a formal program with strong proposals for projects that can continue past the life of the grant, using best practices, and "franchising" instead of "enterprising"/"experimenting" were discussed. It was acknowledged that adequate assessment tools may not exist, the metrics for assessment are very important, and the types of students need to be addressed as there is a difference in

biology majors and non biology majors. It was also suggested that looking at best practices needs to have a transformative element that will change how the portfolio of CCLI looks as BIO has not fared well in CCLI. There was some debate on the “experts” of assessment and the dependence upon them to aid BIO. Data is needed to support one education style over others, i.e. evidence that inquiry based learning is better. The BIO AC decided that more education was needed and after educating themselves, the topic would be revisited.

Collections Update – Dr. Judy Skog, OAD

Dr. Judy Skog presented the progress of BIO’s efforts towards the digitization of US scientific collections, including a focus group held in February and continued funding efforts (FY 2009 ARRA funds and inclusion in the FY 2011 budget request). There have been interagency activities, which have led to the establishment of a working group co-chaired by a USDA employee. International interest in promoting linked data resources has developed and models from other countries are being evaluated. An internal BIO working group was formed to engage collections community and a blog has been set up for the community. Overall, it has been a positive experience, and community is commenting positively for the need for a national resource. A workshop is being scheduled later this year to focus on the development of a 10 year strategic plan.

BIO AC members Drs. Donoghue and Dr. Mares added comments concerning their experience during the focus group meeting. Both agree digitization is significant and critical. Dr. Donoghue felt the size and cost of the job may have been underestimated earlier. This issue was analyzed at the focus group meeting, and it was acknowledged that some of the collections communities will have an easier job and all digitization will not move at the same rate. Other points addressed were:

- What do you digitize? Do you digitize everything? If not, how to select what gets digitized? Was this discussed at the workshop?
 - Need to look at everything but need to prioritize
 - Gravitated towards easier ones to chew off and will make money quickly
- Bulk of collections have a high probability of being completed in a 10 year span
- What about small collections that are as well maintained?
 - Maybe physically (and permanently) bring them into the larger collections
 - Don’t want to just have 20 places where things are deposited
 - Want to keep a larger array of museums out there
- Maybe prioritize specimens that are used most? Maybe by research area (climate change?)
 - Good strategy mix prioritization and experimentation
- NEON will need this kind of support and there isn’t enough of support built into NEON
 - Digitization will be a nice complement

Dimensions of Biodiversity Update - Dr. Penny Firth, DDD, Division of Environmental Biology (DEB)

Dr. Penny Firth began the update with the announcement of a solicitation for the program, which was released the second week of March and included NSF-China as a partner in the formation of international RCN. She discussed a 10 year campaign to characterize the dimensions of

biodiversity on Earth and the driving issues affecting the campaign. The campaign's strategic plan has 5 goals: research, analyses and syntheses, workforce, collections, and cyberinfrastructure. Each goal has a working group and planning activities associated with it. In addition there are planning activities for international, interagency, and private partnerships, base-lining the characterization, and assessment of the progress. The discussion began with question concerning the overarching goal of the program. Dr. Firth stated the goal is to understand and characterize the unknowns about Biodiversity on Earth over a decade. Dr. McCombie worried that a useful program to get lost in a lack of focus if there are no boundaries set up front as it would be impossible to define biodiversity in 10 years. Other thoughts:

- Research agenda will help as well to add parameters to the program
 - In the absence of baselining, maybe baseline should be a goal
- How is it going to work with NSF-China?
 - Had numerous intersection meetings with china
 - China has PI community that is ready to go
 - Right now, difficult to get funding for
 - China will pay for whatever is on the china end, we will pay for whatever is on the US end
 - Mechanically, US PIs will come in with proposal and china as a supplementary document
 - Going to send them their proposal that has their money requested
- What about other organizations?
 - Maybe need to emphasize that, because the NSF goes in deeper
- Staying within the intersection of the three target areas (genomic, taxonomic, and functional) contributes the added value to the program
 - Possibly add other areas in the future

Working Lunch

Action Item: Should a BIO AC Research Resources sub-committee be charged with developing a report for the next BIO AC meeting and what should be the scope of its charge?

Dr. Roskoski suggested the meeting will be a small focus session to brainstorm on what current resources require more attention or should be approached in a different way. The subcommittee would produce a short report to be used for the BIO strategic plan for budget development.

Participating BIO AC members were:

Dr. Juliette Bell	Dr. Susan Bryant	Dr. Christopher Comer
Dr. Michael Donoghue	Dr. W. Richard McCombie	Dr. Eva Pell
Dr. Robert Robbins	Dr. Barbara Schaal	Dr. Joseph Travis
Dr. Muriel Poston		

NSF Staff Participants were:

Dr. Charles Liarakes	Dr. Joann Roskoski	Dr. Peter Arzberger
Dr. Stephen Howell	Dr. Mari Kimura, AAAS Fellow	

General Discussion: The Future of Biology

2 NRC Reports: A New Biology for the 21st Century (2009) and Research at the Intersection of the Physical and Life Sciences (2010)

Dr. Roskoski started the discussion with a brief history of the reports: Dr. Collins, former BIO AD, felt the conceptual/theoretical aspects of biology were getting lost and sought to redirect the direction of the directorate. He wanted a report to address the theories that are the foundation of biology and analyze the importance of fundamental biology research in collaboration with other federal agencies. These reports identified areas of science with societal impacts. The strategic areas identified by the first report are food, environment, energy, and health. The second report presented 5 grand challenge areas: synthetic biology, neurobiology, genotype to phenotype, environment, and biodiversity. BIO provided a few questions to drive the discussion.

There were a few areas of the first report that were seen as lacking in the report, primarily discussion of the social sciences and recognizing the emergence of regenerative medicine and stem cell research. A committee member was impressed with the concern regarding losing opportunity and value by not integrating efforts across the government. Another felt the first report was incisive about how science worked, but naïve about how funding works, the amount of money needed, and the amount of new money that will be available. The report was thought to have avoided policy. There was disappointment expressed regarding the placement of education sections and the limited number of recommendations. It was thought that a further step away from cellular biology maybe needed to study life's processes.

The report was praised as a welcome call to invest more in biology. It was seen that almost every scientist can get behind one of the areas identified. The discussion turned to ways to train the next generation of biologists, if the way training and education are being done now is effective or the "right" way, and the implications in the way institutions are structured.

The need for a list of grand challenges/questions for biology was questioned. If so, will agencies put money into them? It was felt that tractable grand challenges were needed. The challenges needed to be "doable" as compared to biological open ended questions. What are the basic questions that need to be addressed to solve the "grand problems"? It needs to be a list that can be applied. Having the grand challenges articulated is great, but you need to be careful to not allow the list to become unofficial criteria.

Dr. Roskoski was asked what NSF does with the reports. She stated BIO held brown bag discussions to identify areas that were not seen in the existing programs. There is a working group to talk about the interface between BIO and MPS and to think about actions to be taken in FY2011 with the new resources available. There is an interagency meeting with DOE to discuss the first report, the responses to the report, and how to fund activities in FY2012.

A question arose concerning NSF's efforts to break down boundaries in different programs, divisions, and directorates. Dr. Roskoski commented that there are cross directorate and cross program activities within BIO. NSF is starting to look at the interface areas and creating panels across programs to deal with proposals that are in those areas. The next level is interagency activities, which brings the challenge of the legal aspects to the forefront.

Both reports say peer review is an area that needs to be addressed. NSF needs to look at peer review mechanisms and make sure we're up to the task. Would pre-proposals make some sense? It may be useful in dealing with workload to have pre-proposal process. Should the AC/NSF revisit how merit review is done? There is a lot of latitude with there being only one requirement (have at least 3 reviewers). AC members felt time may need to be set aside for more discussions on peer review. It was also suggested the whole proposal submission process may need to be evaluated so that it is more streamlined.

Discussion was turned to the question of core disciplines being at risk due to a focus on inter- and transdisciplinary research in the reports. The overall feeling of the group is that they would not disappear as modern biology requires interdisciplinary research. There was a concern that the scientific community may be inadvertently moving towards few researchers wanting to be in certain core areas. Tenure opportunities and requirements in the time of interdisciplinary research were discussed. Different criteria are needed for tenure decisions than those used historically. There may exist a need for new training of researchers in some areas (such as taxonomy).

Dr. Roskoski raised the question: Is the focus of multidisciplinary science and science at the interface reflected at institutions? The general feeling of the group was that the organization and structure of universities make it very difficult. It takes money, a different organizational approach, and buy-in from the people on the ground to make it truly work. The Carnegie Institute, the National Cancer Institute, and, to some extent, Penn State have gotten it to work.

The issue of interdisciplinary undergraduate education was discussed next. It was thought tension exists between preparing undergraduates in the basics and interdisciplinary so they can do more advanced work. However, "basics" are different for different types of students: 95 % of the students will not go to graduate school. There needs to be some flexibility in the curriculum and in the training of students. Getting students to cross disciplines takes time on the part of the faculty and may require cross discipline students and faculty in one class.

Advances in Sequencing Technology – Dr. Richard McCombie, Cold Spring Harbor Laboratory

Dr. McCombie presented the challenges, opportunities and implications of disruptive sequencing technologies, primarily with the Solexa/Illumina platform. At CSHL, they are approaching a trillion bases sequenced a month with 15 people working. It is difficult to determine how much it costs to sequence a genome, as it changes monthly. Dr. McCombie discussed the evolution of sequencing technology and equipment, which continues to get faster and better. The next generation sequencer is being produced by Pacific Biosciences (3rd generation sequencing technology (PacBio RS)) which has the following characteristics:

- Long wavelength
- DNA polymerase as a sequencing engine
- Realtime incorporation movie
- Single Molecule resolution
- Long read length is highly advantageous
- Strobe read

DEB COV Report – Joe Travis, BIO AC Liaison to DEB COV

Dr. Travis reported to the BIO AC his observations of the DEB COV review, which occurred in June 2009. Discussion occurred as he presented the findings. The purpose of the review was to assess the quality and integrity of DEB operations. The committee felt there was excellent science being supported, including some potentially transformative projects. Dr. Travis stated the committee was impressed with DEB's management of operations, wise judgment in assessing proposals, and leadership in fostering multidisciplinary projects. The program officers are responsive to changes and needs of DEB's scientific community. Two-thirds of the new investigators succeed.

The committee thought the microbial ecology community was not being served well in the division and the effectiveness of Broader Impacts (BI) is unknown. The independent postdoctoral fellowship program should be revived. It was also noted that the Dear Colleague letters were not working as well as hoped. The committee felt aspects of the proposal review and assessment process should be reviewed: the disparity of panel summaries and reviewer comments, the Conflict of Interest (COI) policy, and the broader impacts of proposals.

At times there appeared to be a disconnect between panel summaries and reviewer comments. The panel summaries do not always capture all of the comments made during the panel discussion or those submitted by other reviewers. The degree of conflict with in the NSF COI policy should be reviewed in cooperation with PIs. The effectiveness broader impacts of proposals should be evaluated. Although most PIs know what should be written in proposals to be funded, but how effective are the activities? If there are no standards or metrics, how are the BI sections of the proposal being evaluated? Discussion then shifted to the BIO-wide postdoctoral program regarding the number of proposals received, the amount of money that should be allocated, and how the decisions should be made. The BIO AC accepted the DEB COV report.

Emerging Frontiers (EF) COV Report – Dr. Jacquelyn Fetrow, BIO AC Liaison to EF COV

Dr. Fetrow reported the COV was impressed with the quality of the projects funded in EF. EF supports cross-disciplinary and multidisciplinary projects, fills a niche in science and brings scientific communities together. The committee felt the new mission statement captures what EF should be doing better but did not capture all aspects of what EF should be doing. There was a concern that EF needs to be careful to not become a "catchall".

Dr. Fetrow mentioned three programs specifically: Advancing Theory in Biology (ATB), Ecology of Infectious Disease (EID), and Microbial Genome Sequencing. ATB has a good balance between innovative and potentially transformative projects, but the program needs to clearly define what "theory" means. It has only had two panel cycles; the first round had questionable quality of reviews, but the second round had excellent reviews. EID is a strong ongoing program, which demonstrated strong leadership, and should be considered a model for interagency cooperation. Given its success, the COV expressed concern for the fate of the program as it transitioned out of EF. NSF staff noted that EID has become a program in DEB.

The Microbial Genome Sequencing program filled an unique niche in sequencing microbial genomes. The COV expressed concern about leadership issues for this program, the lack of appreciation for the impact and value of the resources provided, and the limited multidisciplinary nature of the projects funded. It was reported to the COV the program has ended and projects associated with the program would go into other core programs in the directorate. The lack of articulation of a plan for transitioning worried the committee, because they felt key successes of the program need to survive.

There were 3 major recommendations by the COV:

- EF needs to serve as an incubator of new ideas; it is crucial to identify the frontiers of science.
- There needs to be a better plan for transitioning programs from EF to core divisions; identify what should be done when programs are “sun setting”; there needs to be metrics to measure program success.
- Increase staffing levels; Pos need more time to think about the programs; possibly incorporate more science assistants’ help.

Discussion by the BIO AC centered around BI as it was identified in the report (as well as the DEB COV report) to be an area of concern. To the EF COV, BI and education components of proposals and the evaluation of BI appeared to be weak through all EF programs. It was stated that scientists need to figure out what BI means, because it is apparent PIs are branding it differently in their minds. Again it was acknowledged that it is difficult to talk about the efficiency of BI funding and if BI activities are effective.

The BIO AC accepted the EF COV report.

Dr. Schaal adjourned the meeting.

Thursday, March 18, 2010

Convening of Meeting

Dr. Schaal convened the meeting at 8:30 am. Possible dates and venues for the Fall 2010 BIO AC meeting were discussed. It was decided BIO (Dr. Liarakes) would email the AC members dates to compare to their schedules after the meeting.

Report and recommendation of BIO AC “Resources and Facilities subcommittee” (Wednesday’s lunch time discussion) – Dr. Michael Donoghue

Dr. Donoghue stated the questions the group had to begin the discussion:

- What is looming for the next decade to enable biological research?
- Should there be a subcommittee that focuses on the issues and develop a report by the next meeting?

- What would the charge and scope be for the subcommittee? How many groups would be needed? What are the products to be developed by the subcommittee?

The discussion group decided there are several major areas that need attention: storage of samples (maintain, build, infrastructure needed?), genomics (deal with the amount of data generated), other imaging needed, and generation of a lot of data (can we handle it?). The discussion turned to some issues such as cultural changes that may affect the discussion, indirect cost effects, different communities (the education community, small institutions as compared to large ones) and partnerships. Overall, there was a strong interest in the formation of a working group or two.

More discussion was requested concerning BIO's interest in the formation of the subcommittee and development of a report. DR. Roskoski stated BIO is always in a strategic planning mode and depending on what is needed, the planning horizon may be long. BIO wants to take a hard strategic look at what biologists will be using 10 years from now and what is needed to enable that research. It was decided to engage the AC in getting a sense of what the future holds for biological research and what infrastructure is needed.

It was decided to form two working groups: a cyber resources working group (WG) and a physical resources WG. The BIO AC members who volunteered to be on the Cyber Resources WG are Richard McCombie, Robert Robbins, and James Siedow. The BIO AC members who volunteered for the Physical Resources WG are Barbara Schaal, and Susan Bryant. Dr. Donoghue offered to supply BIO with names of others for this WG.

It was suggested that the charges to the WGs should be clarified. Dr. Roskoski responded that BIO will develop a draft charge and interact to pull together information requested by each subgroup to aid in the development of a report.

Innovation Experiments Update – Dr. Joanne Tornow, Director EF & Acting BIO Executive Officer

Dr. Tornow began by discussing a sandpit workshop held FY 2009 involving the Mathematical and Physical Sciences (MPS), Social, Behavioral, and Economic Sciences (SBE), Engineering (ENG) and BIO directorate as a vehicle to develop, review, and support potentially transformative research. In FY 2010, \$2M was set aside for each division in NSF for innovation activities, and in BIO an additional \$8M was allotted in EF to be leveraged for division investments. Dr. Tornow then presented the major areas for experiments in innovation. These are proposal development, merit review, and community input. DBI, DEB, and MCB are working together in a new program called Innovations in Biological Imaging and Visualization (IBIV). The IBIV solicitation has been released, and a mentoring committee will select participants to the Ideas Lab to be held May 24-28, 2010. During the Ideas Lab, the participants will develop proposal ideas in collaboration with the mentoring committee. IOS is working to develop a "Craig's List" Wiki to facilitate and increase the number of collaborations between end-users and investigators who develop tools and resources and will analyze the degree to which the

interactions resulted in the submission of EAGERS/RAPIDs. Lastly, Dr. Tornow presented the ideas under development: Experiment in Merit Review (MCB and IOS) – a comparison of outcomes of standard review of full proposals versus blind review of two page summaries of ideas and Experiment in Community Input (DEB and DBI) – use of a “design charrette” to develop a fully integrated research agenda in a collaborative way.

The discussion began with a question concerning the physical rearrangement with BIO and GEO. The move has received approval and is progress; however, the role as a virtual unit has yet to be determined. The selection of ideas for the sandpit was deemed the key to the success of the activity. BIO has based the selection of the ideas on the gaps in the portfolio and the ideas either drive the cutting edge of science or answer a hard question. The committee was intrigued by the experiment in merit review and asked for further clarification. DR. Tornow stated the PIs would be involved with the process and asked to provide “punchy” 2 pagers from proposals they have submitted. The reviewers will also know they are participating in an experiment. Further explanation of the fit of community input in the strategic plan was requested. Community input is being used to develop NSF’s strategic plan. A new plan is being vetted by the NSB and will go to the ACs for input afterwards. The BIO AC expressed enthusiasm for both of the new experiments and for the evaluation of the merit review process.

White Paper Discussion: A Dialogue among Biological Sciences, the Arts, and the Humanities – Drs. Christopher Comer and Ellen McCulloch-Lovell, authors and discussion leads

The discussion started with the assertion that a dangerous situation results when the two sides do not talk. The question remains how to bridge the scientists and the general public. There are exciting things happening in the arts and humanities and they are turning to the sciences for models. Therefore, this is a fertile time for discussions about the interface. The main points of the paper are:

- Look at joint research and inquiry occurring now
 - Look at potential for future research
 - Examine how techniques are the same or diff
- Arts increase cognition
- How to use the expressive powers of the arts and humanities
- Take a look at inspiration the arts and humanities.

Drs. Comers and McCulloch Lovell proposed a symposium to begin the discussions; NEA is interested in co-sponsoring it. They want to get more several agencies working so that it reaches more people. Several BIO AC members were excited about the symposium and volunteered to be involved with the process (as participants and potential funding sources). Dr. McCombie mentioned an upcoming meeting on linguistic phenotype. The AC had several suggestions:

- Do not forget the artist and scientist could be the same person.
- The meeting will be valuable if the activities could jointly close the abyss a bit.
- Scholarship in the arts and humanities could benefit from the methods of hard science by not being so isolated.

- The challenge is to decide the optimal mix of breadth and depth of participants.
- Think of it as more of a mapping exercise: getting the lay of the land.
- Study 3 or 4 cases: what works about it and what does not: come away with general principles.

A working group was established with Drs. Comers and McCulloch-Lovell as co-chairs. Members are Drs. Richard McCombie, Jacquelyn Fetrow, Juliette Bell, Warren Burggren, and Michael Donoghue.

Meeting with Drs. Arden Bement and Cora Marrett

DR. Bement reflected on his time at NSF. He spoke of the achievements of which he was the most proud:

- Recognizing the importance of cyberinfrastructure
- Major investments made in networking worldwide
- Improved the MREFC process
- Management within NSF: great leadership, sense of camaraderie, and focus on the community
- Focused on data storage, generation, and imaging
- Strengthened EPSCOR program: more strategic and higher quality proposals
- Investments in international partnerships
- Increased inter-agency leadership: joint programs with other agencies and global connections
- Increased partnerships with other agencies, countries, and industry
- Broken down “silo” working structures within NSF and built horizontal threads
- NSF offices in Tokyo, Beijing, and Paris have become majorly important
- Interdisciplinary research has grown
- Increased Education Initiatives: support of career development for teachers has increased
- Projects: SOCD, NEON, OOI, ARRV (Sikuliaq), TMT, IceCube, Advanced LIGO, SPS, and wind power in Antarctica

Dr. Bement spoke of the importance of NSF staying at the frontier, looking beyond current research, and identifying transformative research in which to invest. If this is not done, NSF will do a disservice to the nation. He suggested there are levels of complexity that have not been surmounted. The scientific community is entering a period of “data tsunami” as data collection intensifies exponentially, and transformative research is the key to dealing with it. He also commended his three deputy directors Joseph Bordogna, Kathie Olsen, and Cora Marrett.

Dr. Schaal expressed gratitude for Dr. Bement’s leadership of NSF and role as a national leader in support of science. She then opened the floor to questions:

- What advice would you give to your successor? What are areas of focus?
 - Interagency collaborations
 - International collaborations
 - CI investment

- Investment of K-12 education: teachers fight in the trenches almost daily and invariably if they can show evidence of research funded by NSF they win more battles
- Money given for development
- Social areas: they help to determine if teachers will stay on
- Where will NSF in a couple of years?
 - Foundation is one of those that excel and succeed in spite of the director
 - Hopefully still in Ballston but don't know
- What are the opportunities in BIO for private sector
 - Metagenomics, synthetic biology
 - Metabolomics
 - Foundation should be more involved in neuroscience
 - If not human brains, at least primate brains
 - How much of brain is binary and how much is analog?
 - How is information processed in holistic way?
 - Field is going to move very rapidly
- How do you assess NSF's position on underrepresented minorities?
 - Underinvesting
 - Need to serve all minorities, not just a few
 - Consolidation in our program
 - Transition will take place over 3-5 years
 - More opportunities for leveraging funding with interagency

Lunch Discussion with Dr. Shere Abbott, Associate Director for Environment, Office of Science and Technology Policy joined by the NSF Advisory Committee on Environmental Research and Education (AC-ERE)

The discussion began as Dr. Abbott described OSTP as a conduit for science and technology advice to the administration and a science think tank within the administration. OSTP has 5 senate confirmed positions and is divided into four divisions: Science, Technology, Energy and Environment, National Security and International Affairs. It also works closely with the President's Council of Advisors on Science and Technology (PCAST). She spoke about concerns such as how to deal with complicated world, where all issues under energy, climate, and sustainability tend to be integrated and how to set up structure across agencies to set up R&D, that will help collect various energy R&D and sustainable approaches. A realignment of committees may need to occur with a bifurcation between resource management issues and Green environmental R&D. OSTP is working on national ocean policy that will reach president in next week or 2, recommends a new national ocean council. The Office of Energy and Climate Change Policy is another process for developing policy across whole domain of energy and climate change. Dr. Abbott also identified a few challenges:

- Interface of science and policy
- What are new technologies?
- Adaptation research and impact research?
- Trying to find way to align everything
- Basic research to understanding and adapting to climate change

After her introduction, the floor was opened for questions.

- How much effort from OSTP is focused on education?

- 3 dimensions: huge portfolio in STEM education overall; climate science education -USGCRP (integrated programs and efforts); climate change science exhibit at the Smithsonian and it's a priority in White House itself; Does it add up to a great change? Promote greater understanding; working on the messaging constantly
- Putting the emphasis on adaptation and mitigation is important; How do you ensure the whole is greater than the parts? Who makes sure it is done? Overlap of areas and managing operational observatories?
 - Observing systems; working towards a national strategy for earth observations. There are a series of challenges about observing systems. Attempted a shared observation system between NASA, NOAA, and DoD but it turned out to be a disaster. Climate services: allow agencies (NOAA and DOI) to work towards their goals and pull together to form an interagency (announce in the next week or so), but more than 2 agencies are needed.
- One AC member (Dr. Robert Hazen) talked about the Alfred P Sloan Foundation- Deep Carbon Observatory: International partnerships and the opportunities for coordination.
- Can you say to what extent OSTP interacts with ArdentE (ArborE)?[not sure correct word here]
 - New so it takes time
- Taken steps backward in terms of climate change education; survey of meteorologists in the Tampa Bay region and only 1 of 16 thought positively about climate change; can OSTP pump up the volume on this in terms of public understanding?
 - Don't disagree; Meteorologists are the interface between climate change and public. A series of efforts is required that add up to education program, but how do we go about this? Execution across the government is a challenge; challenge on the media side. The public's view of general science is a bigger concern than the public's view on climate change.
- What is the Administration's view on SEES?
 - No answer to this; no visible metrics to make determination about long term impacts; begin to talk about how the programs add up
- How is biodiversity as a topic fairing at OSTP? What are people thinking/planning to do?
 - "Biodiversity" does not appear on the administration's priority list. This administration thinks of things in the way of integrated into sustainability; working toward a better interagency strategy; sort of late in the game as it has not been a "problem"; working within the US government to get a similar effort as to the international effort; need to know what we got
 - PCAST is interested in looking at the teeming with life.
- Intersection of policy and science on GMO foods and crops; anything going on in the area?
 - USDA detail working on this issue; lots going on; can the debate be changed very quickly---no; interagency working group and governance groups; there will be some initiatives
- Intersection of science and budget: what is the entire US government doing? Cannot easily put together the budget together for agencies.

- It is beginning to come out; the open government initiative is causing agencies to release some data as a part of this; OSTP has released all of the data related to USGCRP budget for the last ten years. More should be released
- To what extent is there data sharing with other countries?
 - A lot; GEO working to develop a data sharing system; still a challenge in certain countries; challenges of open access; working hard to push this; data sharing and openness is a policy in the Obama Administration

Wrap Up and Adjournment

There was agreement for subcommittees to look at resources: cyber, collections, gene banks, museum collections, and imaging. Support was talked about for an activity related to arts and science and one informs the other and for an activity focusing on graduate education as resources decline. The AC also agreed there is an interest to look at education: the data analyzing metrics which kind of teaching is effective and generating a larger body of knowledge on how people learn. They deemed it important to look at the proposal submission and review process, particularly ways to streamline the process and issues concerning merit review. Concerns were expressed regarding public acceptance of science and the accurate communication of scientific information. By the next meeting, the DBI and PGRP COVs and the reports from the subcommittees should be completed.

Dr. Schaal adjourned the meeting.