National Science Foundation
Directorate for Biological Sciences

Advisory Committee (AC)
Minutes of the May 2023 Hybrid Meeting

BIO AC Members in Attendance:

Dr. Michael Ibba (Chair)	Dr. Erich Grotewold	Dr. Maria Pellegrini
Dr. Suzanne Barbour	Dr. C. Robertson McClung	Dr. Scott Santos
Dr. Henry Bart, Jr.	Dr. B. Gail McLean	Dr. Maria Uriarte
Dr. Barbara Beltz	Dr. Gretchen North	Dr. Kennedy S. Wakesa
Dr. Thomas Daniel		

Wednesday, May 3, 2023:

Dr. Simon Malcomber, Acting Assistant Director (AD) for Biological Sciences (BIO), convened the meeting at 10:00 AM EDT by welcoming the AC members, NSF staff, and guests.

Ms. Montona Futrell-Griggs, Staff Associate for the Office of the Assistant Director for BIO, reminded attendants of the FACA rules and NSF virtual public meeting policies.

Dr. Michael Ibba, AC Chair, provided hybrid meeting instructions and opened it up for introductions.

The AC unanimously approved the minutes of the September 2022 Meeting minutes without changes.

BIO Update:

Dr. Malcomber provided an update on recent activities in the BIO directorate.

- There have been leadership changes in the divisions and BIO expects a new AD to arrive in June 2023.
- NSF received its largest budget ever with the passing by Congress of the FY 2023 appropriations bill in December 2022. The money will fund the new Technology, Innovation and Partnerships directorate, as well as other efforts outlined in the CHIPS and Science Act.
- New legislative and executive updates included NSF's Plan on Open Science and NSF participation in authoring the Bioeconomy Reports in response to the Biden administration Executive Order 14081 issued in September 2022. The Reports point to cross-cutting activities that could involve NSF in leveraging biodiversity for biotechnology, enhancing prediction and design of biological systems, advancing ability to scale up biotechnologies, innovating in biomanufacturing, and engaging in ethical, safe, and equitable co-generation and translation of new biotechnologies.
- Several new policies were highlighted, including new formats for some forms in proposals (biographical sketches and current and pending support), as well as new requirements for institutional reporting on dual use research of concern and safe and inclusive working environments for off-campus or off-site research.

- Dr. Malcomber also highlighted some programmatic changes--for integrative research, support for mid-career faculty, new synthesis centers, biodesign opportunities, and global centers—some examples of exciting science outcomes, and recent NSF-produced videos featuring BIO program directors talking about science and outreach topics.
- Dr. Malcomber concluded with a brief overview of the NSF Strategic Plan and how it is being used to help shape priorities for the directorate and discussions for part of the AC meeting.
- Reactions from the AC members included comments on the potential for innovative uses of artificial intelligence (AI) and concerns about graduate student and postdoctoral recruitment and training in the context of providing the workforce of the future, which might require new paradigms to be developed.

BIO Responses to Committee of Visitors (COV) Reports:
Dr. Charles Cunningham, Acting Deputy Division Director for the Division of Molecular and Cellular Biosciences (MCB) presented BIO's response to the COV Report for MCB.

- The report covered FY2014-2018. The report was complimentary of how MCB addressed concerns in the previous report. They had several recommendations.
- In response, MCB created several working groups with specific goals and reporting structures to address the COV comments on broadening participation, outreach to underserved areas of the country, design of metrics for measuring program impacts, and communication to researchers about declined proposals. Outcomes from some of these groups have already been realized.
- BIO was among the directorates at NSF that participated in a new pilot for processing declined proposals, which includes increased use of so-called PO comments to provide more information to investigators about the decision-making process on their proposals.

Dr. Michelle Elekonich, Deputy Division Director, for the Division of Integrative Organismal Systems (IOS) presented BIO's response to the COV Report for IOS.

- The report covered FY2014-2018. The COV complemented IOS on changes made since the last COV. They made several recommendations in the areas of data analysis for the self-study report, methods used for collecting demographic information from reviewers and investigators, broadening participation, reviewer training, and transparency to investigators on review processes.
- In response, IOS noted that NSF data analytical capabilities continue to evolve, such that new methods will be easy to incorporate in the future. The recommendations for new policies on demographic data will be referred to the responsible NSF bodies. IOS has re-charged its working group for broadening participation, led by its new science advisor, has taken specific actions, such as use of blogs and virtual office hours to promote visibility and transparency of IOS science and processes (which, like in MCB, includes increased use of PO Comments for investigators whose proposals are being declined) and new guidance for awarded investigators how to report their scientific impacts to their program directors and in their annual reports.

NSF's Strategic Goal 2 – Discover: Create new knowledge about our university, our world and ourselves:
Introduction: Dr. Theresa Good, Acting Deputy Assistant Director of BIO, provided context for the session, focusing on the strategic objectives (SO) of this Strategic Goal. She noted that SO 2.1 is to advance the frontiers of research by accelerating discovery through strategic investments in ideas, people, and infrastructure, and SO 2.2 is to enhance research capability by advancing the state of the art in research practice, including collaboration, interdisciplinarity, and reproducibility.

Presentation: Dr. Allen Moore, Division Director of the Division of Environmental Biology, and Dr. Denise Dearing, Division Director of IOS, gave a presentation describing how BIO is creating knowledge through its core research activities. This included overviews of the priorities for: each of the divisions, cross-cutting programs that include elements from more than one division, programs for tool development, and programs that include partnerships with other agencies.

AC Member Breakout Sessions and Report Out – Emergent Research Areas

The AC members divided into groups to discuss emergent, impactful research areas where BIO can support Strategic Goal 2, approaches or methods required to advance research in those areas, and barriers to doing so. Guiding questions included: What is the most exciting or impactful research that is emerging for biological sciences? What are the factors/new approaches that are required to advance that research or are barriers to advancing it?

- One key outcome of these discussions centered on the potential for AI to serve as enabling technology to help advance discovery, modeling, and prediction across many biological systems and at multiple scales of organization.
- Another discussion point was the importance of considering multiple dimensions of biology for crafting solutions to climate change, including not just mitigation but also adaptation.
- The AC underscored the importance of fundamental basic research as a pathway towards filling the gap towards translation.
- Some specific areas mentioned included methods-driven and needs-driven science, interdisciplinary research, microbiome science, genomics, and synthetic biology for hypothesis testing as well as exploration.
- There was also discussion of the need for need for enhanced, but perhaps shorter, student training, in ethics, team-based science, hands-on research, all aimed at preparing a new generation of scientists for broad range of careers in science and technology.
- Finally, it was posited that a focus on longer-term solutions-based research questions with more tolerance for risk could be a good complement to the short-term basic research that NSF traditionally supports.

Advisory Committee on Environmental Research and Education (AC-ERE) Update – The Environmental Impacts of Research

Dr. Kim Jones, Associate Provost for Faculty Affairs and Professor of Environmental Engineering, Howard University, AC-ERE Chair, provided context for this discussion.

- The AC-ERE was established in 2000 to provide advice, interface with the scientific community, serve as a forum, provide broad input, and perform oversight on interdisciplinary environmental and education research supported by NSF. Dr. Jones provided a brief description of discussions being led by an interest group within the AC-ERE aimed at exploring the sustainability of science.
- Her remarks posed several questions related to addressing the environmental impacts of research. For example, how should institutions and researchers provide input to NSF on the impact of proposed research and associated travel? What should or could NSF do to encourage a more sustainably cognizant way of conducting research supported by the agency? How should institutions or NSF engage students in conversations about these questions?
- The BIO AC responses included the question of how much of the responsibility lies with the institutions vs. with the investigator; how this might differ across well-resourced and under-resourced institutions; the importance of understanding what the energy expenditures of research are, as well as how costs might be mitigated; alternatives and trade-offs to in-person

meeting; using a carrot vs. stick approach that might enable institutions to be best-rated for smaller carbon footprints or greening of their campuses.

Preparation for visit with Office of the Director (OD) leadership
Dr. Ibba led the discussion to develop talking points for the meeting with OD leadership. Topics were based on the day's discussions, and roles as discussion leads were assigned.

Dr. Malcomber adjourned the meeting at approximately 5:00 PM EDT.

Thursday, May 4, 2023
Dr. Malcomber convened the meeting at 10:00 AM EDT.

Strategic Partnerships Framework
Introduction: Dr. Brent Miller, Science Advisor in BIO, provided context for how BIO's development of a strategic framework for partnerships is aimed at advancing new areas of biological research to support NSF's priorities and impact. Highlights included realization that discovery and translation go hand-in-hand and can benefit from different types of partnerships such as within federal government, with industry and non-profit organizations, and with international institutions. Dr. Miller outlined BIO's vision for building partnerships and how that vision is influenced by other entities, such as Congress, priorities and synergies withing NSF, the research community, and interests and needs from the private sector.

Partnership Examples Relevant to NSF Strategic Goal 2: BIO program directors from IOS, DEB, and MCB described a diverse group of programs, how they advance biological sciences, and how partnerships serve as a foundation for program success. Dr. Irwin Forseth (IOS) presented an overview of the Organismal Responses to Climate Change (ORCC) Program. Drs. Matthew Carling (DEB) and Colette St. Mary (IOS) described Partnerships to Advance Conservation Science and Practices (PACSP). Dr. David Rockcliffe (MCB) presented on the program Accelerating Innovations in Biomanufacturing through Collaboration Between NSF and the DOE BETO-funded Agile BioFoundry (NSF-DOE/ABF Collaboration). Dr. Kendra McLauchlan (DEB) described the Biodiversity on a Changing Planet (BoCP) program. Collectively, the presentations highlighted the multi-faceted importance of partnerships in which there are synergistic gains for NSF researchers, the partners, and science or society at large.

AC Member Breakout Groups and Report-Out – Strategic Partnerships: The AC members divided into groups to discuss existing and new strategic partnerships for BIO that could be leveraged to advance the exciting research discussed on the first day of the meeting and how these partnerships might assist in overcoming barriers. Guiding questions included: What are strategic partnerships that could be leveraged to advance exciting or impactful research discussed on the first day, and how might partnerships overcome some of the barriers identified in the science discussions on the first day?

- The AC commented that partnerships seem to lend themselves well to solutions-based research and they might lower the barrier for researchers to engage in this kind of research.
- Also, partnerships might be leveraged for augmenting training opportunities, for instance at graduate and postdoctoral levels, for catalyzing quantitative science, or for training in team-based science.
- The AC appreciated hearing of specific examples of partnerships, including the partnership with DOE-BETO on use of the Agile BioFoundry and the partnership with the Paul G. Allen Family Foundation on conservation science.
- The AC suggested that the area of conservation science could spur additional partnerships with

non-profits and other federal agencies, and they also mentioned AI as another topic that might be ripe for partnering.

- Finally, the AC was pleased to learn that some of BIO's partnerships have led to funding of investigators who have not had NSF funding before, providing some evidence that partnering can provide additional avenues for broadening NSF's reach.

Meeting with OD Leadership

The BIO AC met with Dr. Karen Marrongelle, Chief Operating Officer, and with Mr. Brian Stone, Chief of Staff. Dr. Ibba provided a brief overview.

- Dr. Daniels kicked off the discussion by pointing out that biological sciences is at an inflection point with the convergence of three elements--AI, technologies for sensing, and a push for predictive, mechanistic models. Melding these together for biology in the future will require leveraging the power of AI for new discovery of the dynamic, multi-scale, multi-spatial design of biological systems. Reciprocally, knowledge of the complexity of biological systems will inform computational capabilities and systems, including devising new ways to reduce the massive energy costs of engineered computation and AI.
- Dr. Uriarte followed by asserting the need for interdisciplinarity and new opportunities in education, training, and mentoring to prepare the next generation of scientists to engage in team-based, solutions-oriented research aimed at predictive, quantitative science. A new paradigm needs to be grounded in co-design, fostered by diverse partners, including those from minority-serving institutions, industry, and the students themselves.
- Dr. McClung underscored the value of analyzing biological problems at all scales of organization to solve real-world problems in areas such as climate change. Analysis of existing data, without the need for acquiring new data, offers outstanding opportunities for creating new knowledge from images, perhaps by fostering citizen science and education at all levels, including K-12. However, there are challenges presented by the long term of the traditional educational route, as well as by the resistance to interdisciplinary training, and solutions will require implementation of 'safety nets' for students to engage in cross-disciplinary training.
- Returning to a science-focused theme, Dr. Pellegrini emphasized the importance for development of new methodologies and instruments, despite the inherent risk in such development. She said that risk has two 'flavors': bad risk could be exemplified by sloppiness, whereas good risk could mean simply that there is not enough preliminary data. The AC thought that NSF should be more willing to assume good risk, even if it comes with a higher likelihood of failure.

Dr. Marrongelle expressed her appreciation of the topics presented. She agreed with the importance of interdisciplinarity and cross-directorate collaboration as crucial for breaking down the silos that are typical in our traditional training. On the topic of graduate student education, Dr. Marrongelle was intrigued with the idea of involving graduate students in their own training trajectory, especially encompassing innovative topics like AI and solutions-based research in the training. This is congruent with the funding priorities for NSF that are coming from Congress. Dr. Marrongelle agreed that the need for better quantitative knowledge is undeniable and that training towards this end should start early in a student's education. She expressed enthusiasm for the notion of using existing data, together with reformed math curricula and out-of-classroom engagement, as promising, but challenging opportunities. She agreed that team science and the length of science education is important to consider in context of training, especially for postdocs and alignment of the training with the needs for the workforce. On the topic of risk, Dr. Marrongelle remarked that this is an important area for consideration, especially in biology, and she invited continued conversation about this topic. Mr. Stone closed the session by

expressing his appreciation for the highlights on AI, as this topic is one that is being discussed broadly in the context of policy development across US government.

Recap and Discussion of Topics for Fall 2023 Meeting

Dr. Ibba led discussion of key take-home points from the meeting and additional items that might be considered for discussion in upcoming meetings.

- One required topic for discussion at the next meeting will be a presentation of the report from the recent DEB COV.
- Topics suggested by the AC for future discussion included: update on mid-career advancement programs; discussion with/presentation from EDU on a) possible new paradigms for graduate student and postdoc training, including emphasis on ethics training, or b) funding for community college programs; partnerships with other agencies (how they develop and evolve); update from the Technology, Innovation and Partnerships directorate; and discussion about how various state laws relevant to diversity, equity, inclusion, and accessibility impact NSF.
- In closing, Dr. Malcomber challenged the group to reflect on what has been discussed in the Discover theme from the Strategic Plan and to consider if there are other related points they would like to discuss.

Dr. Malcomber thanked the AC for their participation and adjourned the meeting at 2:06 PM EDT.