

**Directorate for Biological Sciences
National Science Foundation**

Response to the Report by
Committee of Visitors
Division of Biological Infrastructure
(FY2016-2020)
Meeting Dates: December 15-17, 2020

The Directorate for Biological Sciences (BIO) and the Division of Biological Infrastructure (DBI) are extremely grateful to the members of the Committee of Visitors (COV) for the hard work, thoughtful comments, and constructive recommendations provided in their evaluation of the review processes, portfolio characteristics, and management practices of DBI. BIO extends an extra level of gratitude to the members of the COV who, because of the COVID-19 pandemic, were forced to conduct their review in a 100% virtual environment.

The COV Report covers DBI activities during the period of October 1, 2015 – September 30, 2020. This timeframe is one year longer than the usual four-year interval for COV reviews, because the pandemic required the review to be postponed from its original date in July 2020 to December 2020.

The Report noted many specific strengths in the Overview and Synthesis section, These included: documentation of funding decisions, improved communications within DBI and across BIO, operations during the pandemic, diversification of panelists, implementation of formal training in project management for Program Officers, development of new tools for managing the portfolio, reorganization of Research Resources programs into a continuum of innovation-development-sustainability, and support for biological infrastructure. The overall conclusion from this section was that *“DBI is in a strong position to fulfill its mission in BIO and NSF.”*

The Report also contained suggestions on “Areas for Development,” specific comments on the structure of the virtual COV, and recommendations in the templated sections of the report that were organized by Cluster. Our responses to these suggestions and recommendations are presented in the same order. For comments that were duplicated in more than one section of the Report, we provide an aggregate response in the “Areas for Development” section.

Areas for Development

QUALITY AND INTEGRITY OF OPERATIONS, INCLUDING TECHNICAL AND MANAGERIAL MATTERS PERTAINING TO PROPOSAL REVIEW AND RECOMMENDATIONS:

- 1. Evaluate and strengthen use of the Broader Impacts criterion:** *The BI criterion remains a perennial source of confusion and inconsistency...We recommend that DBI lead the development of a Directorate-wide process to assess the effectiveness and impact of the "broader impacts" criterion...Because DBI has extensive experience in administering programs that explicitly aim to integrate research, education, and broadening participation, the Division is well placed to lead such an evaluation.*

Response:

BIO appreciates the COV's perspective on the Broader Impacts criterion. Use of Intellectual Merit and Broader Impacts as merit review criteria is NSF-wide policy that was established by the National Science Board. Evaluating the effectiveness of this merit review policy is the responsibility of a Merit Review Steering Committee, coordinated by the NSF Office of Integrative Activities (OIA). This Committee draws on expertise from all the NSF Directorates, including BIO. A priority activity for this committee is strengthening the consideration of broader impacts within the review process. Also, within OIA is the Evaluation and Assessment Capability Section, which provides central support for programmatic evaluation of impact. BIO will work with OIA to seek ways to strengthen the review and evaluation of broader impacts in proposals submitted to all BIO divisions.

- 2. Evaluate and strengthen the quality of reviews:** *The COV recommends that DBI work with other parts of BIO (or NSF) to analyze review quality and to develop methods to help ensure that reviews are consistently detailed and informative.*

*From the templated section for the Research Resources Cluster (Q. 1.3): We judge the reviews to have been sufficient for fairly evaluating the merit of the submitted proposals. **However, we recommend that a formal analysis of review quality be undertaken for the purpose of identifying patterns of variation in the quality of reviews solicited by NSF of scientists in the broader community.** Consideration of possible reasons for the variability would be a useful part of any such analysis. In our informal, semi-quantitative analysis of the review quality across all programs, we found the quality of the reviews was highly variable.... We observed some tendency toward the insufficient reviews with high rankings being those assigned in cases where the PIs on the grant proposal were from high-profile institutions, whereas lower rankings most often occurred in cases where the PIs were in less prominent institutions. **Reviews should be analyzed for possible implicit bias.***

Response:

BIO considers this to be critical feedback provided by the COV. The merit review process and subsequent award selection are the hallmark activities that allow NSF to carry out its mission. Heterogeneity in review quality has also been noted by other NSF COVs and flagged by the NSB as a serious concern. Consequently, NSF is continually working to assess and improve the quality of the merit review process. Current activities include a training [video](#) for panelists/reviewers, which features tips for writing reviews and avoiding bias and a [survey](#) for NSF reviewers to provide feedback on the merit review process. NSF is also developing AI tools for rapid, qualitative assessment of review quality that can be used to baseline and measure improvement. This is being overseen by the Merit Review Steering Committee

(which has BIO representation, as mentioned above). BIO will continue to work with the Merit Review Steering Committee in piloting ways to measure and improve review quality.

PORTFOLIO CONTENT AND BALANCE:

- 3. **Assess the success of programs and emphasis areas:** We recommend that DBI identify easily captured metrics of success for each program and emphasis area, and the outcomes be communicated effectively to the community...We emphasize the term “easily captured metrics” knowing that DBI staff are already stretched, so any metrics would ideally be available in data that are already provided in some form.*

Response:

BIO agrees that establishing ways to determine whether programs in DBI are meeting their designed goals is important. This is especially challenging in DBI, given that the distinct types of programs supported--research, training, and infrastructure--have different goals, outcomes, and impacts. Outcomes of research projects are easily measured by publications tracked to the award and PI. However, outcomes of training or infrastructure awards are typically revealed through publications or other outputs produced by people other than the PI of the award. For example, the most impactful publications attributed to a DBI-funded cyberinfrastructure or collections award may be published by users of the funded resources, rather than by the PI. Tracking such impacts often involves deep data mining and/or conducting surveys. BIO and DBI have been working together to develop strategies to address this problem. We have recruited a new staff member with expertise in program evaluation to work in DBI to develop and implement approaches to track award outcomes and map them against program goals to assess success. In addition, BIO is piloting the use of semantic analysis software, tailored to NSF-funded research and our internal data systems, to track linkages between our awards and outcomes (e.g., publications, datasets, patents, policy documents).

- 4. **Explore reasons for differential representation of types of institutions:***

The COV agreed with and further underscores the self-study’s concern with the dramatic drop in the success rate of proposals from Minority Serving Institutions (MSI) in 2020...We recommend that DBI consider new outreach to MSI and new programs aimed at scientists in such institutions...

*From templated section on Research Resources (Q. IV.5). The geographic representation of awards is similar to that of the proposals submitted. The unusually low success rate in some states identified in the self-study suggests that there may be a need for more mentoring or other ways of engaging PIs from those states. For programs within the Research Resources cluster, **funding rates in EPSCOR states were generally lower than those of non-EPSCOR states. We recommend that DBI consider carefully what is driving this result.***

Response:

BIO reaffirms its commitment to supporting projects from different types of institutions and will continue to explore potential reasons for the noticeable drop in the success rate of proposals submitted from MSI in FY 2020. As possible explanations arise, BIO will adjust its outreach efforts to address this important issue. Also, as part of a suite of activities aimed at broadening participation, BIO has recently launched a new program ([NSF 22-500](#)) called “*Building Research Capacity of New Faculty in Biology (BRC-BIO)*,” which has a focus on enhancing research capacity and broadening participation of new

faculty of biology at MSI and other non-research intensive institutions. A goal is to expand the types of institutions that submit proposals to BIO and to expand opportunities for groups who are underrepresented in the biological sciences. The choice to target MSI in this funding opportunity was informed in part by discussions BIO had with its Advisory Committee at a joint session with the Committee on Equal Opportunity in Science and Engineering in Fall 2020 and in part by a National Academies report on MSI.¹

BIO is equally committed to ensuring a broad geographic representation in its awards. DBI will continue to monitor the funding rates in the Research Resources cluster, with special attention given to trying to understand the possible causes for low funding trends for institutions from EPSCoR states. Outreach efforts will be modified, as warranted.

5. *Take advantage of new online/virtual/hybrid learning and working skills to enhance broader participation and new opportunities...*

On-line options for research and teaching are rapidly becoming more widespread and improved, and DBI is in a position to support these efforts...[and to mitigate effects of] pre-existing inequities in access to resources...

Response:

BIO is committed to enhancing opportunities for populations of students underrepresented in STEM. For example, DBI/BIO partnered with the Division of Undergraduate Education in the Directorate for Education and Human Resources (DUE/EHR) for joint release of a Dear Colleague Letter ([NSF 21-026](#)), “*Requesting proposals for online biology education to the Research Coordination Networks for Undergraduate Biology Education*”. This DCL is part of BIO’s COVID-19 pandemic response and seeks to support proposals to develop and test innovative strategies and share best practices to transform the online learning environment. Several awards were made in FY2021, including to Hispanic- or Alaska Native-serving institutions and to Historically Black Colleges and Universities. These awards are expected to help transform higher learning in biology by offering more options for diverse students in new and emerging settings.

PROGRAM MANAGEMENT:

6. *Continue to be vigilant about communication within DBI, BIO and NSF:*

*Communication within and outside DBI has clearly improved appreciably since the last COV. However, it is such a critical area that **we flag it here as an area that will need continual attention.** As noted in the 2016 COV report “[DBI] requires constant multi-way communication, and should involve stakeholders (i.e., the community of biological scientists and educators who do or should avail themselves of NSF’s programs) before critical decisions are made about the nature or timing of major programmatic activities. DBI in particular, and perhaps BIO in general, should regularly revisit this challenge, so as to identify hurdles to effective and timely communication, and devise tactics and strategies to overcome them.”*

¹ National Academies of Sciences, Engineering, and Medicine. 2019. *Minority Serving Institutions: America's Underutilized Resource for Strengthening the STEM Workforce*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/25257>.

Response:

BIO agrees with the COV's assessment that communication within and outside DBI has improved since the last COV and that maintaining strong and effective communication with all DBI stakeholders needs to continue to be a priority. Examples of recently instituted channels of communication include: a) monthly PO meet-ups for within-BIO communication to introduce new POs or to discuss cross-BIO programs; b) monthly division virtual office hours for POs to engage the community in discussions of various topics, such as new funding opportunities, best practices for writing proposals, and how to work with your PO; c) quarterly newsletters from the Assistant Director of BIO, Dr. Tornow, to communicate newsworthy events and funding opportunities to the community; and d) regular meetings between Dr. Tornow and leaders of professional societies who represent the interests of the BIO community. BIO also solicits community input on major programmatic activities from its Advisory Committee and will continue to use social media and other means of engaging with the community.

7. Enhance communication with PIs:

While the COV was universally impressed by the quality of the Review Analyses, we felt that the POs could do more to be sure that more of the rationale for the decision was communicated to the PIs. We found that the Panel Summary was often somewhat limited in conveying the rich information that was in the Review Analysis. POs could make more and more effective use of the option of Program Officer comments. Many PIs are not aware that calling the PO is an option and thus miss out on that valuable post-review conversation.

*From templated section on Research Resources Cluster (Q. 1.5): The Review Analyses were comprehensive and detailed. They filled gaps between individual reviews and the panel summary and connected the award/decline decisions to broader program priorities. The COV felt that an edited version of the Review Analysis would be very useful to the PI. **Making sure that PO comments to the PI include the relevant information and finding a way to draw PI attention to this information would be helpful.** This information was particularly important in programs without panel discussion (EAGER, RCN, SABI).*

Response:

BIO agrees with this assessment, and DBI has already implemented an increased use of PO comments, especially for proposals that may have received relatively strong reviews but were not recommended for funding. Moreover, through its outreach efforts, including virtual office hours, DBI will continue to emphasize the PI's option to call a PO to better understand the basis for funding decisions and to obtain information that can help increase the quality of their proposals.

8. Consider moving the Post-doctoral Research Fellowship (PRFB) and Research Experience for Undergraduates (REU) programs to no-deadline submissions:

The move to no-deadline submissions has been largely successful in much of BIO, but deadlines remain in place for the programs within the HR cluster. The COV recommends considering whether no-deadline submissions might be appropriate here. For example, graduate students can complete theses any time of year. REUs and UBEs are also not time critical. A no-deadline system could also increase diversity of REU sites.

From the templated section on Human Resources Cluster (Q.IV.3). The pivot to online and virtual learning in 2020 has demonstrated that alternative models for how HR cluster projects (e.g., REU

*Sites, RCN UBE) are structured should be explored. The classic summer program model of an REU site fits some students better than others...**The COV recommends that DBI re-think the classic summer program model of an REU Site.** Changes might influence both the structure and budget of a given Site, could offer year-round mentoring in some cases, and might be offered online. By considering several models, DBI might help to broaden participation in these programs. **Support for all these innovations could be facilitated with a move to no-deadline applications.***

Response:

During the last few years, BIO has given much consideration to the idea of no-deadlines and to the eligibility requirements for DBI's Human Resources (HR) programs to determine how they could best be adjusted to facilitate program-specific goals aimed at increasing diversity, equity, and inclusion. What has become apparent through these deliberations is that deadlines and review processes that allow program officers the opportunity to consider all proposals at the same time are extremely helpful in achieving greater diversity in the populations served by the distinct programs in the HR cluster.

For the PRFB program, DBI has taken actions to broaden submission eligibility while keeping a deadline. As has been stated in the PRFB solicitation for over a decade, "*PRFB awards are intended primarily for graduate students who are seeking independent support for their first postdoctoral position*" and until 2019, applicants were not eligible to apply to the program if they had been in a postdoctoral position for 6 months or more. This requirement was problematic for graduate students who completed their theses at times of the year that were offset from the due date. To address this issue, BIO gradually lengthened the maximum allowable time post-degree to what is now 15 months in the 2021 release of the PRFB solicitation.

The REU program presents a different challenge. First, NSF has only a single foundation-wide solicitation for REU Sites, which is used by all the Directorates. Therefore, any consideration of converting to a no-deadline mechanism would have to gain support from all of the other Directorates. Furthermore, as with PRFB there is an advantage to reviewing and making funding decisions at one time in order to maximize our ability to achieve programmatic broadening participation goals. An NSF-wide deadline is also helpful in coordinating cross-directorate co-funding of interdisciplinary awards. As noted by the COV, the submission deadline has been chosen to provide awardees with sufficient time to recruit students ahead of a summer experience. We agree with the COV that REUs can also be conducted during the academic months and note that this is often the case with REUs provided through regular research awards or supplements to those awards. However, it is important to note that an expectation of REU site awards is that they provide opportunities to students from colleges/universities other than their own. This is a critical aspect of the program's efforts to provide opportunities to undergraduates attending institutions that do not have intensive research activity on their campuses. For this important reason, most REU site activities are designed to take place during the summer. Finally, with regard to the comment (from the templated section) on incorporating virtual learning as part of a new year-long model for REU Sites, BIO agrees this offers new opportunities, which could be leveraged to broaden participation. In fact, DBI made awards during 2020 to specifically develop and disseminate such virtual research resources. (see response to #5 above.)

For the RCN-UBE program, BIO has not yet considered a no-deadline mechanism. This is a joint program with DUE/EHR, which has deadlines. To effectively coordinate co-review and co-funding, this program will need to remain on deadline until EHR agrees to shift to no-deadlines.

9. Continued attention to staffing levels:

DBI (and probably BIO as a whole) needs to work to maintain staffing levels. This appears to be an ongoing challenge. In particular, it does not appear that DBI has sufficient staff (either at the program level or at other levels) to appropriately manage the Centers Cluster, which includes a number of large and complex programs. If DBI does make additional hires, it might be useful to think about sharing those hires in a meaningful way with other BIO divisions. A program officer with a home in DBI who manages a separate grant portfolio in IOS (or any division) and participates in all IOS division meetings might help coordination between various parts of BIO. Shared administrative staff might also be worth considering.

Response:

BIO sets staffing across the directorate with input from the Divisions and guidance from NSF's Division of Human Resource Management (HRM). Workload is a continual point of discussion. We are sensitive to these issues and will continue to work with HRM to address workload concerns.

The suggestion of sharing POs with diverse expertise across Divisions is a good one that we are already using. We note that two current DBI POs came to DBI from other Divisions; one was a rotator in IOS, and one is on detail from DEB. Similarly, sharing of administrative staff expertise across the Directorate is common, especially when help is needed for cross-Directorate programs, such as Biology Integration Institutes or Integrative Research in Biology. This kind of sharing has been facilitated by use of standardized administrative practices across Divisions.

Specific Comments on Structure of the Virtual COV

- *Three 6-hour days are not long enough, particularly for reviewing all the eJackets in the time allotted. COV members should be encouraged to review the eJackets prior to the meeting. A rubric...with the COV report topics would be very helpful.*
- *The virtual COV process is necessary because of the pandemic. We could have used a little more time on the first day to review the material provided. Hopefully, the next COV meeting will be in person and the agenda for the meeting will be more similar to previous meetings. In hindsight, starting the conversations with program staff should have begun later in the second day rather than at the start of the day.*

Response:

These comments provide important feedback for conducting the COV under the 100% virtual environment. A 6-hour day was chosen to accommodate the diversity of time zones. However, given this feedback, BIO will consider the benefits of adding an extra day to the COV process for virtual COVs either consecutively or possibly a week or more prior to the 3-day agenda. BIO also will explore the idea of developing a rubric for virtual or on site COVs in the future. Also, as BIO develops our best practices for on-site and virtual COV reviews, we will consider the idea of pushing the conversations with program staff to a later time on the agenda.

Responses to Templated Sections by Cluster:

Human Resources Cluster

- *Q. III.2. The overwhelming importance of quantitative and computational skills for the workforce in biological sciences will remain a key issue, one that DBI can take a lead on with regards to future REU, UBE, and Postdoc programs. Strengthening a data literate workforce (#NSF10BigIdeas) is absolutely critical. The programs fostered so far go a good way towards this goal (REU efforts have been particularly good in this regard). **Even more effort in this space seems warranted – computational and data analytic efforts can be a key component integrated into all programs.***

Response:

BIO agrees and notes the following specific examples relevant to DBI's participation. The Rules of Life track in the PRFB solicitation, which focuses extensively on data literacy and data integration, was developed by DBI as the lead. Also, after the COV met, DBI collaborated with DEB to draft a new solicitation calling for a Synthesis Center for the "Advancement and Synthesis of Open Environmental Data and Sciences" ([NSF 21-549](#)), which has as one of its five primary objectives to be: "... a leader in diversifying the data-intensive environmental science workforce across demographic, geographic, institutional, and disciplinary dimensions."

- *Q. III.4. The 2016 COV had question about post-doc mentors and mentoring institutions. In response, DBI said they would provide spreadsheet of mentors and institutions to 2020 COV. We couldn't find it. But POs pointed out the importance of mentoring plans and institutions. **For next COV (2023/2024), more documentation on this in the self-study would be helpful.***

Response:

BIO apologizes for this oversight and will make every effort to include it in the review materials for its next COV.

- *Q. IV.2. The size and duration of postdoctoral fellowships both seem reasonable. **The COV suggests discussing the implications of high variation in the cost of living between different locations.***

Response:

This is a good suggestion, but it is something BIO would need to consider in consultation with other units within NSF, as it may have implications for postdoctoral fellowships beyond BIO. Also, we note that PRFB awards go to the fellows directly, and the fellows are allowed to change the institution or split training among multiple institutions even after the award is made.

Research Resources Cluster

- *Q. I.4. For solicitations with program-specific review criteria (e.g., CAREER, Field Sites) **the panel consensus on strengths and weaknesses with respect to the program-specific review criteria was not consistently communicated.***

Response:

BIO appreciates this observation and will re-examine the panel summary templates across the Research Resources cluster to ensure that evaluation of solicitation-specific criteria is included.

- *Q. I.7. While it is clear that NSF and the POs in this division are attentive to issues of representation and portfolio balance, **further training of POs—both permanent and rotators—in recognition of bias in reviews, program summaries, and recruitment of proposals from different kinds of institutions would likely improve the review process.***

Response

BIO appreciates this perspective. We note that POs participate in multiple training courses, including a two-day Program Management Seminar, four mandatory one-to-two-day sessions of Merit Review Basics, and yearly Merit Re-Boot sessions on varied topics, including avoidance of bias in the review process. That said, DBI leadership will encourage and support additional training on recognizing and mitigating potential biases.

- *Q. IV.9. Progress has been made, but URM's are still underrepresented nationally, and as long as that is true, that is insufficient participation. However, specifically within DBI, we do not have an accurate measure of underrepresented groups' participation. **Perhaps, in the call for proposals, DBI and the BIO directorate could make a good case for why the question about minority status is useful for helping NSF/DBI reach its programmatic targets.***

Response:

BIO appreciates this concern. The agency as a whole has changed its policies recently to make it easier to obtain this information in the future. Specifically, when new PIs register in the NSF system, the default settings now include asking PIs to enter demographic information, and PIs must actively opt out if they do not wish to provide the requested data. This contrasts with the previous scenario in which the default was not to provide the information and PIs had to opt in to enter it.

Centers Cluster

- *Q. II.3. One general concern, not related to this suite of proposals: **could panel service be tracked for all reviewers across the agency to ensure that no single reviewer receives too many requests?** It would be helpful to publicly share/post guidelines or expectations for service, especially with junior faculty. Including a question about the number of panels the potential reviewer participated during the last two years could help in that aspect.*

Response:

NSF business systems allow us to track every review and all reviewer service, whether as an *ad hoc* reviewer or as a panelist. POs are trained to use this information to ensure that requests for reviews are not overly burdensome. In terms of providing guidance on review-writing, we do share such information with the community through our blogs and virtual office hours. Also, POs have the option of offering to comment on draft reviews from new reviewers and panelists to help them learn how to formulate informative reviews. Moreover, as noted above in the response to review quality, NSF provides a training video and promotes it for all new reviewers to watch.

- *Q. IV.9. While the success rate of underrepresented groups in 2020 in the Centers Cluster was similar to the percentage for all applicants, the total number of applications submitted by members of underrepresented racial or ethnic groups is very low. This lack of participation represents a real*

concern, and DBI should try to understand why potential PIs who are members of underrepresented racial or ethnic groups are not applying to the cluster.

Response

While it is difficult to know the direct cause, it is possible that the low submission rates to the Centers Cluster programs is an indirect reflection of PI career stage. PIs of Centers proposals, on average, tend to be at a more advanced career stage than PIs for other programs across BIO. This, coupled with the relatively low numbers of PIs who are both members of underrepresented racial or ethnic groups and at later career stages, may explain the paucity of racial or ethnic diversity of PIs of Centers proposals.

That said, BIO has included specific language on diversity and inclusion in all of its newest solicitations. For example, in the required Management and Governance section of the project description of the current Centers competition for Open Environmental Data and Science ([NSF 21-549](#)), BIO emphasizes that the Center's management structure, "*should include a diversity of types of participants, including individuals from a variety of career stages and members of underrepresented groups in science, including women, minorities and those with disabilities. This diversity should extend to members of the leadership team.*" The same language is used in the solicitation for Biology Integration Institutes ([NSF 21-619](#)) to convey the expectation for diversity in the senior personnel teams. It is through this type of clear communication of expectations, oversight, and outreach that BIO is addressing this issue over the longer term.