

PROGRAM EVALUATION AND MONITORING INFORMATION

Evaluations at NSF are currently performed at the discretion of the individual directorate, office, or program being evaluated. A list of major external evaluations completed in FY 2020 follows, including Committees of Visitors and significant workshops. For more information about program evaluation and collection and management of NSF programmatic data, see the Office of Integrative Activities chapter's section on NSF's Evaluation and Assessment Capability.

Major External Evaluations Completed in FY 2020

EHR

During FY 2020, an evaluation of the Advanced Technological Education (ATE) program was performed to document patterns of investments over time; explore the effects of program supported activities on student recruitment, retention, and completion at two-year institutions in advanced technological fields in STEM; assess the effects of program supported activities on building the capacity of faculty and institutions to address workforce needs in advanced technological fields in STEM; and explore contributions to practice and the knowledge base on technician education in STEM. The report, delivered to DUE in FY 2020, is currently under internal review.

GEO

The NASEM Decadal Survey for EAR, *Earth in Time, A Vision for NSF Earth Sciences 2020-2030*, was released in May 2020¹. It emphasizes "the need to understand how the Earth can continue to sustain both civilization and the planet's biodiversity" because "the Earth system functions and connects in unexpected ways—from the microscopic interactions of bacteria and rocks to the macro-scale processes that build and erode mountains and regulate Earth's climate". The report identifies 12 priority research questions and provides recommendations to help NSF plan and support the next decade of Earth science research.

MPS

- CHE sponsored external evaluation of the Centers for Chemical Innovation (CCI) Program (2004-2016) was completed in FY 2020. The report and executive summary were published² in April 2021. The evaluation yielded substantial information about the operation and outcomes of the CCI Program.
- Several PHY sponsored decadal reports have been recently completed or are currently underway that provide important strategic advice for the division. The *Decadal Assessment and Outlook Report on Atomic, Molecular, and Optical Science AMO*³ was published in early 2020 and the *Decadal Assessment of Plasma Science* report⁴ was released in the summer of 2020.

IA

In FY 2020, the following studies and statistics reports were completed and informed decisions:

- *Research Experiences for Undergraduates Data System (REU, NSF-wide)*⁵. NSF supported the design, development, and testing of a data system for program monitoring and future research and evaluations. Results from the original pilot enabled NSF to identify the approach (from three tested) to pursue in the scale-up pilot.
- *A study of NSF's Established Program to Stimulate Competitive Research (EPSCoR)* provided findings that influenced the definition and focus of an extended effort (the Future of EPSCoR⁶) to engage stakeholders in developing a better understanding of the impact of EPSCoR's investment

¹ www.nap.edu/catalog/25761/a-vision-for-nsf-earth-sciences-2020-2030-earth-in

² www.nsf.gov/od/oia/eac/products.jsp

³ www.nationalacademies.org/our-work/decadal-assessment-and-outlook-report-on-atomic-molecular-and-optical-science

⁴ www.nationalacademies.org/our-work/a-decadal-assessment-of-plasma-science-of-plasma-science

⁵ The REU data system has now become etap and can be reviewed at www.nsfetap.org/

⁶ www.futureofnsfepscor.com/

strategies and identifying opportunities to increase its effectiveness. This activity includes opportunities for the public to provide evidence-based input. An external committee will synthesize the collected input in a summary report, which will include recommendations for both NSF and its stakeholders nationwide.

- *NSF INCLUDES*. NSF supported a foundational fact-finding study of the alignment between existing evidence and current information needs (as reflected in the NSF INCLUDES learning agenda). Findings were used by the NSF INCLUDES program staff to: (1) inform the development of shared measures and (2) identify technical assistance needs for the NSF INCLUDES National Network.

OPP

The Science and Technology Policy Institute (STPI) performed its annual Survey Analysis of the United States Antarctic Program Logistical Support Services for the 2019–20 Field Season report.

Advisory Committees and Committees of Visitors

Each directorate and office has an external advisory committee that typically meets twice a year to review and provide advice on program management, discuss current issues, and review and provide advice on the impact of policies, programs, and activities in the disciplines and fields encompassed by the directorate or office. In addition to directorate and office advisory committees, NSF is also advised by external committees on specific topics. Recent examples include: astronomy and astrophysics; environmental research and education; equal opportunities in science and engineering; direction, development, and enhancements of innovations; polar programs; advanced cyberinfrastructure; international and integrative activities; the agency’s merit review processes; and business and operations.

Committees of Visitors (COVs) are subcommittees of NSF directorate advisory committees. COV reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) comments on how the outputs and outcomes generated by awardees have contributed to the attainment of NSF’s mission and strategic outcome goals. COV reviews are conducted at regular intervals of approximately four years for programs and offices that recommend or award grants, cooperative agreements, and/or contracts and whose main focus is the conduct or support of NSF research and education in science and engineering. Approximately one-fourth of NSF’s divisions are assessed each year.

A COV typically consists of up to 20 external experts, selected to ensure independence, programmatic coverage, and geographic balance. COV members come from academia, industry, government, and the public sector. They meet for two or three days to review and assess program priorities, program management, and award accomplishments or outcomes. Each COV prepares a report and the division or program that is being reviewed must prepare a response to the COV recommendations. These reports and responses are submitted to the parent advisory committee and to the Director of NSF. All reports and responses are public and posted on NSF’s website.⁷

In FY 2020, six directorates and two offices convened 13 COVs, covering 12 divisions and one program. A table of the COVs performed in recent years and planned through FY 2022 is provided on the next page. This chapter’s earlier section also contains information on these COVs, as well as information on *ad hoc* reports.

⁷ www.nsf.gov/od/oia/activities/cov/covs.jsp

Table 1 of 2, List of Committees of Visitors Meetings, FY 2016-FY 2021

All: all programs within the division were covered. Some COVs cover only some of a division’s programs; these are noted under the FY.

Proj: projected to be completed in the designated FY.

DIR	DIV	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
BIO	Biological Infrastructure	All					All	
	Environmental Biology				All			
	Integrative Organismal Systems			All				Proj
	Molecular and Cellular Biosciences			All				Proj
CISE	Advanced Cyberinfrastructure			All				
	Computing and Communication Foundations					All		
	Computer and Network Systems					All		
	Information and Intelligent Systems					All		
EHR	EHR Core Research		All					
	Graduate Education							Proj
	Human Resource Development						All	
	Research on Learning in Formal and Informal Settings					All		
	Undergraduate Education		TUES STEP WIDER IUSE					Proj
ENG	Chemical, Bioengineering, Environmental and Transport Systems				All			
	Civil, Mechanical and Manufacturing Innovations				All			
	Electrical, Communications and Cyber Systems			All				Proj
	Emerging Frontiers and Multidisciplinary Activities			All				Proj
	Engineering, Education and Centers	All				All		
	Industrial Innovation and Partnerships	All				All		

Table 2 of 2, List of Committees of Visitors Meetings, FY 2016-FY 2021

All: all programs within the division were covered. Some COVs cover only some of a division’s programs; these are noted under the FY.

Proj: projected to be completed in the designated FY.

DIR	DIV	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
GEO	Atmospheric and Geospace Sciences	Atmosphere Section		Geospace Section		All		
	Earth Sciences		All				Proj	
	Ocean Sciences: Integrative			All	All			Proj
	Ocean Sciences: Research							
	Education and Diversity Programs		All				Proj	
MPS	Astronomy				All			
	Chemistry	All				All		
	Materials Research				All	All		
	Mathematical Sciences	All						
	Physics				All			
SBE	Behavioral and Cognitive Sciences				All			
	Office of Multidisciplinary Activities					All		
	Social and Economic Sciences	All					Proj	
TIP	NSF I-Corps, PFI, SBIR, STTR					(in IIP)		
OIA	Major Research Infrastructure	All					Proj	
	Established Program to Stimulate Competitive Research					All		
	STC							Proj
OISE			All (2)					Proj
OPP	Antarctic Sciences (ANT)	All				All		
	Arctic Sciences (ARC)	All				All		

Committees of Visitors (COV)⁸

BIO: In 2020, the DBI COV convened December 15-17 and reviewed division operations and the programmatic portfolio for the five-year period spanning FY 2016 – FY 2020. BIO is evaluating all the COV recommendations and working to include them in future planning activities.

CISE: In November 2019, CISE convened a COV to examine and assess the quality of the merit review process of the FY 2014-FY 2018 programmatic within its CCF, CNS, and IIS divisions. The report from that COV was accepted by the CISE Advisory Committee at its December 2019 meeting.

EHR: An external Committee of Visitors (COV) met to review DRL in October 2019. The co-chairs of the COV presented a summary of the committee’s recommendations, and the COV report was discussed and accepted, at the (virtual) EHR Advisory Committee meeting held on May 21, 2020. Overall, the COV’s findings were quite positive about the quality and effectiveness of DRL’s merit review processes and program management. The main area of concern was the balance of awards to new and early-career investigators. In addition, the committee encouraged DRL to consider additional opportunities for incorporating NSF’s “10 Big Ideas” in solicitations; to clarify “broadening participation,” “broader impacts,” and “transformative” in the context of proposals for STEM education research; to continue efforts to diversify the pool of reviewers; to document the processes and the criteria that programs use to analyze and shape their award portfolios; and to consider ways to make more effective analytical use of the annual project reports submitted by investigators. DRL is addressing the recommendations as it plans future revisions of solicitations and future reviews of proposals in the programs.

ENG: In 2020, COVs reviewed IIP and EEC. The IIP COV presented its report to the ENG Advisory Committee in October 2020, and the EEC COV presented its report in April 2021.

GEO: In 2020, a COV reviewed the Division of Atmospheric and Geospace Sciences. The COV presented their report to the Advisory Committee for Geosciences at the October meeting. The COV made several recommendations including that letters of acknowledgement for reviewers be automatically generated and that a central database of reviewers with ratings/notes be created. The COV did not recommend a timeline for implementation of their recommendations.

MPS: In 2020, COVs reviewed CHE and DMS. The COVs presented their reports⁹ to the DIR Advisory Committee, which convened in August and November of 2020. CHE and DMS provided responses, which are updated annually, to the COV findings.

SBE: In 2020, a COV assessed the SBE Office Of Multidisciplinary Activities (SMA) division’s merit review process and presented their report to the SBE Advisory Committee (AC) in December 2020. Based on recommendations from the COV concerning additional feedback to principal investigators and reviewers; the directorate is evaluating best practices for helping researchers improve their proposals. In addition, and more broadly in response to other COV inputs, SBE is reviewing emerging areas of research, strategies for open science, and ways to optimize communication with both the research community and the general public.

TIP: The NSF I-Corps, PFI, and SBIR and STTR programs were reviewed as part of a COV convened in June 2020. The report from that COV was accepted by the ENG Advisory Committee at its October 2020 meeting.

⁸ www.nsf.gov/od/oia/activities/cov/covs.jsp, NSF Committee of Visitors (COV) Reports.

⁹ www.nsf.gov/od/oia/activities/cov/mps/2020/CHE_COV_2020_Final_2020-07-13.pdf

IA: In 2020, a COV reviewed the EPSCoR Program and found no significant programmatic gaps or needs for significant improvement.¹⁰

OPP: In FY 2020, COVs reviewed the Antarctic and the Arctic programs. The COVs presented their reports to the Office of Polar Programs Advisory Committee (OPP AC), which convened in fall of 2020. The COVs made several recommendations including that OPP, in both polar regions, expand efforts to broaden participation of under-represented individuals (PIs, students, and reviewers) and institutions. OPP provided responses to both 2020 COV reports during the spring 2021 OPP AC.

Workshops

BIO

BIO supported the following workshops in FY 2020 that inform planning of the directorate's research programs.

- A workshop entitled “Trans-US Government expert meeting to examine synthetic biology roadmap” was held in October 2019. The workshop, which included attendees across academia, industry, and US government agencies, was convened to examine use cases in the field of synthetic biology and the most pressing basic research, technology, infrastructure, and workforce needs to advance the field. The results of the workshop helped inform the development of the work plan for the Interagency Synthetic Biology Working group as well as agency priorities in this area. An ongoing Dear Colleague Letter in plant synthetic biology, released in FY 2020 and supported by BIO and ENG at NSF, is one early outcome of this activity. This workshop has stimulated discussions that may lead to new funding opportunities. In FY 2021, a follow up retreat is being held to refresh and reprioritize the science needs that will enable the rapid advance of synthetic biology to address societal problems.
- A series of virtual and in-person workshops entitled “Reintegrating Biology Jumpstarts” were funded in 2019 and held throughout fall 2019 to engage the broader biological community in identifying: the exciting new research questions that could be addressed by combining approaches and perspectives from different sub-disciplines of biology; the key challenges and scientific gaps that must be addressed to answer these questions; and the physical infrastructure and workforce training needed. These workshops continue to inform research and training activities supported by Biology Integration Institutes.

MCB supported multiple workshops in FY 2020 that inform the planning research programs.

- A Workshop, organized by OECD, entitled “Collaborative Platforms for Engineering Biology: Biofoundries and Distributed Biofoundries” was supported in FY 2020 as one in a series of activities to catalyze the development of a global network of biofoundries capable of addressing societal needs, including rapid response to pandemics. The workshop was part of the US voluntary contribution to OECD work in the circular bioeconomy space and helped inform future activities at OECD and across US science funding agencies regarding the role of Biofoundries in the Bioeconomy.
- A workshop entitled “Workshop: Biology, Information, Communication and Coding Theory”² was funded in 2019 and was held in January of 2020. The workshop and report are helping to frame a new initiative in Biological Information and the next generation solicitation of Semiconductor synthetic biology.
- A workshop on “High Pressure Small Angle X-ray scattering” was funded in FY 2020 to highlight the new capabilities of NSF funded infrastructure to address questions about biology in extreme environments. The workshop was intended to be hands on and has been delayed because of COVID-19.
- A workshop on “The Plant Cell Atlas Initiative” was held in January of 2020. The workshop aimed to

¹⁰ www.nsf.gov/od/oia/activities/cov/oia/epscor/2020EPSCoRCOVReport_070720_final.pdf

bring together a plant cell biology community to develop an atlas of imaging resources for plant biology in much the same way as the Allen Institute has brought such resources to the field of neuroscience.

- A series of workshops were funded in FY 2020 and will be held over multiple years, “Modern Methods in Microscopy: Elucidating the physical biology of the Cell” with the aim of expanding the knowledge and access to modern microscopy tools and techniques to under-resourced institutions. This is one of many efforts in MCB to democratize access to tools associated with modern molecular and cellular biosciences.
- A workshop entitled “Broadening participation of persons with disabilities in STEM” was held in FY 2020 at the National Federation of the Blind, motivated by the need for new resources for researchers and others in academia and the private sector to increase their ability to create inclusive environments that enable the participation of persons with disabilities. The outcomes of the workshop will be widely disseminated through the NSF funded Center for Advancing Research Impacts in Society.

IOS supported multiple workshops and meetings in FY 2020 that informed planning for research programs:

- A workshop in FY 2018 “Breakthroughs 2030: A Strategy for Food and Agricultural Research”¹¹ led to a National Academies of Sciences, Engineering and Medicine (NASEM) Breakthroughs 2030 report and continues to help guide investments in agriculturally related plant genomics and plant biotic interactions programs. In addition, in late FY 2019 and again in late FY 2020, IOS held a community visioning workshop with the plant genomics research community to discuss future directions and new areas for high impact plant sciences research. These meetings informed the FY 2021 update of the solicitation for plant genomics research in IOS which includes the ongoing opportunities released in FY 2020 for synthetic plant biology research suggested by the community and the simplification of the submission process.
- In FY 2019, IOS commissioned a workshop from the NASEM on future directions in Functional Genomics. That workshop was held February 10-12, 2020 at the NASEM in Washington, D.C. The workshop report entitled “Next Steps for Functional Genomics”¹¹ will inform future investments in all IOS programs and NSF’s URoL Big Idea in FY 2022 and beyond.
- Both the “Interagency Strategic Plan for Microbiome Research FY 2018-2022”¹² released in April 2018 and the outcomes from a hybrid virtual and in person community visioning workshop entitled “Deciphering the Microbiome” held in December of 2019 guide IOS investment into microbiomes, including microbial interactions with plants and animals in the warming world, and important ecosystem services such as soil stability, fertility, and sustainability.

DEB supported multiple workshops in FY 2020 to inform planning of research programs:

- A series of cumulative workshops entitled “Revolutionizing Systematics - Revitalizing Monographs” has continued through FY 2021 with the goal of developing ideas from a wide swath of the systematics community for modernizing the practice and products of taxonomic monography. Participants are developing white papers on 5-10 topics that will be published in a special volume of a society publication.
- A virtual workshop series entitled: “Workshop to Investigate an Integrated Data Architecture for Paleogenomics, Micropaleontology, and Macropaleontology” was held in the summer of 2020 to establish the current state of the science and informatics for ancient DNA, and identify the most promising short-term and next-stage opportunities for integrating ancient DNA with existing and to-be-built cyberinfrastructure for broad-scale analyses of the diversity and distribution of life over space and time.
- A virtual conference entitled: “Networking Microbiome Research: A Symposium for a Microbiome Center Consortium” was held in the winter 2020 to advance and network microbiome centers at the national level.

¹¹ www.nap.edu/catalog/25780/next-steps-for-functional-genomics-proceedings-of-a-workshop

¹² www.commonfund.nih.gov/sites/default/files/Interagency_Microbiome%20Strategic_Plan_Final_041918_508.pdf

- The 5th Symposium on Urbanization and Stream Ecology hosted a workshop in February 2020 to share knowledge about effective approaches for managing streams in urban landscapes. The workshop discussed four case studies as a foundation for exchanging ideas and generating actionable outcomes and draft project plans for four real-world sites in Austin, TX. This approach to sharing knowledge across natural and social science disciplines that integrated knowledge and values of the local community had clear potential benefits for achieving ecological improvements and equitable social outcomes for local communities.

DBI supported multiple workshops in FY 2020 to inform the planning of the division's promotion of open data platforms for the BIO community and to inform future program management :

- DBI supported a workshop in 2019 entitled "Developing skills for advanced careers in biology for NSF postdoctoral fellows in the PRFB Broadening Participation 2019 cohort." This was a one-day workshop held at the November 2019 Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) Diversity in STEM Conference that provided PRFB Fellows and their mentors within the Broadening Participation Area an opportunity to network and attend career talks, best-practices talks, and poster sessions focused on broadening participation in Biology. This workshop aimed to help generate long lasting partnerships and potential collaborations among PRFB fellows, mentors, and the SACNAS community.
- A 2020 workshop entitled "A Virtual Workshop to Facilitate the Use of NEON Data and Infrastructure at HBCUs" was conducted virtually (Jan 20-22, 2020) and included an overview of the NEON project goals and data provided by NEON/Battelle project staff. Twenty-two faculty and graduate students from 11 HBCUs attended. It is hoped that this workshop serves to re-ignite engagement with this community of researchers and teachers in the NEON resource.

EHR

- In FY 2020 the STEM Education Future of the Future Subcommittee of the EHR Advisory Committee submitted a report on its work to envision how to create STEM education that prepares and advances the U.S. for the future. *STEM Education for the Future* concludes STEM education should be student-centered, project-based, and personalized; grounded in principles of equity and inclusion; and include technology as both a tool for and a topic of learning. EHR used these insights in developing strategies for supporting STEM education during and mitigating the effects of the COVID-19.¹³
- In FY 2020 EHR/DUE/IUSE and EHR/DRL/DRK-12 supported *Workshop on Mid-scale STEM Education Research Infrastructure*,¹⁴ a project to convene experts in STEM education offering perspectives on i) what are the key R&D questions for which no current research infrastructure exists to carry out investigations and ii) what might the characteristics of prospective research infrastructures (e.g. data aggregation and management infrastructure) look like. Insights will be used to help inform EHR deliberations about how to support such infrastructure.
- In FY 2020 NSF issued *NSF INCLUDES Special Report to the Nation II*.¹⁵ NSF INCLUDES completed its fourth year of activities in 2019. This report provides information on the progress of the NSF INCLUDES initiative.
- In FY 2020 and FY 2021 NSF/HRD/EASE (Excellence Awards in Science and Engineering) staff, in collaboration with Booz-Allen and others, conducted multiple meetings and debrief sessions (e.g., with State Coordinators, the Presidential Awards for Excellence in Mathematics and Science Teaching [PAEMST] National Selection Committee, the Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring [PAESMEM] National Selection Committee, and the State Coordinator Leadership). Resulting insights were used to inform a variety of program decisions and plans.

¹³ See www.nsf.gov/news/news_summ.jsp?cntn_id=301784&org=EHR.

¹⁴ www.nsf.gov/awardsearch/showAward?AWD_ID=2013314&HistoricalAwards=false.

¹⁵ www.nsf.gov/pubs/2020/nsf20099/nsf20099.pdf

ENG

- During FY 2020, a CMMI-supported workshop and follow-on training on Increasing Reviewer Risk Tolerance Through Awareness (IRRTTA) explored the use of reviewer training on cognitive biases to increase one's tolerance toward (i.e., make them more accepting of) high-risk research. Based on the results of that pilot, CMMI funded the development of training resources and in FY 2021 began training CMMI reviewers to recognize and appropriately evaluate high-risk, high-reward proposals.
- In February 2020, a CBET-supported workshop, "Exuberance of Machine Learning in Transport Phenomena," was held in Dallas, Texas. Experts at the workshop highlighted future directions for AI in transport phenomena research. The forthcoming workshop report will inform the division's programmatic efforts.
- In February 2020, ECCS supported the "NSF SpecEES PI Meeting and Workshop on Future Wireless Research Challenges" in Newport Beach, CA, which was attended by participants from academia, industry and government. Attendees identified advanced wireless research challenges, including spectrum efficiency, latency, spectrum sharing and usage co-existence, spectrum sensing and monitoring, wireless quality of services, mm-wave and terahertz microelectronics, low-power wireless for internet of things (IoT), and wireless security.
- From July to September 2020, CMMI supported four FW-HTF stakeholder workshops, organized by SRI-International. Each of the virtual workshops focused on a different aspect of FW-HTF: restructuring the physical and virtual workspace; exploring the human-technology partnership; fostering reskilling, upskilling and lifelong learning; and ethical questions and the implications for policy. Workshop participants represented industry, other government agencies, non-profit organizations, and academia. The workshops helped identify emerging areas of FW-HTF research and ways to support larger scale collaboration between stakeholders and the FW-HTF research community.

MPS

- In FY 2020, CHE, DOE Office of Fossil Energy, DOE Office of Science, National Institute of Standards and Technology, and the American Chemical Society initiated a consensus study through the National Academies' Board on Chemical Sciences and Technologies on *Enhancing the U.S. Chemical Economy through Investments in Fundamental Research in the Chemical Sciences*. Results from the study, planned for FY 2022, are expected to inform the scope of core funding activities in the chemical sciences.