UNITED STATES

National Science Foundation

FY 2022

Agency Financial Report

THE NSF STATUTORY MISSION

To promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense; and for other purposes.

—from The National Science Foundation Act of 1950 (P.L. 81-507)

THE NSF VISION

A nation that leads the world in science and engineering research and innovation, to the benefit of all, without barriers to participation.

—from "Leading the World in Discovery and Innovation, STEM talent Development and the Delivery of Benefits from Research"
NSF Strategic Plan for FY 2022-2026

ABOUT THIS REPORT

For fiscal year (FY) 2022, the National Science Foundation (NSF) issues three reports to provide financial management and program performance information to demonstrate accountability to our stakeholders and the American public. These reports are produced using guidance from the Office of Management and Budget and meet the requirements of the Chief Financial Officers (CFO) Act, as amended by the Government Management Reform Act of 1994, the Federal Managers' Financial Integrity Act of 1982, the Reports Consolidation Act of 2000, and the Government Performance and Results Modernization Act of 2010.

The ***Agency Financial Report*** (AFR) focuses on financial management and accountability. Below is a high-level summary of the AFR's three chapters:

- *Chapter 1: Management's Discussion & Analysis* provides a high-level overview of NSF's organizational structure, strategic framework, programmatic and financial performance, and management assurances related to NSF's internal controls.
- *Chapter 2: Financials* includes the results of NSF's annual financial statement audit and financial statements and accompanying documents.
- *Chapter 3: Appendices & Other Information* contains the memorandum from the NSF Inspector General (IG) on the agency's FY 2023 management challenges, NSF management's report on the progress made on the challenges identified by the IG for FY 2022, information on grant reporting, patents and inventions resulting from NSF support, and other relevant information.

- The ***Annual Performance Report*** (APR) provides information on the progress NSF has made toward achieving its goals and objectives as described in the agency's strategic plan and Annual Performance Plan, including the strategic objectives, performance goals, and Agency Priority Goals. The ***APR*** will be included in NSF's *FY 2024 Budget Request to Congress.*
- NSF's ***Performance and Financial Highlights*** report summarizes key financial and performance information from the *AFR* and *APR*. This will be available on NSF's website when the *FY 2024 Budget Request to Congress* is published.

All three reports are available on NSF's website as they are completed.[1] We welcome your suggestions on how we can make these reports more informative. You can reach us at: accountability@nsf.gov or call (703) 292-8200.

NSF by the Numbers	
$8.8 billion	FY 2022 Appropriations (does not include mandatory accounts)
2,000	Colleges, universities, and other institutions receiving NSF funding in FY 2022
39,000	Proposals evaluated in FY 2022 through a competitive merit review process
11,000	Competitive awards funded in FY 2022
187,000	Proposal reviews conducted in FY 2022
352,000	Estimated number of people NSF supported directly in FY 2022 (researchers, postdoctoral fellows, trainees, teachers, and students)
66,000	Students supported by NSF Graduate Research Fellowships since 1952

Numbers are rounded.

[1] Online resource for NSF's accountability reports: https://www.nsf.gov/about/performance/

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A MESSAGE FROM THE DIRECTOR

Photo: NSF/Stephen Voss

The U.S. National Science Foundation is pleased to present its *Fiscal Year 2022 Agency Financial Report*. This AFR is one of three NSF accountability reports that provides key financial and performance information to our stakeholders and the American people.

This past year has been an exciting one at NSF. In FY 2022, the "CHIPS and Science Act" (the Act) was signed into law, and we announced the establishment of the first new NSF directorate in over 30 years, the Directorate for Technology, Innovation and Partnerships, or TIP. The Act empowers NSF's core research programs to expand their impact and work together in new ways to spur innovation across all science and engineering fields and help bring new technologies to society more rapidly. It enables NSF to further strengthen the next-generation workforce by proposing significant investments in STEM training and education and broadening participation in under-represented communities. Together, these changes ensure that NSF's investments in talent and ideas will produce remarkable results for years to come.

NSF also published its FY 2022-2026 Strategic Plan and began working to implement its vision and goals. The plan reflects input from across NSF and from our stakeholders, envisioning a future where NSF investments in science and engineering unleash the power of learning, innovation, and discovery in ways that have deep and meaningful impacts on lives and communities throughout the Nation. The four strategic goals — Empower, Discover, Impact and Excel — are the foundation for transformational developments both inside the agency and externally with the science and technology communities we support. We like to say that the four strategic goals tell a brief, but powerful, story about NSF: We Empower people to make Discoveries with Impact, and we do it by Excelling as a federal agency.

With the publication of the *FY 2022 Agency Financial Report*, I am pleased to report that for 25 consecutive years, NSF has received an unmodified "clean" opinion on its financial statements. The independent auditors did not identify any material weaknesses or significant deficiencies. In addition, NSF provided reasonable assurance that the agency complied with the "Federal Managers' Financial Integrity Act" and that internal controls were operating effectively to support accurate financial reporting. The AFR also includes summary performance information for FY 2022. For more information on NSF's performance management process and the complete results of our FY 2022 annual goals under the "Government Performance and Results Modernization Act of 2010," I invite you to read NSF's *Annual Performance Report*, which will be released with NSF's *FY 2024 Budget Request to Congress*.

As responsible stewards of taxpayer dollars, NSF works hard to build and sustain public trust in our operational and fiduciary capabilities through transparency and accountability. We remain committed to ensuring NSF funds are used effectively to support curiosity-driven, discovery-oriented research as well as new solutions-oriented innovations to make all our lives, and our world, a better place.

/s/
Sethuraman Panchanathan

November 14, 2022

Chapter 1

Management's Discussion and Analysis

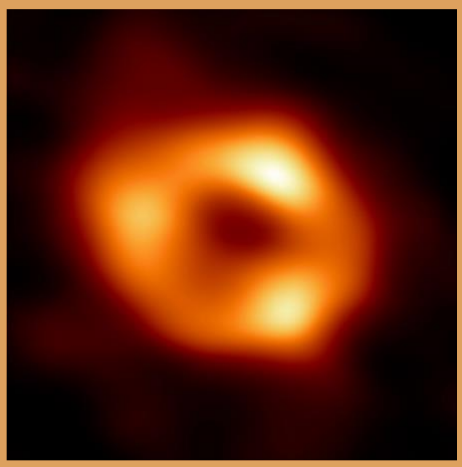
Agency Overview

Mission and Vision

The National Science Foundation (NSF) was established in 1950 "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…"[1] As the only federal agency that invests in fundamental, basic research across all non-medical fields of science and engineering, this mission continues to guide the agency today.

For over seven decades, NSF has been at the forefront of discovery and innovation. NSF-funded discoveries have been instrumental in developing new ways of thinking about scientific, economic, and sociotechnical challenges facing the Nation and the world. Among the many discoveries, the agency has supported use-inspired innovations such as the manufacture of personal protective equipment and accelerating sequencing the structure of the COVID virus; laid the technological foundation for smartphones, GPS, and the Internet; invested in research to make people safer in times of natural disasters; and accelerated advances in 3D printing and nanoscience. The *CHIPS and Science Act of 2022*,[2] enacted in August 2022, emphasizes the importance of investments in NSF's mission and will further accelerate discoveries and innovations that help to overcome the challenges of today and realize the opportunities of tomorrow. The legislation strengthens investments in science, technology, engineering, and math (STEM) education and in efforts to broaden participation and build a diverse, inclusive workforce for the jobs of the future.

During fiscal year (FY) 2022, NSF marked its 72nd anniversary by unveiling the first-ever image of the black hole that lies at the center of the Milky Way. The image required the synthesis of ideas and collaborative efforts involving dozens of researchers—across nations, institutions, and disciplines—and in this way inspires and illuminates the future of the scientific enterprise.



The first image of the black hole at the center of the Milky Way. *Credit: EHT Collaboration*

The hole at the center of our galaxy, Sgr A*

In May, NSF-supported scientists released the first direct visual evidence of the supermassive black hole at the center of our Milky Way galaxy. The black hole, dubbed Sagittarius A*, or Sgr A*, was challenging to view due to its relatively small size and because it is surrounded by fast-moving gas and other objects in our galaxy passing through the viewing path. A composite image was produced by a global research team called the Event Horizon Telescope, or EHT, Collaboration, which layered observations gathered by a worldwide network of radio telescopes. Because Sgr A* is located at the center of the Milky Way, understanding how it functions is fundamental to the larger goal of understanding how our galaxy formed and continues to evolve.

[1] National Science Foundation Act of 1950 (Public Law 81–507).

[2] *The CHIPS and Science Act of 2022*, Public Law 117-167 was enacted August 8, 2022, and authorizes various new programs and activities at NSF. https://www.congress.gov/bill/117th-congress/house-bill/4346/text

This report is focused on FY 2022, a year in which NSF funded the groundbreaking research that has long been its hallmark and pursued efforts to help researchers and educators rebound from the unprecedented disruptions brought by the COVID-19 pandemic. The agency prioritized the deployment of its regular appropriations, as well as funds provided through the *American Rescue Plan* (ARP) *Act of 2021*[3] to support individuals and institutions most affected by the pandemic, with special focus on those at vulnerable transition points in their research careers.

In FY 2022, NSF's research priorities included supporting fundamental research and development, strengthening U.S. leadership in emerging technologies, improving equity in science and engineering, and advancing climate science and sustainability research. For example, as the primary non-defense federal funder of basic research on artificial intelligence (AI), NSF made critical investments in AI that will enable breakthroughs across nearly every sector of society. Other breakthroughs from NSF-supported research included materials scientists working toward the development of new, high-performance synthetic fibers; biomedical engineers creating an implantable computer–brain interface to enable precise, high-speed, multifinger movements; and pathbreaking efforts to understand the tuberculosis genome and the complex evolution of this ancient pathogen. In FY 2022, NSF also announced a new investment, in collaboration with other federal agencies and private industry, aimed at the development of intelligent, resilient, and reliable next-generation networks and computing technologies. Throughout 2022, NSF remained committed to shaping a sustainable future by building on long-standing programs for crosscutting advances in climate change research and the translation of fundamental discoveries in clean energy into technologies and systems.

Recycling CO_2 into sustainable aviation fuels

Dimensional Energy, launched with help from NSF's SBIR/STTR programs, known as America's Seed Fund, has developed a method to use sunlight to convert carbon dioxide into energy. Co-founded by two Cornell faculty members, the company gathers carbon dioxide from a sources like industrial sites (cement plants) or from direct-air capture, then adds renewable energy and hydrogen to their system of reactors, to transform it into an environmentally friendly fuel. The goal of the founders is to decarbonize the aviation industry with sustainable jet fuel and, in June 2022, United Airlines agreed to purchase at least 300 million gallons of their product over 20 years from the company.

Dimensional Energy, launched with the help of NSF's SBIR/STTR programs, produces sustainable aviation fuels.
Credit: Dimensional Energy

NSF prioritizes investments in a wide array of research infrastructure that is geographically distributed and broadly accessible to advance discovery, learning, and exploration. This infrastructure includes observatories, detectors, optical and radio telescopes as well as ships, aircraft and autonomous airborne platforms and other state-of-the-art tools that foster collaboration and provide sophisticated platforms for conducting cutting-edge research. In 2022, the upgraded NSF Natural Hazards Engineering Research Infrastructure shake table was reopened and provides researchers access to state-of-the-art facilities to

[3] https://www.congress.gov/bill/117th-congress/house-bill/1319/text

study natural hazards and the performance of civil infrastructure. Also in 2022, astronomers obtained the sharpest image to date of the universe's most massive known star using the Gemini South Telescope of the International Gemini Observatory, operated by NSF's National Optical-Infrared Astronomy Research Laboratory (NOIRLab), which is the preeminent U.S. national center for ground-based, nighttime optical and infrared astronomy. The Foundation's long-term commitment to steady advancements and upgrades to research facilities enables continued ground-breaking research across scientific disciplines.

In March 2022, NSF established the Directorate for Technology, Innovation and Partnerships (TIP), which advances use-inspired and translational research, giving rise to new industries and engaging all Americans in the pursuit of new, high-wage jobs in STEM. A long-standing priority for NSF is the translation of science and engineering discoveries into innovative technologies and solutions that reach the marketplace and society. Key investments through TIP in support of this priority include Partnerships for Innovation, NSF Innovation Corps (I-Corps™), and America's Seed Fund™ (also known as the Small Business Innovation Research and Small Business Technology Transfer [SBIR/STTR] programs) powered by NSF. These programs support researchers as they pilot, prototype and otherwise demonstrate their innovations and technologies, facilitating the licensing of NSF-funded research outcomes and provide opportunities for entrepreneurial education. NSF investments through these programs have led to new startups and small businesses that have created jobs and positively benefited society by bringing significant outcomes and innovations to bear. Additionally, TIP supports programs like the NSF Convergence Accelerator and NSF Regional Innovation Engines, which foster convergent, use-inspired research, innovation, and workforce development. Ultimately, TIP will serve as a cross-cutting platform that spurs innovation across all science and engineering fields to bring new technologies to market and the benefits to society faster than ever, while investing in and nurturing the diverse talent needed for the future.

NSF programs help transform discoveries into cutting-edge solutions

NanoView Biosciences' journey shows how NSF's lab-to-market programs can help breakthrough technologies make the leap from research to commercialization. In 2011, NanoView Biosciences' cofounders received a Partnerships for Innovation grant to develop a prototype for diagnostic technology capable of rapidly detecting exosomes—messenger particles in blood, serum, and other samples that provide information about diseases. They completedNSF Innovation Corps™ training in 2013 and went on to receive a SBIR Phase I award in 2015, followed by a SBIR Phase II award in 2018. As its business grew, so did its technology, with new tools aimed at the rapidly expanding gene therapy sector. In 2022, NanoView Biosciences was acquired by Unchained Labs, a leading life sciences company. With help from three NSF programs, it was able to transform its research into cutting-edge solutions for gene therapy, biologics, and diagnostics.

NSF's investment strategy is multifaceted: it combines support for basic and translational research, which together generate a steady flow of new knowledge, with support for STEM education and workforce development at all levels. This is a central pillar of the U.S.'s standing in the global research enterprise. The sustained funding NSF provides for STEM education through its research awards keeps

the Nation's workforce competitive and readies it for future challenges. Embedded in these investments is an intentional focus on broadening participation in STEM and increasing engagements with minority-serving institutions (MSIs), community colleges, and other emerging institutions. These are critical to transformational breakthroughs shaped by capitalizing on a wide range of perspectives. One example of this is NSF's Louis Stokes Alliances for Minority Participation (LSAMP) program, which celebrated its 30th anniversary in 2022. LSAMP builds institutional alliances that assist universities and colleges in developing and retaining STEM talent from underrepresented communities so that students can more successfully transition from community colleges to four-year universities and on to graduate programs.

NSF's support for the Graduate Research Fellowship Program (GRFP) is an important component of its STEM workforce portfolio. Since 1952, NSF has funded approximately 66,000 Graduate Research Fellows, many of whom go on to become leaders in their chosen fields and make groundbreaking and important discoveries in STEM research. NSF also has funded the research of 258 individuals who have gone on to win the Nobel Prize, along with 44 individuals who have gone on to win the ACM[4] A.M. Turing Award, often referred to as the "Nobel Prize of Computing." NSF strives to provide every aspiring scientist and engineer access to the resources they need to prepare for a career in science or engineering.

Research and Mentoring for Postbaccalaureates in Biological Sciences (RaMP)

Every year, millions of American students graduate with a degree in biology, but for some, it is hard to see a path forward toward a career in biotechnology, bioengineering, or other fields that require extensive research experience. This is especially true for individuals from groups underrepresented in STEM and first-generation college students, as well as for students at institutions with limited resources for research projects. To ensure talented students everywhere have the opportunity to join the STEM workforce and research community, NSF's Biological Sciences Directorate launched the Research and Mentoring for Postbaccalaureates in Biological Sciences program, known as RaMP. Based on research that shows how inclusive training, cohort-based mentoring, and personal networks can make a big difference in future career success, RaMP is helping colleges, universities, nonprofits, and other organizations build research opportunities that expand pathways into the biosciences for more students and help recent graduates get research experience that can boost their careers.

Members of the RaMP program discuss research equipment. *Credit: Michael Reichert*

The partnerships that NSF undertakes represent another way that the agency adds value to the research enterprise. In addition to increasing access to research infrastructure and building broader communities of researchers, partnering can accelerate scientific discovery as well as the translation of research into products and services. In January 2022, NSF announced a new $100 million partnership with Intel Corporation to support research and workforce development to advance semiconductor design and manufacturing. This effort enhances U.S. competitiveness through research-based innovations that will drive future semiconductor design and manufacturing and addresses workforce shortages. Also announced this year was a $12 million partnership between NSF and the Department of Defense to

[4] ACM: Association for Computing Machinery

advance secure 5G technologies and communications for U.S. military, government, and critical infrastructure operators.

The new NSF strategic plan, *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research*,[5] for FY 2022 – 2026 sets forth an ambitious vision, calling for the Nation to lead the world in science and engineering research and innovation, to the benefit of all, without barriers to participation. NSF staff pursue this vision by working to expand the frontiers of knowledge and integrate that knowledge into industry and education. In addition, NSF core values include diversity and inclusion, integrity, and excellence in devotion to public service, and innovation and collaboration in our support of the work of the scientific community and of each other. These values and the agency's vision are embodied in the strategic goals established in the plan: (1) EMPOWER: empower STEM talent to fully participate in science and engineering; (2) DISCOVER: create new knowledge about our universe, the world, and ourselves; (3) IMPACT: benefit society by translating knowledge into solutions; and (4) EXCEL: excel at NSF operations and management.

It can take many years for the new knowledge gained through basic research to benefit society, but the benefits are undeniable. Investing in high-risk, foundational research inspires innovation, and innovation influences fundamental research. NSF supports 23 percent of all federally sponsored basic scientific research conducted by America's colleges and universities; and the share of NSF's support increases to 56 percent when medical research supported by the National Institutes of Health is excluded.[6] NSF also has well-established programs that accelerate the translation of fundamental science and engineering discoveries into new technologies that have the potential to impact society. Supporting curiosity-driven, discovery-oriented research and use-inspired innovations has transformed American lives, powered the economy, and elevated the Nation's competitiveness on the global stage.

New technology surpasses long-sought solar energy milestone

Engineers supported by NSF developed a new class of renewable solar energy technology that is as efficient as silicon-based solar cells but can be produced at lower cost and more sustainably. The new technology is based on perovskites, semiconductors that have a crystal structure compatible with solar cell technology– but that are also fragile and have a short lifespan. The team designed an accelerated aging process to improve testing and forecast long-term performance, and the perovskites can operate for nearly 30 years, a significant increase over the prior threshold of 20 years. As the technology becomes more efficient and long-lasting, competing designs will result in more durable and commercially viable technologies.

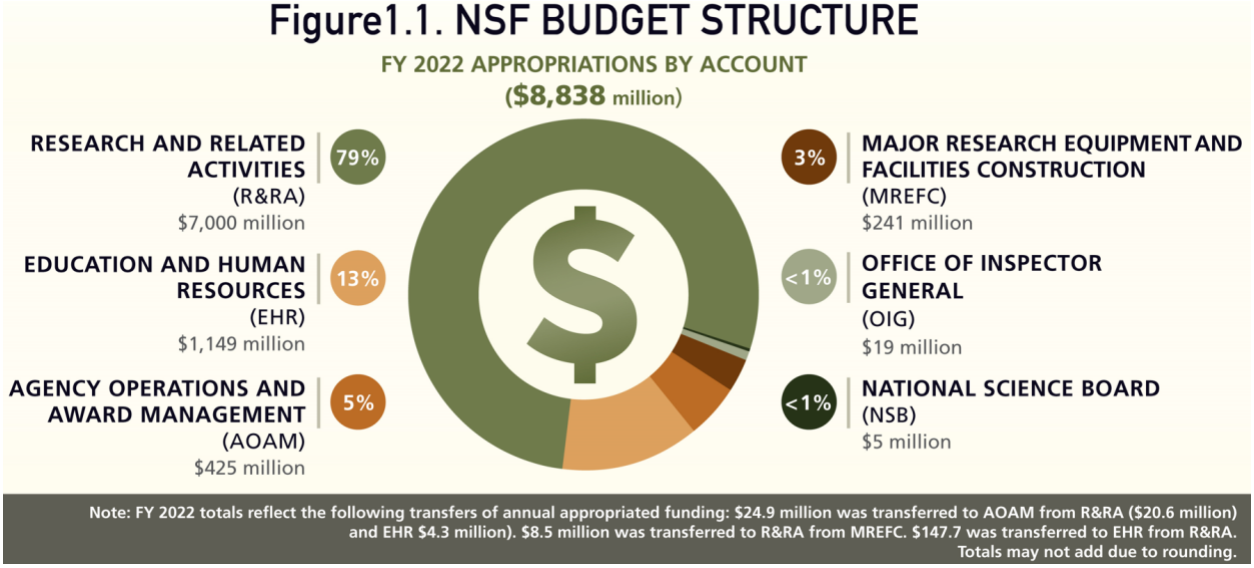
Engineers have developed an accelerated aging process to forecast long-term solar cell performance. *Credit: Bumper DeJesus*

NSF by the Numbers

NSF is funded primarily through congressional appropriations that are provided to six accounts: Research and Related Activities (R&RA), Education and Human Resources (EHR), Major Research

[5] NSF Strategic Plan FY 2022 – 2026: https://www.nsf.gov/pubs/2022/nsf22068/nsf22068.pdf
[6] National Center for Science and Engineering Statistics Survey of Federal Funds for Research and Development Fiscal Years 2020–2021: https://ncses.nsf.gov/pubs/nsf22323

Equipment and Facilities Construction (MREFC), Agency Operations and Award Management (AOAM), the National Science Board (NSB), and the Office of Inspector General (OIG). Appropriations in these six accounts in FY 2022 totaled $8,838 million.[7] When adjusted to account for the $600 million in supplemental ARP funding received in FY 2021, the FY 2022 NSF funding level was approximately $350 million, or 4 percent, higher than in FY 2021. In FY 2022, R&RA, EHR, and MREFC appropriations fund the agency's programmatic activities and accounted for 95 percent of NSF's total appropriations.



Bulleted comparisons between FY 2022 and FY 2021 appropriations exclude the one-time supplemental ARP funding in FY 2021.

- R&RA supports research and education activities in science and engineering, including high-risk and transformative research. This appropriation accounted for 79 percent of FY 2022 funding. The FY 2022 R&RA funding level of $7,000 million was approximately $120 million higher than FY 2021 of $6,880 million.
- EHR, which supports education research and activities to develop a diverse and well-prepared U.S. STEM workforce and a scientifically literate citizenry, is NSF's second largest appropriation and is over 13 percent of the agency's budget. EHR's FY 2022 funding level of $1,149 million was $181 million above the FY 2021 EHR appropriation of $968 million. In FY 2022, a transfer was made from R&RA to EHR to consolidate GRFP funding into the EHR appropriation. In FY 2021 and prior, GRFP was funded equally by the EHR and R&RA accounts.
- The MREFC appropriation supports the acquisition, construction, and commissioning of major facilities and larger mid-scale research infrastructure that provide unique capabilities at the frontiers of science and engineering. This account was 3 percent of the agency's total appropriations in FY 2022. The FY 2022 MREFC funding of $241 million was level with the FY 2021 funding.

[7] Amount shown is NSF's FY 2022 discretionary appropriations. This amount does not include Donations and H-1B Nonimmigrant Petitioner Receipts. These amounts are included in NSF's appropriations shown in the Statement of Budgetary Resources (SBR). The SBR is on page Financials-18 of this Agency Financial Report (AFR).

- FY 2022 AOAM funding of $425 million supported NSF agency operations and award management activities through which NSF's science and engineering research and education programs are administered. AOAM was 5 percent of NSF's total FY 2022 appropriations and funding increased $50 million between the two years.
- Separate appropriations support the activities of the OIG and the NSB; each accounted for less than 1 percent of NSF's total FY 2022 appropriations. The FY 2022 OIG appropriation of $19 million increased approximately $1 million over the FY 2021 appropriation. The NSB received an appropriation of $4.6 million in FY 2022; 2 percent more than the previous year's funding level.

During FY 2022, NSF evaluated over 39,000 proposals through a competitive merit review process and made approximately 11,000 new competitive awards, mostly to academic institutions. In addition to these proposals, GRFP reviewed about 13,000 applications for fellowships. Almost 32,000 members of the science and engineering community participated in the merit review process as panelists and proposal reviewers.[8] Awards were made to 1,800 institutions located in all 50 states, the District of Columbia, and three U.S. territories. These institutions employ many of America's leading scientists, engineers, and educators; and they train the leading innovators of tomorrow. In FY 2022, approximately 352,000 people were directly involved in NSF-funded programs and activities. Beyond these figures, NSF programs indirectly impact millions of people, reaching K-12 students and teachers, the general public, and researchers through activities including workshops; informal science activities such as museums, television, videos, and journals; outreach efforts; and dissemination of improved curriculum and teaching methods.

A person controls a robot to feed himself. *Credit: Cleveland State University Center for Human-Machine Systems*

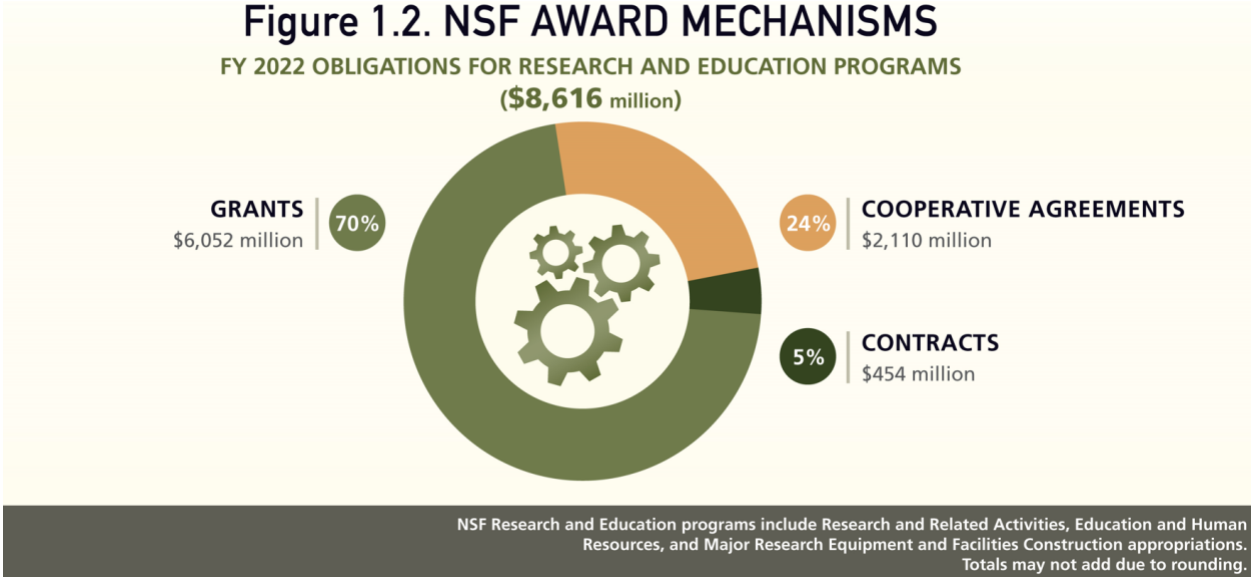
NSF Research Traineeship: Human-machine systems for physical rehabilitation

People with disabilities abandon assistive technologies at high rates, largely because their perspectives are not included in the development process. The NRT Program at Cleveland State University trains graduate students to work on transdisciplinary research teams in direct collaboration with the disability community. The goal is to ground new, accessible rehabilitation and assistive technologies in the unique perspectives and experiences of those living with disabilities. In the program, the students learn to span diverse perspectives in human-machine systems and develop human-centered approaches to research and design. This NRT program hopes to establish a new model for engineers, psychologists, and urban experts to collaborate with therapy professionals and the disability community to deliver future technologies for the most complex rehabilitation challenges.

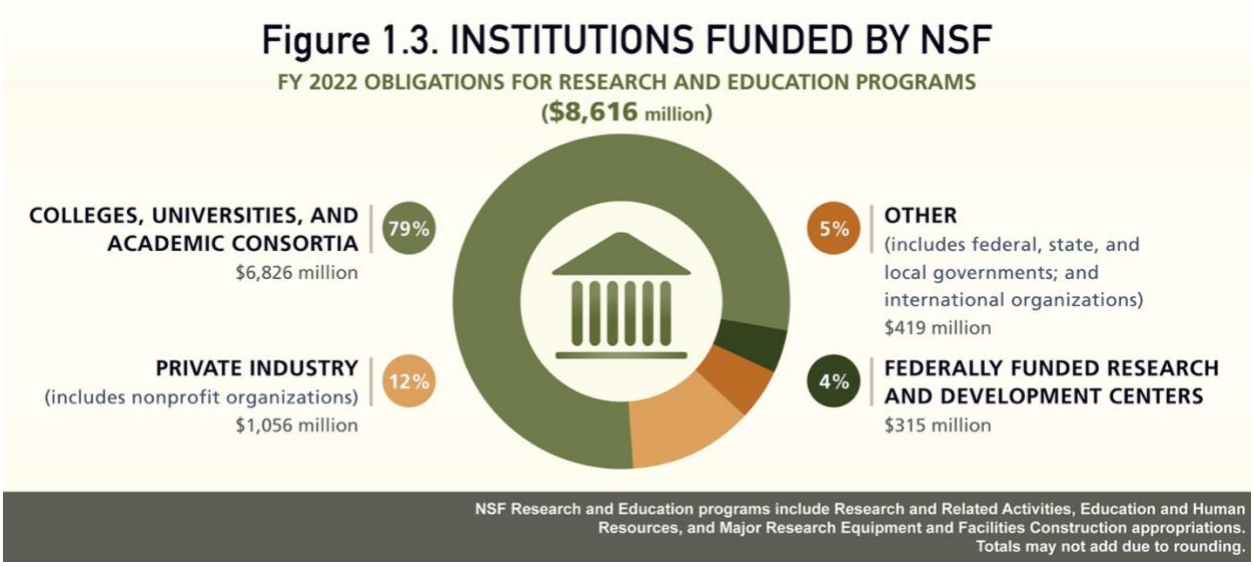
As shown in Figure 1.2 (NSF Award Mechanisms), NSF's award funding was used primarily for financial assistance to carry out a public purpose through grants and cooperative agreements. Grants can be either standard awards, in which funding for the full duration of the project is awarded in a single fiscal year, or continuing awards, in which funding for a multi-year project is awarded in increments.

[8] For more information about NSF's merit review process, see https://www.nsf.gov/bfa/dias/policy/merit_review/ and *NSF's Merit Review Process, FY 2020 Digest* (NSB-2021-45) at https://nsf.gov/nsb/publications/2021/merit_review/FY-2020/nsb202145.pdf

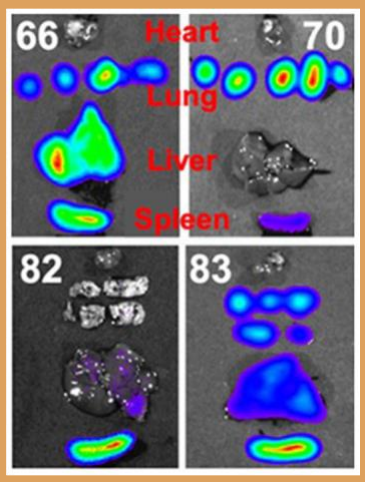
Cooperative agreements are used when the project requires substantial agency involvement (such as research centers and major facilities). Contracts are generally used for the direct benefit of the federal government (i.e., to acquire products or services), but they may be used to benefit the public in specific circumstances. NSF has had long-standing authority to use "other arrangements," and in FY 2022, NSF received "other transaction authorities" as part of the CHIPS and Science Act. These two mechanisms may support innovative approaches to fund programs managed by the TIP Directorate.



As shown in Figure 1.3 (Institutions Funded by NSF), 79 percent of support for research and education programs ($6,826 million) was provided to colleges, universities, and academic consortia. Private industry, including small businesses and nonprofit organizations, accounted for 12 percent ($1,056 million), and support to Federally Funded Research and Development Centers accounted for 4 percent ($315 million). Other recipients (federal, state, and local governments; and international organizations) accounted for 5 percent ($419 million) of support for research and education programs.



COVID-19 Activities



Representative images of mRNA delivery to different organs.
Credit: J. Am. Chem. Soc.

Targeted delivery of mRNA improves vaccine efficiency

NSF investments are about to make mRNA vaccines more effective and easier to store. Designing mRNA vaccines, like those used to protect against COVID, is a complex process. One of the key tools is macromolecules, large and complex molecular structures that play a role in countless biological processes and are critical to mRNA vaccine delivery systems. Currently, all COVID vaccines require an assembly of four different macromolecules to ensure the vaccine works. But this combination of macromolecules is unstable, and therefore the vaccine needs to be stored at extremely low temperatures to be effective—and they don't always agree on the right temperature or solubility and therefore need to be stored at extremely low temperatures. That is about to change, though, thanks to NSF-funded researchers who have found a single new macromolecule that can replace all four currently being used. In addition to increasing stability and eliminating the need for ultra-cold storage, this revolutionary approach delivers the mRNA payload more efficiently and has the new capability to target specific organs. The major vaccine producers are already working to integrate this research into future production.

As part of national efforts to recover from the COVID-19 pandemic, NSF in FY 2022 continued to fund important research, as well as recovery efforts to stabilize projects in construction and help the science, engineering, and STEM education communities rebound. Activities were funded from FY 2021 ARP funds[9] (a 2-year appropriation), NSF's FY 2022 base appropriations, and other available funds to support research related to COVID-19. NSF's FY 2022 COVID-19 activities funded over 6,000 awards to 9,000 principal investigators in 50 states, the District of Columbia, and two territories. Table 1.1 shows the FY 2022 obligations related to COVID-19 activities.[10] NSF's website provides updates on NSF's response to the pandemic.[11]

Table 1.1 FY 2022 COVID-19 Activity Awards and Obligations

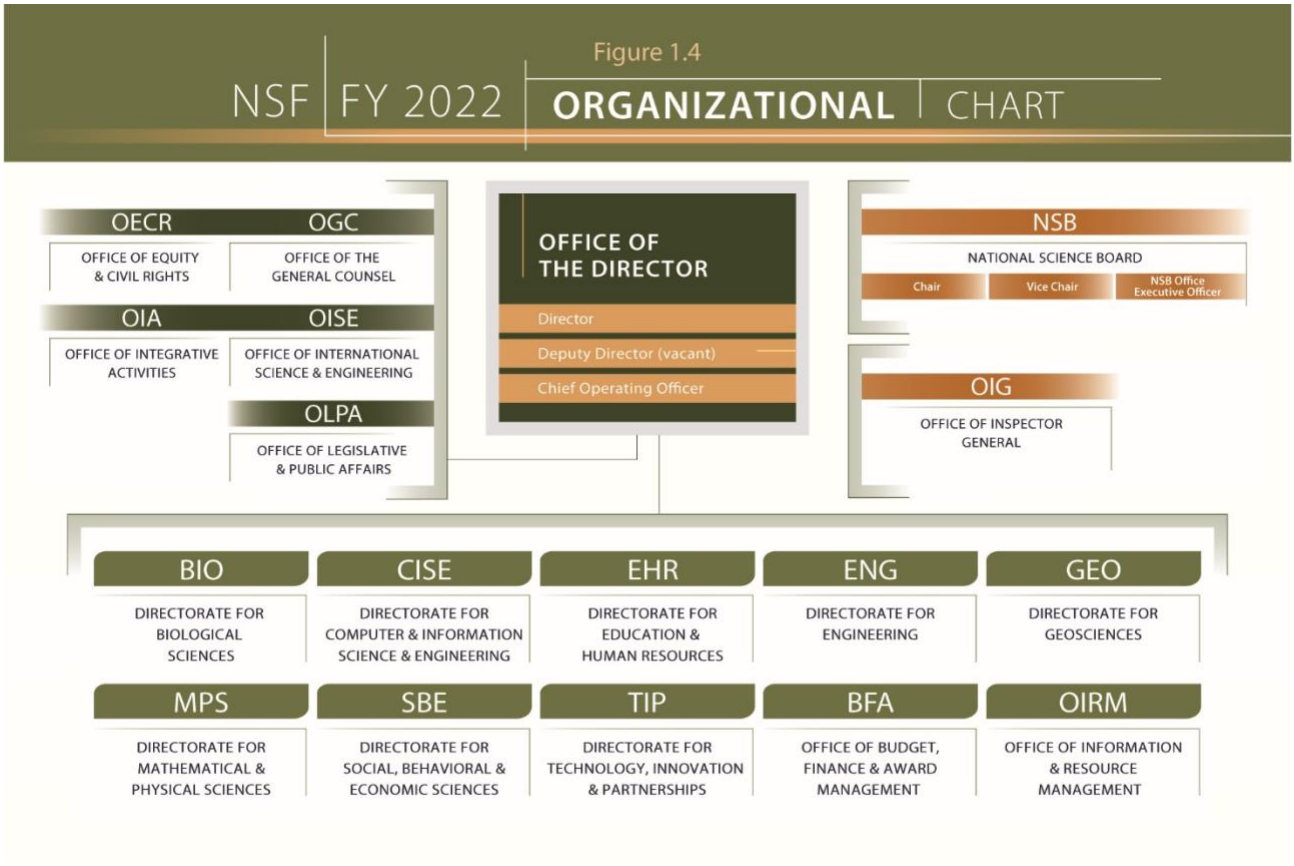
	ARP Act	All COVID-19
Number of Awards	874	6,134
FY 2022 Obligations ($ in Millions)		
Total	$361	$1,385
R&RA	*277*	*1,091*
EHR	*37*	*217*
MREFC	*47*	*47*
Other funding	*-*	*30*

Total may not add due to rounding.

[9] *American Rescue Plan Act*: https://www.congress.gov/bill/117th-congress/house-bill/1319/text
[10] Additional information on COVID-19 activities by appropriation is on page Financials-33 of this AFR.
[11] NSF Coronavirus Information page: https://www.nsf.gov/news/special_reports/coronavirus/
ARP & COVID-19 Response Updates: https://www.nsf.gov/about/congress/covidfundupdates.jsp

Organizational Structure

NSF is an independent federal agency headed by a director who is appointed by the President and confirmed by the U.S. Senate.[12] As shown in Figure 1.4, NSF's organizational structure aligns with the major fields of science and engineering.[13] In FY 2022, NSF established TIP, NSF's first new directorate in more than 30 years.



The NSF Director and the 24-member NSB jointly pursue the goals and functions of NSF, including the duty to "recommend and encourage the pursuit of national policies for the promotion of research and education in science and engineering."[14] The NSB identifies issues critical to NSF's future and helps chart the strategic direction of NSF's budget and programs. NSB members are appointed by the President and are prominent contributors to the STEM research and education community.[15] NSF's Director is a member *ex officio* of the Board. The Director and the other NSB members serve 6-year terms.

In FY 2022, NSF's workforce was comprised of approximately 1,500 federal employees and 200 scientists on temporary appointments under the Intergovernmental Personnel Act (IPA) program.[16] NSF regularly recruits scientists, engineers, and educators through the IPA program who work at NSF for up to 4 years.

[12] The Director's biography: https://www.nsf.gov/staff/staff_bio.jsp?lan=spanchan&from_org=
[13] NSF's organization chart: https://www.nsf.gov/staff/organizational_chart.pdf
[14] 42 U.S. Code 1862(d): https://www.law.cornell.edu/uscode/text/42/1862
[15] NSB members during FY 2022 are shown in Appendix 10 of this AFR
[16] The 1,516 Full-time equivalents (FTEs) in FY 2022 included the federal employee workforce for NSF, the NSB, the OIG, and U.S. Arctic Research Commission

They bring fresh perspectives from across the country and across all fields of science supported by NSF, helping explore new directions for research in science, engineering, and education, including emerging interdisciplinary fields. On returning to their home institutions from across academia, they bring knowledge of NSF programming and leading research from a national perspective.

In addition to the Foundation's headquarters in Alexandria, Virginia, NSF maintains an office in Christchurch, New Zealand, to support the United States Antarctic Program.

NSF partners with leading foundations to improve U.S. STEM education

At the core of NSF's approach to accelerating discovery, innovation, and STEM education is a commitment to building strong partnerships across an array of agencies, industries, and organizations. That is why NSF, together with the Bill & Melinda Gates Foundation, Schmidt Futures, and Walton Family Foundation, have developed a new partnership to fund unique initiatives that will improve the quality of U.S. STEM education for all students, particularly those whose talents, intelligence, and entrepreneurship have been underutilized in the nation's STEM enterprise. This historic collaboration brings together some of the largest public and private funders committed to STEM education and is one of the first of its kind involving these organizations. NSF is proud to match the money from the foundations for each funded activity and help researchers answer some of the most pressing challenges in U.S.

Credit: NSF

Management Challenges

In October 2021, the OIG identified eight areas representing challenges for NSF in FY 2022: (1) Increasing Diversity in Science & Engineering Education and Employment, (2) Overseeing the United States Antarctic Program (USAP), (3) Overseeing Grants in a Changing Environment, (4) Managing the Intergovernmental Personnel Act Program, (5) Overseeing Major Multi-User Research Facilities, (6) Mitigating Threats Posed by Foreign Government Talent Recruitment Programs, (7) Mitigating Threats Posed by the Risk of Cyberattacks, and (8) Managing Transformational Change.[17]

Management's report on the significant activities undertaken in FY 2022 to address these challenges is included in *Appendix 2B: Management Challenges – NSF's Response* of this Agency Financial Report (AFR). The report also discusses activities planned for FY 2023 and beyond. The following are highlights of the agency's significant actions and planned next steps to address the FY 2022 OIG Management Challenges.

Increasing Diversity in Science & Engineering Education and Employment

Since its founding, NSF has recognized the importance of diversity, equity, and inclusion in science and engineering education and employment. Today, these efforts warrant unprecedented urgency given the national and economic concerns, and the global science and engineering trends outlined in the NSB's *Vision 2030* report,[18] which notes "women and underrepresented minorities remain inadequately represented in science and engineering relative to their proportions in the U.S. population." NSF also recognizes the grand scale of these issues and the pressing need to recognize and embrace the full scope of challenges they bring.

[17] Inspector General's Management Challenges for NSF in Fiscal Year 2022 can be accessed at: https://oig.nsf.gov/reports/top-management-challenges/management-challenges-national-science-foundation-fiscal-year-2

[18] The *Vision 2030* report is available at: https://www.nsf.gov/nsb/publications/2020/nsb202015.pdf

Efforts to address these challenges span across every NSF directorate and office. Most notably in FY 2022, NSF published a new strategic plan that explicitly incorporated its commitment to ensuring accessibility and inclusivity into the agency's vision statement.[19] Selected specific actions taken in FY 2022 to increase diversity in science and engineering education and employment include the release of the development of action plans in response to diversity, equity, inclusion, and accessibility (DEIA)-related Executive Orders; the enhancement of the merit review process with exploratory pilots to strengthen the broader impacts criterion; the support of funding for resource centers and hubs to strengthen Hispanic-serving Institutions; and the implementation of listening sessions with focus groups spanning 259 individuals across 143 MSIs, two-year colleges, and primarily undergraduate universities to "design into" programming for the TIP Directorate considerations of DEIA.

Going forward, NSF will leverage its broad portfolio and sphere of influence, and act deliberately when developing and deploying all available strategies and programs. Specifically, the agency will implement, strategically monitor, and oversee an Agency Priority Goal related to improving representation in the scientific enterprise; initiate the new Growing Research Access for Nationally Transformative Equity and Diversity (GRANTED) initiative to improve the Nation's research support and service capacity at emerging and developing research institutions that are often underserved and under-resourced compared to those more established research universities; and continue the DEIA work of the agency as well as support the NSB and Committee on Equal Opportunities in Science and Engineering.

Map of Civic Innovation Challenge awards supporting community-based solutions across the U.S. *Credit: NSF*

For a larger image: *https://beta.nsf.gov/news/civic-innovation-challenge-awards-support-community-based-solutions-mobility-and-disaster*

Community-based solutions to mobility and disaster resilience

Mitigating the effects of disasters or bridging the gap between essential resources and services and nearby populations is the driving force behind the Civic Innovation Challenge. Led by NSF in partnership with the Department of Energy and Department of Homeland Security, researchers worked with civic partners to identify and address community challenges with research-based pilot projects. The two focus areas were resilience to natural disasters, and mobility and access to jobs and services. In the first stage, teams of local, state and tribal officials as well as nonprofit and community leaders, refined the projects. In Stage 2, 11 disaster resiliency teams and six mobility teams received awards of up to $1 million to develop ready-to-implement pilot projects in a 12-month time frame. The solutions were also designed to become templates to address community-level issues across the U.S.

Overseeing the United States Antarctic Program (USAP)

NSF – through the Office of Polar Programs in the Directorate for Geosciences – funds and manages USAP which supports the United States' research and national policy goals in the Antarctic. The global pandemic associated with COVID-19 resulted in significant changes to program and construction project plans as deployed construction crews were brought home due to health and safety concerns and science deployers were significantly reduced. USAP's recovery from the drastic curtailment of activity during the pandemic is now underway along three lines of thrust – executing a temporary surge in logistics support

[19] NSF's FY 2022-2026 Strategic Plan is available at: https://www.nsf.gov/about/performance/strategic_plan.jsp

to clear the backlog of delayed science and construction work, resuming major construction projects under newly established cost and schedule baselines, and pivoting the recapitalization approach to an enduring program rather than a single major effort. To provide effective government oversight of these activities, the Antarctic Infrastructure and Logistics Section in the Office of Polar Programs continues to mature financial management, performance monitoring, and planning processes.

In addition, information security improvements continue to be implemented, using a risk-based prioritization approach that ensures effective cybersecurity in the unique environment of the USAP network. Enforcement of Personal Identity Verification, or PIV, credentialing for network access has been put into place, enhanced logging capabilities have been implemented to prepare for a future managed security service provider to automatically detect malicious network events, and the transition to screening of all permanent USAP contractor personnel through standard NSF processes is underway.

Going forward, NSF will continue monitoring and oversight of the Antarctic Infrastructure Modernization for Science project in accordance with established internal management and project execution plans, including through the Office of the Director's Watch List. Cybersecurity improvements will continue to be implemented, using a risk-based prioritization approach that ensures effective cybersecurity in the unique environment of the USAP network.

Promising anti-melanoma properties discovered in a sea squirt

Researchers identified a compound produced by bacteria living on the sea floor near Antarctica that could be used to create a naturally derived treatment for melanoma. A team of NSF grantees from the Desert Research Institute at Los Alamos National Laboratory and the University of South Florida, traced the compound, palmerolide A, to a microbe that shares a symbiotic relationship with a species of ascidian, or sea squirt, common to the waters of Antarctica's Anvers Island archipelago. To survive, ascidians and other invertebrates developed relationships with microbes that play a role in photoprotective pigments, bioluminescence, and chemical defenses. The compounds produced by these microbes may also have other applications in science, health, and industry.

Synoicum adareanum pictured with a starfish in 80 feet of water near Bonaparte Point, Antarctica. *Credit: Bill J. Baker/Department of Chemistry, USF*

Overseeing Grants in a Changing Environment

NSF's well-established advanced monitoring and Enterprise Risk Management (ERM) programs provide a strong foundation for effective oversight over the agency's grant portfolio. ERM provides a framework for NSF to objectively evaluate the need for new or enhanced controls by monitoring potential changes in portfolio composition, or other emerging risks in the research community, such as fiscal constraints and student enrollment challenges. NSF continually assesses the risk and control environment related to grants award, oversight and monitoring, and closeout processes to confirm controls are operating effectively against the evolving risk environment.

In addition, NSF has a robust payment integrity program, which was effective in assessing potential changes to improper payment risk from the COVID-19 pandemic. In the OIG's FY 2022 Performance Audit of NSF's Compliance with the *Payment Integrity Information Act*, the independent auditor determined that NSF's risk assessment conclusion that the overall low improper payment risk level for its grant and cooperative agreement programs was reasonable. The auditor also determined that NSF adequately concluded the programs have low risk of making improper payments above the statutory

threshold, with no findings and recommendations. NSF has also made significant enhancements to improve compliance on the timely submission of grant project reports across the agency. These enhancements will solidify NSF's controls around result-oriented accountability, enabling the agency to better scale its processes to integrate additional small and mid-size institutions under future, more substantial budget increases and increased emphasis on awards to groups underrepresented in STEM. Finally, NSF has recently implemented a suite of awardee self-assessment tools and fact sheets on subrecipient monitoring and participant support costs along with additional fact sheets on various topics. These tools allow awardee organizations to independently self-assess compliance in the areas of participant support and sub-recipient risk assessment and monitoring.

Going forward, NSF will continue to monitor changes to the composition of its awardee portfolio through its normal award monitoring and oversight processes. Utilizing these existing processes to monitor portfolio composition will verify whether risks noted in the management challenge have been realized. NSF's ability to successfully navigate the challenges of the pandemic demonstrates the adaptability of these processes to respond to emerging risks.

Managing the Intergovernmental Personnel Act (IPA) Program

NSF provides the opportunity for scientists, engineers, and educators to rotate into the agency on a temporary basis, bringing fresh perspectives from across all fields of science and engineering supported by the agency. NSF takes a proactive approach to the management of the IPA program to appropriately consider and mitigate inherent risks associated with its execution, including through an IPA Steering Committee that advises the senior leadership on matters that directly concern policy on the use of the IPA Program. In addition to establishing the IPA Steering Committee, significant accomplishments in recent years have included resolving and closing recommendations from the OIG report, *NSF Controls to Mitigate IPA Conflicts of Interest*,[20] and implementing a cost sharing policy requiring that institutions provide a minimum of 10 percent cost share for every full-time IPA agreement.

NSF has identified the need to better vet incoming IPA rotators via the recent OIG audit on the agency's internal processes. To address concerns and risks identified, NSF has established an IPA Vetting Working Group comprised of the agency's leaders and subject matter experts. The purpose of the IPA Vetting Working Group is to make recommendations to the Chief Operating Officer regarding the agency's approach to vetting candidates for IPA positions at NSF.

Going forward, the IPA Vetting Working Group will partner with NSF stakeholders to address issues such as (1) potential threats to national or economic security by IPA candidates with foreign affiliations or sources of funding; (2) potential risks due to other conflicts of interest and commitments; (3) confirmation of eligibility, salary, and employment history; (4) timeliness of vetting relative to employment offers and start of assignment; and (5) responsibility and overall timeline for various aspects of vetting and assessment.

Overseeing Major Multi-User Research Facilities

NSF understands the importance of its role in overseeing current award recipients' on-going management of major facilities, and of assessing prospective recipients' capabilities for managing major facilities prior to award. Since a National Academy of Public Administration report on NSF's use of cooperative agreements for major facilities was published in December 2015, NSF has greatly strengthened its oversight policies and procedures in response to that report, prior OIG audits, and

[20] The OIG report on IPA conflicts of interest is available at https://www.oversight.gov/sites/default/files/oig-reports/17-2-008_COI.pdf

General Accountability Office (GAO) reviews. Since 2017, GAO has conducted five reviews related to oversight of projects funded from the MREFC account. The reports published in 2018 and 2019 contained recommendations related to cost and schedule estimates and award recipient project management capabilities. The most recent GAO reviews (2020 through 2022) had no new recommendations, illustrating NSF's robust oversight framework for projects funded from the MREFC account.

NSF leadership continues to show its commitment to major facilities oversight through appointment of the Chief Officer for Research Facilities and through the annual Major Facilities Portfolio Risk Assessment process. Further, NSF has taken significant actions in recent years to mitigate the risks inherent in the major facilities portfolio, including the unprecedented degree of complexity and uncertainty resulting from the COVID-19 pandemic. In FY 2022, NSF finalized standard operating guidance related to the major facilities oversight reviews, and revised definitions and policies related to divestment of major facilities in response to pending recommendations from an OIG audit.

Going forward, NSF will complete implementation of the *Program Management Improvement Accountability Act* requirements, including roll-out of a new Course Curriculum Tool to support NSF staff's proficiency development based on self-assessments, and will continue to evaluate title to property (federally owned versus recipient-titled) and develop property transition plans, as necessary.

A multiplexed biomarker sensor that is quantified and read through a mobile phone for patient testing in clinical settings and even at home.
Credit:Ozcan Lab at UCLA

Low-cost, paper-based sensor conducts multiple tests simultaneously

In medicine, diagnosing disease rapidly and reliably is a crucial first step in providing effective care. However, many communities lack the centralized infrastructure and trained personnel to perform these critical and costly tests. This disparity is driving researchers at the NSF-funded Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP) Engineering Research Center (ERC) to develop easy-to-read diagnostic tests constructed from paper. The new sensors developed by the PATHS-UP ERC employ a specially designed 'sensing membrane' that can detect dozens of diseases simultaneously while using only $0.30 worth of paper materials. And with simple operating steps, these tests can be performed in under 20 minutes with minimal training, helping bring critical healthcare access to underserved communities worldwide.

Mitigating Threats Posed by Foreign Government Talent Recruitment Programs

NSF seeks to preserve the integrity of international scientific collaborations and maintain a vibrant science and engineering community for the benefit of the nation. Participation in this community relies on individuals to uphold core principles and values such as openness, transparency, reciprocity, collaboration, and integrity. However, open scientific exchange and research face a challenge from some foreign governments through the use of talent recruitment programs. Some of these programs deliberately disregard these core principles and incentivize participants to misappropriate U.S.-funded scientific research prior to its open publication. These programs target scientists, engineers, and educators of all nationalities working or educated in the U.S.

To mitigate threats posed by these programs, NSF took multiple actions in FY 2022 to continue progress on this issue. The agency (1) published a joint-agency solicitation to develop online training modules designed to promote the understanding of research security threats for research personnel whose work

is supported by the federal government; (2) continued to serve as a co-chair on the National Science and Technology Council Subcommittee on Research Security to further formulating and coordinating guidance for the research community on standardized disclosure formats, digital persistent identifiers, and research security program standards; (3) published a notice on a new system of records that will aggregate, link, and analyze information published and reported by individuals and organizations participating in NSF-supported activities; (4) convened a working group to develop recommendations regarding strategy and implementation of a prohibition of involvement in foreign government talent recruitment programs for those supported by or working for NSF; and (5) convened working groups, which reported several recommendations to establish more consistent and thorough approaches to managing security clearances and vetting IPA candidates agency-wide.

Going forward, NSF will continue to work diligently to address risks of foreign government interference in NSF-funded research. This work will include taking steps to (1) implement existing guidance and new legislation (e.g., National Security Presidential Memorandum-33 Implementation Guidance, the *CHIPS and Science Act*, etc.);[21] (2) continue coordination with the White House, other federal science funding agencies, and intelligence and law enforcement communities; and (3) begin concept development and adoption of new initiatives to address risks to research security (e.g., via the development of a Research Security Risk Assessment Center, an initial implementation of JASON's study on "Research on Research Security").

Mitigating Threats Posed by the Risk of Cyberattacks

NSF's Information Technology (IT) Security Program is committed to ensuring that NSF infrastructure and assets are appropriately protected while maintaining effective interfaces with the community to support an open and collaborative environment for scientific research and discovery. NSF recognizes the importance of moving to a modern data-centric model of cybersecurity as government networks evolve and adopt more resilient architectures. The concept of Zero Trust Architecture (ZTA) provides the framework for implementing controls and providing scalability as NSF extends mission critical applications into diverse cloud environments. NSF's ZTA plan describes the approach to address the five pillars of the Zero Trust Maturity Model. NSF is employing a multipronged approach to the implementation of the ZTA model; this is a long-term effort that will require coordinated efforts across many pillars of cybersecurity.

NSF continues to implement actions in support of ZTA principles. For example, NSF is leveraging the Department of Homeland Security's (DHS) Continuous Diagnostics and Monitoring program to expand asset inventory and information sharing; is maturing endpoint detection and response capabilities through upgraded detection-on-demand capabilities; maintains a Vulnerability Disclosure Policy and rapidly responds to researcher reports; and implements techniques where components are replaced rather than changed in the cloud environment. As NSF continues to move agency systems and services to the cloud, the agency will use the principles of ZTA in cloud planning and deployment efforts and all agency modernization strategies.

Going forward, NSF's near-term zero trust efforts are focused on establishing new capabilities to reduce risk and protect sensitive agency data from compromise. NSF intends to deploy an architectural approach that will converge networking and security services into a cloud service. Planned improvements such as network environment isolation, automation for component build, and secure

[21] Guidance for Implementing National Security Presidential Memorandum 33 (NSPM-33) on National Security Strategy for United States Government-Supported Research and Development is available at https://www.whitehouse.gov/wp-content/uploads/2022/01/010422-NSPM-33-Implementation-Guidance.pdf

application deployment are in progress. Password management technologies are being evaluated for enterprise-facing and public-facing systems. NSF will continue to refine its long-term ZTA migration plan in alignment with DHS's zero trust maturity model and as federal guidance clarifies requirements around emerging zero trust requirements.

Managing Transformational Change

Fiscal year 2022 was one of notable change for NSF. In Spring 2022, the agency announced the establishment of TIP, received its largest increase in annual appropriations in over a decade, and began transitioning staff back to working in the NSF headquarters building after two years of operating under a maximum telework posture. NSF has established processes to identify, anticipate, and manage the risk to accomplishment of these organizational changes, including a strong history of financial controls, robust pre- and post-award monitoring, and an ERM process that leverages tools such as data analytics to identify risk areas. In addition to expanding and improving processes, NSF recognizes it must develop new capacity and centralize certain functions to ensure smooth transitions across growth and change.

In FY 2022, NSF initiated work to establish an enterprise-wide knowledge management framework to position the agency to be more strategic and agile in delivering the mission. Establishment of the TIP directorate required development of novel approaches to funding innovative science in addition to integrating TIP's operations into existing processes. NSF will use the experience of establishing TIP to update, confirm, and validate the process for realignments and reorganizations. Finally, NSF also prepared for the transition to a hybrid workforce by initiating a robust change management strategy that engaged all levels of the workforce, and established new telework and remote work policies, which will take effect in early FY 2023.

NSF will continue to monitor and develop technologies to improve the agency's hybrid work capabilities.

NSF-supported scientists are honing long-range forecasts of U.S. tornadoes and hail. *Credit: Victor Gensini, Northern Illinois University*

Magnetic reconnection breakthrough could help predict space weather

NSF-supported scientists are improving extended-range weather forecasting in the U.S. by studying atmospheric phenomena halfway around the globe. The researchers found 100 instances of significant weather fluctuations from 1979 through 2019 in the Madden-Julian Oscillation – a major disturbance of wind, rain, and pressure that circles the globe every 30 to 60 days. As these disturbances moved over the Maritime Continent, which includes Indonesia and the Philippines, they found 53 of these storms gained strength, creating ripples in the atmosphere, and eventually changing circulation patterns over North America. The researchers identified three categories of storms, and all have heightened the potential to increase U.S. tornado and hail events. This information can be used to create extended-range forecasts and provide more time to raise awareness of severe weather.

Climate-related Financial Risk

As noted in NSF's Sustainability Report and Implementation Plan to the Council for Environmental Quality, in FY 2022 NSF proactively put in place measures to begin evaluating major facilities' resilience to natural hazards created by climate change (fires, flooding, extreme wind, etc.) on a regular cadence as part of major facility external reviews. Although reviews are typically conducted annually, reviewing facility condition will now take place once every 5 years. The assessments will generally be conducted by

the award recipient, and the resulting report will be provided to NSF. External panel recommendations will help inform agency decisions around future investments in the supporting infrastructure to reduce risk to the agency and the scientific community. NSF-owned assets in the Arctic and Antarctic are constructed to withstand the harshest environments on Earth, and their conditions are routinely assessed as part of ongoing operations due to the inherent risks. Over time, NSF will consolidate recapitalization needs for the full suite of research infrastructure into a unified plan.

Performance

In March 2022, NSF released its Strategic Plan for FYs 2022–2026: *Leading the World in Discovery and Innovation, STEM Talent Development, and the Delivery of Benefits from Research*.[22] The four strategic goals in this plan are built upon four themes—Empower, Discover, Impact, and Excel—that form the core of the plan. These themes focus on expanding frontiers, engaging people, and delivering solutions. Under each goal are two strategic objectives, which together encompass all areas of agency activity. This goal structure enables NSF to link its investments to longer-term outcomes.

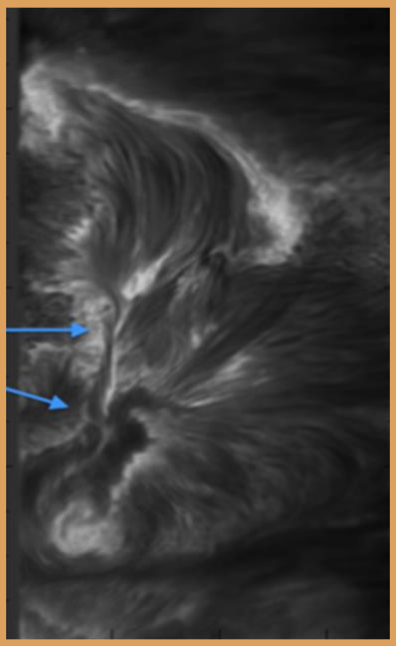
Strategic Goals and Objectives

Strategic Goals	Strategic Objectives
1. Empower: Empower STEM talent to fully participate in science and engineering	**1.1 Ensure accessibility and inclusivity –** Increase the involvement of communities underrepresented in STEM and enhance capacity throughout the nation.
	1.2 Unleash STEM talent for America – Grow a diverse STEM workforce to advance the progress of science and technology.
2. Discover: Create new knowledge about our universe, our world, and ourselves	**2.1 Advance the frontiers of research –** Accelerate discovery through strategic investments in ideas, people, and infrastructure.
	2.2 Enhance research capacity – Advance the state of the art in research practice.
3. Impact: Benefit society by translating knowledge into solutions	**3.1 Deliver benefits from research –** Advance research and accelerate innovation that addresses societal challenges.
	3.2 Lead globally – Cultivate a global science and engineering community based on shared values and strategic cooperation.
4. Excel: Excel at NSF operations and management	**4.1 Strengthen at speed and scale –** Pursue innovative strategies to strengthen and expand the agency's capacity and capabilities.
	4.2 Invest in people – Attract, empower, and retain a talented and diverse NSF workforce.

In support of Strategic Objective 1.1, Increase the involvement of communities underrepresented in STEM and enhance capacity throughout the nation, NSF established an Agency Priority Goal for FY 2022-2023 to "Improve representation in the scientific enterprise." The goal focuses on making changes to NSF practices, processes, and policies that will lead to an increase in proposal submissions from members of groups underrepresented in STEM and underserved institutions. NSF is implementing its approach to this goal through workgroups focused on needed changes in policy, data collection and analysis, engagement with external stakeholders, and internal engagement with NSF staff. Through these efforts, NSF hopes to increase the number and percentage of proposals from groups underrepresented in STEM and underserved institutions by 10 percent.[23]

[22] NSF's Strategic Plan is available at https://www.nsf.gov/about/performance/strategic_plan.jsp

[23] More information on NSF's Agency Priority Goal to "Improve representation in the scientific enterprise," as well as quarterly updates are available at https://www.performance.gov/agencies/NSF/apg/goal-1/



The arrows point to a twisted filament, or magnetic flux rope, before magnetic reconnection occurs. *Credit: K. Reardon, NSF's National Solar Observatory and L. Kleint, University of Bern*

Magnetic reconnection breakthrough could help predict space weather

Space storms can wreak havoc on satellites and power grids, and magnetic reconnection plays a major role in the plasma eruptions on the sun's surface that spark space storms. NSF grantees at West Virginia University learned new information about magnetic reconnection and the physics of space-like plasmas by experimenting with lab-developed plasma. The research, part of the PHAse Space Mapping, or PHASMA, experiment, probed the plasma and light scattered from individual electrons in the plasma to assess how fast the particles were moving. PHASMA can accurately measure the motion and velocity of the ions and electrons on a very small scale, allowing the team to measure the actual speeds of individual electrons. The research will impact how space weather and solar storms are predicted and improve understanding of the universe's mechanics and dynamics.

Progress Toward Achievement of Performance Goals

Each year, NSF issues three reports to provide financial management and program performance information to demonstrate accountability to our stakeholders, including the American public. In addition to the AFR, NSF produces a Performance and Financial Highlights summary report, and the Annual Performance Report.[24] NSF's FY 2022 Annual Performance Report will appear in the *FY 2024 Budget Request to Congress* along with the Annual Performance Plan for FY 2024. This report will provide a complete discussion of NSF's performance measures, including descriptions of the metrics, methodologies, results, and trends. The topic areas of these goals and their FY 2022 targets are listed in the following table. Annual results will be provided in the FY 2022 Annual Performance Report along with information about NSF's verification and validation review of performance data, as required by the *Government Performance and Results Modernization Act of 2010*.

[24] All three reports are made available on NSF's website as they are completed at: https://www.nsf.gov/about/performance/annual.jsp

FY 2022 Performance Goals

Strategic Objective	Annual Goal Statements	FY 2022 Target
Empower 1.1	Two-year Agency Priority Goal: Improve representation in the scientific enterprise.	2023 target: Increase the number and proportion of proposals received from underrepresented and underserved 1) investigators and 2) institutions.
Discover 2.1	Major Facility Infrastructure Investments: Ensure program integrity and responsible stewardship of major research facilities and infrastructure.	100% of facilities with negative cost and schedule variance at or below 10%.
Discover 2.2	Mid-Scale Infrastructure Investments: Ensure program integrity and responsible stewardship of mid-scale research infrastructure.	Track cost and schedule for all defined projects.
Impact 3.1	Grow Partnerships: Increase opportunities for public and private partnerships that will address major scientific and technological goals while ensuring broad societal benefits.	Establish baseline (new goal in 2022).
Excel 4.1	Robust and reliable IT services: Ensure availability of IT resources for NSF staff and the broader research community.	IT systems are available 99.6% of the time.
Excel 4.2	Human Capital Operating Plan (HCOP): Track progress against NSF's HCOP.	Submit draft FY 2022-2025 HCOP to OPM.
	Culture of Inclusion: Foster a culture of inclusion through change management efforts resulting in change leadership and accountability.	Increase agency-wide engagement in Special Emphasis Program observances and Diversity and Inclusion-related activities by 10% from 2021.
Cross-cutting	Make Timely Proposal Decisions: Inform applicants whether their proposals have been declined or recommended for funding within 182 days, or six months, of deadline, target, or receipt date, whichever is later.	75% of proposals have a funding decision communicated to the principal investigator for the proposal within 6 months of receipt.
	Key Program Investments are on Track: American Rescue Plan Ensure key FY 2022 NSF-wide program investments are implemented and on track.	NSF will obligate 100% of designated targets for American Rescue Plan funding.

Renewing NSF

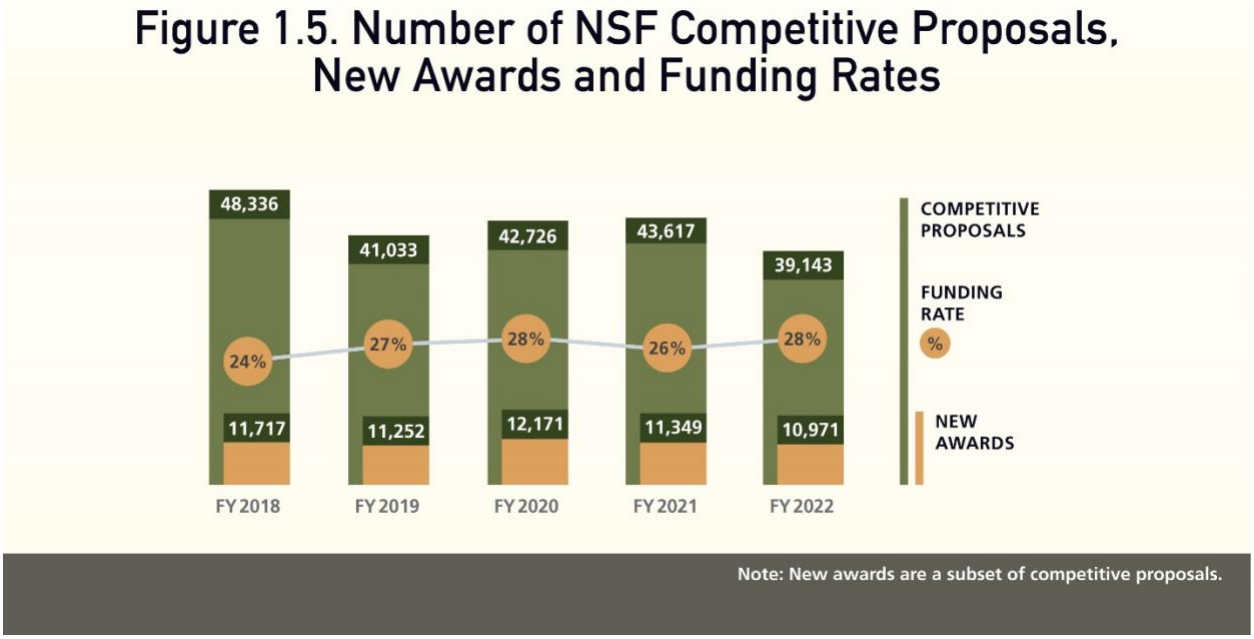
The NSF 2022-2026 Strategic Plan emphasized the agency's continued efforts to excel at operations and management to enhance performance of NSF's mission and thereby maintain U.S. leadership in research and education across all areas of STEM. In FY 2022, the enterprise-scale reform and process improvement efforts, collectively called "Renewing NSF," continued to implement innovative strategies

to strengthen and expand operational capacity and capabilities. Primary outcomes in FY 2022 included: the formation of a new internal group to champion reform projects and explore and prioritize updated priorities; rapid development, piloting, and deployment of the Program Suitability and Proposal Concept Tool to support streamlined intake and handling of project concept outlines; ongoing support of partnerships resources including the eventual transition of these to the TIP Directorate; and, a successful multi-program pilot of a streamlined post-merit review workflow. At the same time, given the success and visibility of Renewing NSF, the agency also transitioned the leadership of this activity into the Office of the Director, formally establishing a program manager position and ensuring a long-term capability to foster continuous organizational adaptation. The focus areas of Renewing NSF remain: (1) making information technology work even better for all; (2) adapting the workforce and the work; (3) streamlining, standardizing, and simplifying processes and practices; and (4) expanding and deepening public and private partnerships.

Proposal Workload and Management Trends

NSF continuously monitors key portfolio, proposal workload, and financial measures to understand short- and long-term trends and to help inform management decisions. For an analysis of the long-term trends in competitive proposals, awards, funding rate, and other portfolio metrics, see the *National Science Foundation's Merit Review Process, Fiscal Year 2020 Digest*.[25]

Figure 1.5 identifies three key portfolio measures: competitive proposals acted upon, new awards, and funding rates.



[25] *NSF's Merit Review Process, FY 2020 Digest (NSB-2021-45)*: https://www.nsf.gov/nsb/publications/2021/merit_review/FY-2020/nsb202145.pdf

Table 1.2 provides proposal workload and management trends over 5 years. Highlights of these indicators are as follows:

- Between FY 2021 and FY 2022, the number of competitive proposal actions decreased by 10 percent; from 43,617 to 39,143.
- There were 10,971 new awards in FY 2022, a decrease of 3 percent from FY 2021.
- The overall funding rate in FY 2022 was 28 percent, an increase of 2 percentage points. Funding rates differ by directorate and are presented in the agency's annual budget request to Congress.
- The average annual award size of competitive awards was $220,680, approximately $11,000 lower than in FY 2021.
- The number of employees (full-time equivalent [FTEs]) increased between FY 2021 and FY 2022, 1,456 FTE and 1,516 FTE, respectively.
- The number of active awards increased almost 4 percent in FY 2022, from 56,427 in FY 2021 to 58,384 in FY 2022. The 5-year average number of active awards is almost 56,000.

Table 1.2 Proposal Workload and Management Trends

Measure		FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	Percent Change (FY 2022-FY 2021)	Average (FY 2018-FY 2022)
Portfolio	Competitive proposal actions	48,336	41,033	42,726	43,617	39,143	–10.3%	42,971
	Competitive award actions	11,717	11,252	12,171	11,349	10,971	–3.3%	11,492
	Average annual award size (competitive awards)	$189,418	$197,530	$213,280	$231,202	$220,680	–4.6%	$210,422
	Funding rate	24%	27%	28%	26%	28%	+2 percentage points	27%
Proposal Workload	Number of employees FTE, usage[1]	1,417	1,415	1,421	1,456	1,516	4.1%	1,445
	Number of active awards[2]	54,386	54,093	55,239	56,427	58,384	3.5%	55,706
	Proposal reviews conducted	223,781	192,033	199,526	211,903	187,318	–11.6%	202,912
Financial	Number of grant payments	21,727	20,935	22,169	23,794	27,065	13.7%	23,138
	Award expenses incurred but not reported at 9/30 ($ in millions)[3]	$393	$425	$390	$461	$462	<1%	$426

Notes:

[1] FTEs shown include the federal employee workforce for NSF, NSB, OIG, and U.S. Arctic Research Commission.

[2] Active awards include all active awards regardless of whether funds were received during the fiscal year.
[3] FY 2022 number reflects an accrual, and all other years reflect the validated estimate for the fiscal year. This metric does not include accruals for SBIR awards.

- All NSF awardee institutions are required to submit payment requests at the award level to the NSF Award Cash Management Service (ACM$). Award expenses are posted to the NSF financial system at the time of the payment request. Reliance on ACM$ reduces the burden of manual invoicing and potential for errors or missed payments.
- Since its introduction in FY 2013, ACM$ has significantly improved the timeliness of grant financial data. The amount of incurred but not yet reported award expenses have averaged $426 million for the last 5 years.

Fire refugia—islands of living trees that remain following forest fires—help forests regenerate. This photo of a forest hit by the 2012 Shadow Lake Fire in Oregon shows a fire refugium (patch of tall trees) and post-fire regeneration (small tree seedlings) in the burn area. *Credit: Sebastian Busby*

'Green islands' help forest regenerate after fire

NSF grantees from Portland State University are helping forest managers determine when they should intervene to help forests recover from fires and when the landscapes should be left to recover naturally. High-elevation forests in the Pacific Northwest are burning more frequently than in the past due to climate change. These forests primarily regenerate from the dispersal of seeds from refugia - areas of live trees that survived fires. If there are only a few live trees, it may be hard for the forest to regenerate naturally, but too much human-aided replanting can be expensive and may result in overstocked forests with high tree density, reduced habitat quality and even greater risk of fires in the future.

Financial Discussion and Analysis

The Foundation recognizes the importance of maintaining sound financial stewardship while improving its systems to ensure proper accountability and alignment with the agency's vision, mission, and strategic goals. For example, in FY 2022, NSF staff across the agency analyzed the new CHIPS and Science Act to understand the full impact of the Act on NSF's funding and operations and develop comprehensive planning scenarios. In addition, the agency put in place the appropriate administrative and financial controls to ensure accountability for the newest NSF directorate, TIP. Following are several important FY 2022 financial management activities that highlight NSF's commitment to fiscal stewardship:

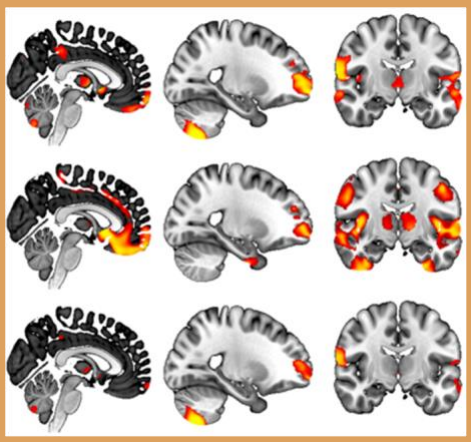
- *Government-wide Initiative on Unique Entity Identification (UEI):* In February, ahead of the Office of Management and Budget (OMB) April deadline, NSF released changes to all production grant management systems to support the UEI. The newly created UEI is assigned and maintained by the System for Award Management (SAM). This transition streamlined the entity identification and validation process, making it easier and less burdensome for entities to do business with the federal government. To comply with the governmentwide mandate, NSF successfully implemented its planned enhancements to the financial system and certain NSF business applications. In addition, NSF reviewed institution data to validate the accuracy of the transition to the new UEI, as well as ensure the consistent usage of SAM data across its externally facing systems.
- *Reporting Innovations:* NSF developed policy and reporting tools to promote proper stewardship of all NSF financial resources.
  - The NSF Open Obligation Monitoring Policy was issued in May to standardize the review of open obligations across the agency and support accurate annual financial reporting and compliance with laws and regulations. It also leverages existing practices and procedures while allowing for future innovation.
  - The agency enhanced its Enterprise Reporting application with self-service reports that facilitate the review and analysis of obligations. The data for these reports is near real-time and users can customize the output to display necessary and relevant data for their analysis.
  - The FOOD (Financial Open Obligation Detective) for Thought is an enhanced analytical tool to help identify invalid open obligations. FOOD represents an advancement from prior approaches to open obligation identification in that it can isolate specific awards with parameters derived from statistical analysis.
  - Using business and visual analytic tools, NSF partnered with agency stakeholders to develop easy to understand dashboards, graphical displays, and ad hoc reporting that facilitate analysis and decision-making.
  - NSF upgraded iTRAK and Research.gov to automate the receipt and processing of banking information for individuals, fellows, and IPAs. This enhancement (1) streamlined and automated a paper-driven process, thereby reducing the administrative burden on agency staff and (2) provides a more-secure payment processing system.
- *G-Invoicing:* NSF implemented G-Invoicing for General Terms and Conditions in FY 2022 and will begin using G-Invoicing for Orders in early FY 2023. Treasury's new G-Invoicing system will serve as the front-end application for users to originate and manage interagency agreements (IAAs) and will store transactional data generated over the full lifecycle of the agreements. NSF will use G-Invoicing and iTRAK to record and interface IAA data between the two applications to address

challenges with accounting, reporting, and monitoring IAAs by providing a common platform between federal partners.

- *Enterprise Risk Management (ERM):* ERM supports NSF's mission by promoting and facilitating a risk-aware culture across NSF and enabling risk-informed decision-making and resource prioritization. The release of NSF's 2022-2026 Strategic Plan provided an opportunity to reflect on the linkage between strategy and risk, and to revisit the risk appetite statements that guide the agency when considering whether to mitigate, transfer, or accept risks. The Chief Operating Officer, with the input of the ERM Risk Captains, developed agency-level risk appetite statements that align with the new Strategic Plan and will help guide risk-based decision-making across the agency.

In accordance with the *Chief Financial Officers Act* and the *Government Management Reform Act of 1994*, NSF prepares financial statements using generally accepted accounting principles (GAAP) for federal entities. The financial statements present NSF's detailed financial information relative to its mission and the stewardship of resources entrusted to the agency. They also provide readers with an understanding of the resources that NSF has available, the cost of its programs, and the status of resources at the end of the fiscal year. NSF's financial statements have undergone an independent audit to ensure they are free from material misstatement and can be used to assess NSF's financial status and related financial activities for the year ending September 30, 2022.

NSF received an unmodified audit opinion on its financial statements, and no material weaknesses or significant deficiencies were identified in the internal control program for financial reporting. The Independent Auditor's Report begins on the first page of Chapter 2, *Financials*. Management's response follows the audit report.



Scientists analyzed the impact of environment, genetics and socioeconomic status on the human brain. *Credit: Farah, Koellinger, et al. Science Advances*

Genetic, environmental factors contribute to how socioeconomic status impacts the brain

An international team of NSF-funded researchers is shedding light on how genetic and environmental factors, including socioeconomic status, interact to affect human brain development. By analyzing brain scans and genetic information of nearly 24,000 individuals, the researchers discovered that while nature and nurture both play a role, only about half of the measured features in the brain were the result of genetic factors. While researchers have known for a long time that environmental factors like water and air quality can affect brain development, this research takes an important step forward in identifying how socio-economic factors such as income, education, and occupation affect the brain and can help inform efforts to mitigate factors that negatively affect brain development.

Understanding the Financial Statements

The following discussion of NSF's financial condition and results of operations should be read together with the FY 2022 financial statements and accompanying notes, found in Chapter 2, Financials, of this AFR.

In accordance with guidance in OMB Circular No. A-136, *Financial Reporting Requirements,* NSF's FY 2022 financial statements and notes are presented in a comparative format to facilitate analysis of FYs 2022 and 2021. Table 1.3 summarizes the changes in NSF's financial position in FY 2022 relative to FY 2021.

Table 1.3 – Changes in NSF's Financial Position in FY 2022

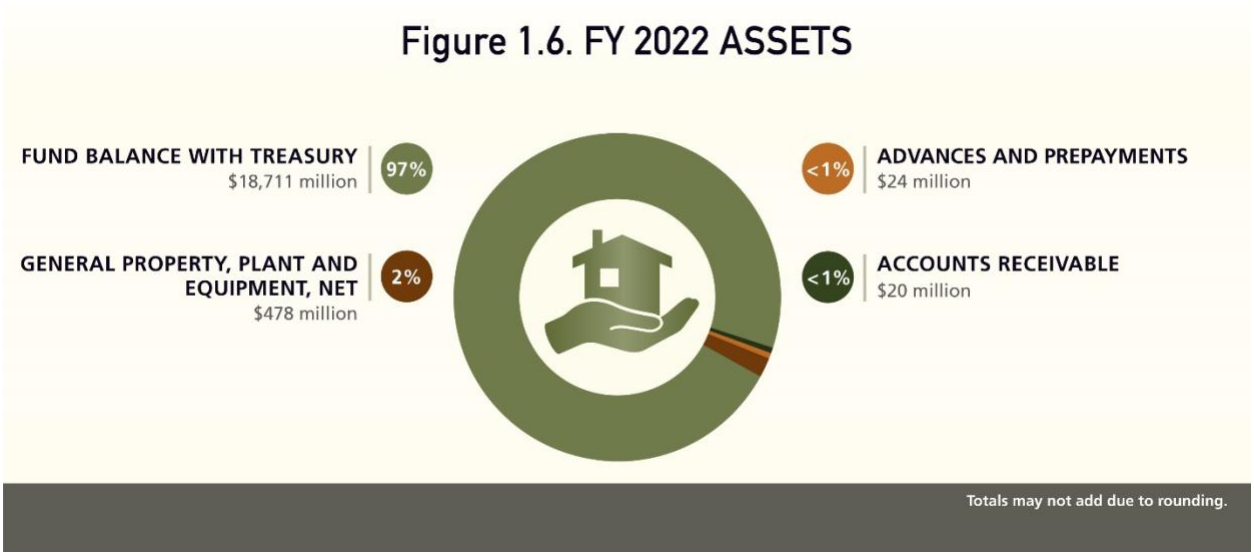
(Dollars in Millions)

Net Financial Condition	FY 2022	FY 2021	$ Change	% Change
Assets	$19,233	$18,349	$884	5%
Liabilities	$796	$665	$131	20%
Net Position	$18,438	$17,684	$754	4%
Net Cost	$8,190	$7,376	$814	11%

Balance Sheet

The Balance Sheet presents the total amounts available for use by NSF (assets) against the amounts owed (liabilities) and amounts that comprise the difference (net position). NSF's total assets are largely composed of *Fund Balance with Treasury*.

In FY 2022, *Assets* (Figure 1.6) increased 5 percent from FY 2021. The majority of the change occurred in the *Fund Balance with Treasury* account, which increased by $855 million in FY 2022. NSF is authorized to use *Fund Balance with Treasury* to make expenditures and pay amounts due through the disbursement authority of Treasury. The *Fund Balance with Treasury* is increased through appropriations and collections and decreased by expenditures and rescissions.



In FY 2022, *Liabilities* (Figure 1.7) increased by 20 percent as compared to FY 2021. Driving this change was a $79 million increase in the *Liability for Non-Fiduciary Deposit Funds and Undeposited Collections*, a $41 million increase in *Accounts Payable, and* a $17 million increase in *Accrued Grant Liabilities*.

The increase in *Liability for Non-Fiduciary Deposit Funds and Undeposited Collections* is primarily attributed to the implementation of an FY 2022 change in accounting principle to account for foreign contributions received by NSF in a deposit fund account, which is a liability to NSF. *Accounts Payable (Other than Intragovernmental)* is estimated annually by utilizing historical data based on the actual expenses incurred but not reported, as a percentage of current fiscal year expenses. NSF determines *Accounts Payable (Intragovernmental)* by performing outreach to its federal trading partners and recording offsetting payables for any reported trading partner *Accounts Receivable*. In FY 2022, *Accounts Payable (Intragovernmental)* increased by $30 million due to an increased federal accounts payable accrual. This was the primary driver of the $41 million increase in NSF's total *Accounts Payable,* mentioned earlier. The accrual for standard grants and cooperative agreements are estimated annually by utilizing a linear regression model based on the correlation of NSF grantee's historical unliquidated obligations and expenses incurred but not reported. The accrual for SBIR/STTR grants uses a methodology that is based on their unique terms and conditions. In FY 2022, the unliquidated obligations balance for grantees increased, resulting in a higher *Accrued Grant Liabilities* as compared to FY 2021.

Figure 1.7. FY 2022 LIABILITIES

ACCRUED GRANT LIABILITIES $524 million 66%
ACCOUNTS PAYABLE $138 million 17%
LIABILITY FOR NON-FIDUCIARY DEPOSIT FUNDS AND UNDEPOSITED COLLECTIONS $79 million 10%
4% FEDERAL EMPLOYEE BENEFITS PAYABLE $28 million
2% ENVIRONMENTAL AND DISPOSABLE LIABILITIES $13 million
1% OTHER LIABILITIES (INTRAGOVERNMENTAL) $8 million
1% ACCRUED PAYROLL $5 million

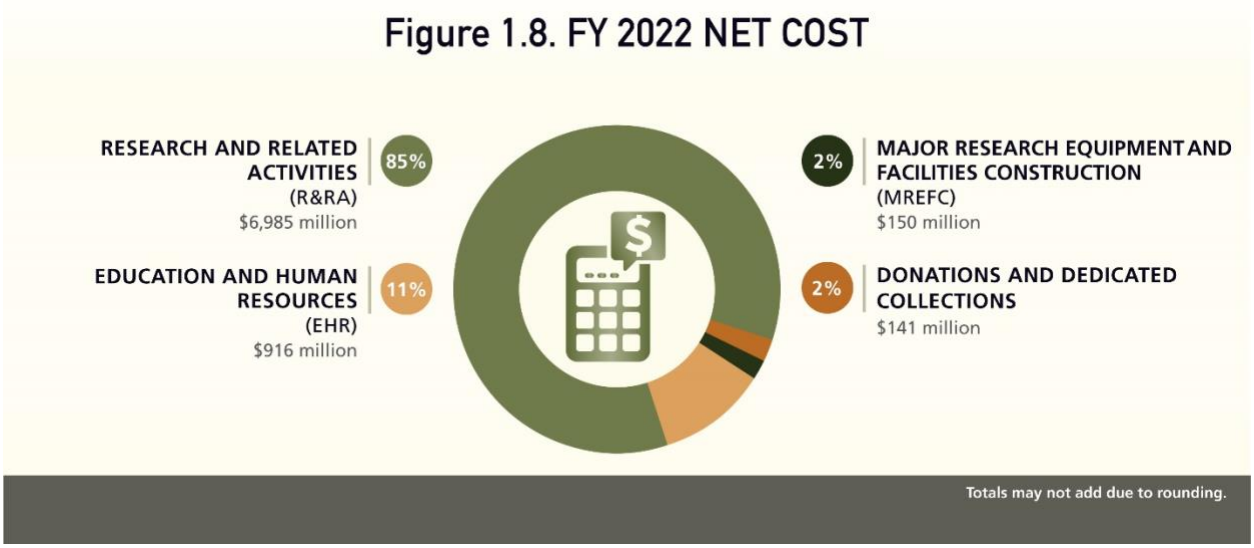
Totals may not add due to rounding.

NSF's assets and liabilities were impacted by appropriated funds received in prior fiscal years related to the *Coronavirus Aid, Relief, and Economic Security (CARES) Act* (2020) and *ARP Act* (2021) funding primarily in support of R&RA for COVID-19. As of September 30, 2022, NSF had $498 million in assets and $15 million in liabilities for COVID-19 related activities.

Statement of Net Cost

The Statement of Net Cost presents the annual cost of operating NSF programs. The net cost of operations of each NSF program equals the program's gross cost less any offsetting revenue. Intragovernmental earned revenues are recognized when related program or administrative expenses are incurred. Earned revenue is deducted from the full cost of the programs to arrive at the *Net Cost of Operations*.

Approximately 95 percent of FY 2022 *Net Cost* (Figure 1.8) was related to the direct support of R&RA, EHR, MREFC, and Donations and Dedicated Collections. Additional costs were incurred for indirect general operation activities (e.g., salaries, training, and activities related to the advancement of NSF information systems technology) and activities of the NSB and the OIG. These indirect costs were allocated to R&RA, EHR, MREFC, and Donations and Dedicated Collections and account for approximately 5 percent of FY 2022 *Net Cost*. These administrative and management activities support the agency's program goals. In FY 2022, net costs related to CARES and ARP for R&RA, EHR, MREFC, and AOAM were $89 million, $7 million, $5 million, and $3 million, respectively.



Statement of Changes in Net Position

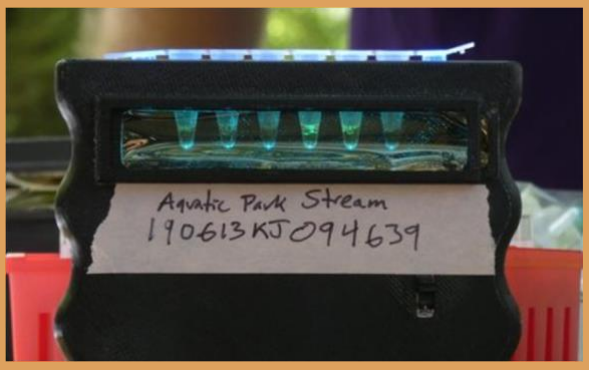
The Statement of Changes in Net Position presents the agency's cumulative results of operations and unexpended appropriations for the fiscal year. In FY 2022, NSF's *Unexpended appropriations* increased by $688 million from FY 2021 and NSF's *Cumulative Results of Operations* increased by $66 million, for a total increase in *Net Position* of $754 million.

In FY 2022, NSF implemented a change in accounting principle that resulted in a $48 million adjustment to the beginning balance of the agency's *Cumulative Results of Operations* as seen on the *Statement of Changes in Net Position.* Further information related to the change in accounting principle implemented by NSF can be found in this AFR's Chapter 2, Financials, Note 1C, *Summary of Significant Accounting Policies* and Note 2, *Fund Balance with Treasury.*

Appropriations received from CARES and ARP resulted in *Unexpended Appropriations* of $4 million and $479 million in FY 2022, respectively. As NSF continues to provide support for COVID-19 related research, costs will increase, which will lead to a decrease in net position.

New DNA computer assesses water quality

Synthetic biologists at Northwestern University have developed a low-cost, easy-to-use hand-held device that can let users know if their water is safe to drink. Rather than complex nanotechnology, quantum sensors, or other exotic, expensive electronics, the researchers turned to bacteria that have specific protein structures that act as "tastebuds" for detecting pollutants like lead, copper, cobalt, and chromium. These "tastebuds" are isolated and combined with custom-engineered strands of DNA to create a solution that glows green when the pollutant-sensitive proteins are activated. While most water testing methods are slow, expensive, and require lab access, the researchers' device is simple and fast, consisting of eight small test tubes that can alert users to 17 different contaminants. Simply add water and within minutes contaminated samples will glow green—a quick and easy way to for people anywhere to monitor water quality and protect their health.



Testing water from an area affected by wildfires in California.
Credit: Northwestern University

Statement of Budgetary Resources

The Statement of Budgetary Resources provides information on how budgetary resources were made available to NSF for the year and the status of those budgetary resources at year end. For FY 2022, *Total Budgetary Resources* increased $242 million from the FY 2021 level. *Budgetary Resources—Appropriations* in FY 2022 for the R&RA, EHR, and MREFC accounts were $6,999 million, $1,149 million, and $266 million, respectively. The combined *Budgetary Resources—Appropriations* in FY 2022 for the NSB, the OIG, and AOAM accounts totaled $449 million. NSF also received $188 million of funding via warrant from the Nonimmigrant Petitioner Account (H-1B); and $20 million of donations from private companies, academic institutions, nonprofit foundations, and individuals.

As part of ARP, NSF received $600 million "to fund or extend new and existing research grants, cooperative agreements, scholarships, fellowships, and apprenticeships, and related administrative expenses to prevent, prepare for, and respond to coronavirus." Further information related to the status of budgetary resources of COVID-19 funding can be found in Chapter 2, Financials, Note 11. *COVID-19 Activity* of this AFR.

Limitations of the Financial Statements

The financial statements are prepared to report the financial position, financial condition, and results of operations, pursuant to the requirements of 31 U.S.C. § 3515(b). The statements are prepared from NSF records in accordance with Federal GAAP and the formats prescribed by OMB. Reports used to monitor and control budgetary resources are prepared from the same records. Users of the statements are advised that the statements are for NSF, a component of the U.S. Government.

Other Financial Reporting Information

Debt Collection Improvement Act of 1996

Net Accounts Receivable totaled $20 million on September 30, 2022. Of that amount, $18 million was due from other federal agencies. The remaining $2 million was due from the public. In accordance with the *Debt Collection Improvement Act, as amended by the Digital Accountability and Transparency Act of 2014*, NSF fully participates in Treasury's Cross-Servicing Program. This program requires NSF to refer

debts due from the public that are delinquent more than 120 days to Treasury for appropriate collection action. In accordance with OMB Circular No. A-129, *Policies for Federal Credit Programs and Non-Tax Receivables*, NSF writes off delinquent debt due from the public that is more than 2 years old. Additionally, NSF seeks Department of Justice concurrence for the write-off of debts greater than $100,000.

Cash Management Improvement Act of 1990

In FY 2022, NSF had no awards covered under *Cash Management Improvement Act* Treasury-State Agreements. The timeliness of NSF's payments to grantees through its payment systems makes the issue of timeliness of payment under the *Act* essentially not applicable to the agency. No interest payments were made in FY 2022.

Analysis of Systems, Controls, and Legal Compliance

Management Assurances

The *Federal Managers' Financial Integrity Act of 1982* (FMFIA)[26] and the OMB Circular A-123, *Management's Responsibility for Enterprise Risk Management and Internal Control*[27] require NSF to evaluate annually the effectiveness of agency internal controls and provide reasonable assurance to the President and the Congress on control system adequacy.

NSF assures its internal control system supports a mature, agile, and sustainable control environment. The approach is proactive and supports effective governance and oversight informed by internal and external risk. A strong risk-based framework ensures focus on the most consequential management issues and confidence that operations are functioning as intended. The risk-based approach also supports a maturing ERM program.

National Science Foundation

FY 2022 Statement of Assurance

The National Science Foundation (NSF) management is responsible for managing risks and maintaining effective internal control to meet the objectives of Sections 2 and 4 of the *Federal Managers' Financial Integrity Act* (FMFIA).

NSF conducted its assessment of risk and internal control processes in accordance with OMB Circular No. A-123, *Management's Responsibility for Enterprise Risk Management and Internal Control*. Based on the results of the assessment, NSF can provide reasonable assurance that internal control over operations, reporting, and compliance was operating effectively as of September 30, 2022.

/s/
Sethuraman Panchanathan
Director

November 14, 2022

The FY 2022 unmodified Statement of Assurance, with no material weaknesses, provides reasonable assurance as to the overall adequacy and effectiveness of internal controls based upon information that the system of internal control is operating efficiently and effectively.

NSF's internal control assessment provides reasonable assurance that the objectives of FMFIA and the *Federal Financial Management Improvement Act of 1996* (FFMIA) were achieved and that the internal control process over financial reporting is effective.

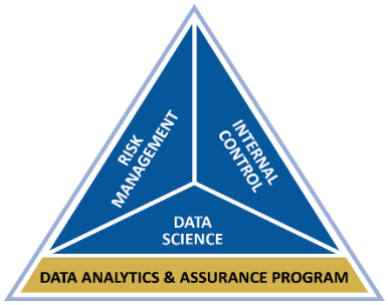
[26] FMFIA: https://www.congress.gov/bill/97th-congress/house-bill/1526/text

[27] *OMB Circular A-123*: https://obamawhitehouse.archives.gov/sites/default/files/omb/memoranda/2016/m-16-17.pdf

Highlights from NSF's FY 2022 Data Analytics and Assurance Program

NSF's Data Analytics & Assurance Program (DAAP) adapts knowledge sharing for ERM and internal control risks leveraged by data science and innovative technology to continuously improve the effectiveness of risk monitoring. The DAAP supports the NSF mission by:

- Dealing with the proliferation of data.
- Leveraging artificial intelligence and automation.
- Targeting and reducing the cost of compliance efforts.
- Strengthening management decision-making.



The DAAP's areas of focus for FY 2022 were as follows:

ERM – NSF continued to mature its ERM program in alignment with risk management standards issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) ERM Integrated Framework. Efforts included the strengthening of ERM governance, increasing the maturity of analytic and risk management tools, supporting the OIG-identified FY 2022 management challenge on grants oversight, aligning ERM entity-level controls to validate internal control practices, and the introduction of GAO's Artificial Intelligence Accountability Framework.

Internal Control – Oversight of NSF's internal controls over financial reporting was conducted to evaluate program integrity in accordance with OMB Circular A-123, the Green Book, and COSO's Internal Control Integrated Framework and Internal Control Over Financial Reporting Compendium of Approaches and Examples through the following key activities:

- Assessed internal control entity level controls.
- Conducted Biannual Risk and Control Checkpoints related to key risk areas.
- Conducted internal control over financial reporting risk assessment through testing and modernizing the control environment.
- Conducted the triennial improper payments risk assessment, including quantitative (grants payments testing) and qualitative assessments.
- Provided support for the validation of the grant accrual.
- Completed IT General Controls assessment.
- Supported the Statement of Standards for Attestation Engagements (SSAE 18) review cycle.

In addition, the DAAP monitors internal controls over compliance, including: the *Anti-Deficiency Act; Digital Accountability and Transparency Act; Government Charge Card Abuse Prevention Act; Federal Information Security Modernization Act Management Act; Federal Financial Management Improvement Act; Single Audit Act,* and other requirements applicable to internal control.

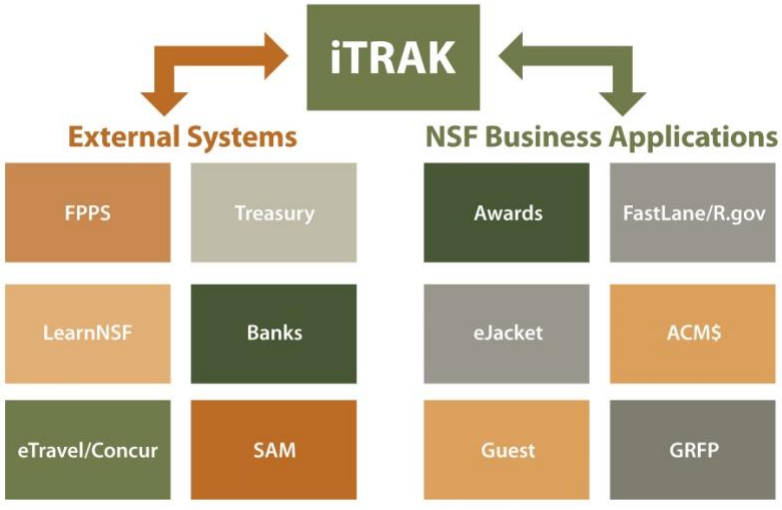
Financial Management Systems

iTRAK is NSF's Oracle-based, commercial-off-the-shelf financial system, hosted off-premises in the cloud. In May 2022, NSF was among the first Federal agencies to transition its financial system's infrastructure to the cloud. This transition significantly strengthened iTRAK's system security, reliability, and performance. The financial system provides automated business processes, funds control management, and reporting capabilities for NSF's external and internal customers, including grantees, financial and administrative staff, and program managers. iTRAK, also performs system edit checks and provides an audit trail for financial transactions, thereby strengthening internal controls. iTRAK aligns with NSF's *Strategic Objective 4.1 – Strengthen at speed and scale: Pursue innovative strategies to strengthen and expand the agency's capacity and capabilities* by enabling efficient, effective execution of financial activities and business operations. NSF has begun planning for the next generation of iTRAK, a cloud-based solution that offers a consumer-like user experience, provides financial analytics, and utilizes artificial intelligence and machine learning.

iTRAK also supports the agency in its stewardship role by providing managers and staff with financial data and reports to aid in data analysis so they can make informed decisions about the programs they manage and support. iTRAK interfaces with NSF's awards, grants management, and business process systems including:

- Award Cash Management Service (ACM$).
- MyNSF Awards (Awards) — NSF's award and award amendment processing, approval, and notification system.
- eJacket — NSF's internal proposal processing system, post-award request tracking and approval system, and document repository.
- Research.gov — Website for the research community that provides quick access to research information and grants management services. Research.gov will replace FastLane.
- Graduate Research Fellowship Program (GRFP) System.
- Guest Travel and Reimbursement System (Guest).

Figure 1.9—NSF Financial Management System Framework



iTRAK also interfaces with external systems operated by Treasury; Citibank and LearnNSF, the Foundation's training system; and with other federal systems such as the Federal Personnel Payroll System (FPPS), eTravel/Concur, and the General Services Administration's SAM.

iTRAK's service provider provides NSF assurance for its financial system through service provider audits (more technically referred to SSAE No. 18) at the application, platform, and infrastructure levels. Application and infrastructure audit opinions were unmodified (i.e., clean), while the platform audit opinion was qualified. NSF's service provider took immediate action to resolve the audit qualification and NSF's complementary controls mitigated any risks to NSF's data, financial reporting or iTRAK application.

Chapter 2

Financials

National Science Foundation • Office of Inspector General
2415 Eisenhower Avenue, Alexandria, Virginia 22314

MEMORANDUM

DATE: November 14, 2022

TO: Dr. Dan Reed
Chair
National Science Board

Dr. Sethuraman Panchanathan
Director
National Science Foundation

FROM: Allison C. Lerner
Inspector General
National Science Foundation

SUBJECT: Audit Report No. 23-2-002, Audit of the National Science Foundation's Fiscal Years 2022 and 2021 Financial Statements

This memorandum transmits the Kearney & Company, P.C.'s reports on its financial statement audit of the National Science Foundation (NSF) for FY 2022, which include FY 2021 comparative information.

Audit Reports on Financial Statements; Internal Control over Financial Reporting; and Compliance with Laws, Regulations, Contracts, and Grant Agreements

The *Chief Financial Officers Act of 1990* (CFO Act, Pub. L. No. 101-576), as amended, requires that NSF's Inspector General or an independent external auditor, as determined by the Inspector General, audit NSF's financial statements in accordance with *Government Auditing Standards* (GAS) issued by the Comptroller General of the United States. We contracted with the independent certified public accounting firm Kearney & Company, P.C. (Kearney) to audit NSF's financial statements as of September 30, 2020, and for the fiscal year then ended. The contract requires that the audit be performed in accordance with GAS; Office of Management and Budget Bulletin 22-01, *Audit Requirements for Federal Financial Statements*; and the U.S. Government Accountability Office/Council of the Inspectors General on Integrity and Efficiency *Financial Audit Manual*.

For FY 2022, Kearney provided: (1) its opinion on the financial statements, (2) a report on internal control over financial reporting, and (3) a report on compliance with laws, regulations, contracts, and grant agreements. In its audit of NSF, Kearney:

- Found that the financial statements referred to above present fairly, in all material respects, the financial position of NSF as of September 30, 2022 and 2021, and its net cost of operations, changes in net position, and budgetary resources for the years then ended, in accordance with accounting principles generally accepted in the United States of America.
- Identified no material weaknesses in internal control over financial reporting.[1]
- Identified no instances in which NSF's financial management systems did not substantially comply with the *Federal Financial Management Improvement Act of 1996* (FFMIA, Pub. L. No. 104-208).
- Identified no reportable instances of noncompliance with provisions of laws, regulations, contracts, and grant agreements tested or other matters.

NSF's response to the draft reports, dated November 14, 2022, follows Kearney's reports.

Kearney is responsible for the attached auditor's reports dated November 14, 2022, and the conclusions expressed therein. We do not express opinions on NSF's financial statements or internal control over financial reporting or on whether NSF's financial management systems substantially complied with the requirements of FFMIA, or conclusions on compliance and other matters.

Kearney's Independent Auditor's Report is meant only to be distributed and read as part of the Agency Financial Report (AFR).

We thank your staff for the assistance that was extended to the auditors during this audit. If you have any questions regarding this report, please contact Mark Bell, Assistant Inspector General, Office of Audits, at 703.292.7100 or OIGpublicaffairs@nsf.gov.

[1] A material weakness is a deficiency, or combination of deficiencies, in internal control, such that there is a reasonable possibility that a material misstatement of the entity's financial statements will not be prevented or detected and corrected on a timely basis.

KEARNEY& COMPANY

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INDEPENDENT AUDITOR'S REPORT

To the Director and Inspector General of the National Science Foundation

Report on the Audit of the Financial Statements

Opinion

We have audited the financial statements of the National Science Foundation (NSF), which comprise the Balance Sheets as of September 30, 2022 and 2021, the related Statements of Net Cost and Changes in Net Position, and the combined Statements of Budgetary Resources (hereinafter referred to as the "financial statements") for the years then ended, and the related notes to the financial statements.

In our opinion, the accompanying financial statements present fairly, in all material respects, the financial position of the NSF as of September 30, 2022 and 2021 and its net cost of operations, changes in net position, and budgetary resources for the years then ended in accordance with accounting principles generally accepted in the United States of America.

Basis for Opinion

We conducted our audits in accordance with auditing standards generally accepted in the United States of America (GAAS); the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States; and Office of Management and Budget (OMB) Bulletin No. 22-01, *Audit Requirements for Federal Financial Statements*. Our responsibilities under those standards are further described in the ***Auditor's Responsibilities for the Audit of the Financial Statements*** section of our report. We are required to be independent of the NSF and to meet our other ethical responsibilities in accordance with the relevant ethical requirements relating to our audits. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Responsibilities of Management for the Financial Statements

Management is responsible for: 1) the preparation and fair presentation of the financial statements in accordance with accounting principles generally accepted in the United States of America; 2) the preparation, measurement, and presentation of Required Supplementary Information (RSI) in accordance with U.S. generally accepted accounting principles; 3) the preparation and presentation of Other Information included in the NSF's Agency Financial Report (AFR), as well as ensuring the consistency of that information with the audited financial statements and the RSI; and 4) the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is required to evaluate whether there are conditions or events, considered in the aggregate, that raise substantial doubt about the NSF's ability to continue as a going concern for 12 months beyond the financial statement date.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements, as a whole, are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance but is not absolute assurance and, therefore, is not a guarantee that an audit conducted in accordance with *Government Auditing Standards* will always detect a material misstatement when it exists. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control. Misstatements are considered material if there is a substantial likelihood that, individually or in the aggregate, they would influence the judgment made by a reasonable user based on the financial statements.

In performing an audit in accordance with *Government Auditing Standards*, we:

- Exercise professional judgment and maintain professional skepticism throughout the audit
- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, and design and perform audit procedures responsive to those risks. Such procedures include examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the NSF's internal control. Accordingly, no such opinion is expressed
- Evaluate the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluate the overall presentation of the financial statements
- Conclude whether, in our judgment, there are conditions or events, considered in the aggregate, that raise substantial doubt about the NSF's ability to continue as a going concern for a reasonable period of time.

We are required to communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit, significant audit findings, and certain internal control-related matters that we identified during the audit.

Required Supplementary Information

Accounting principles generally accepted in the United States of America require that Management's Discussion and Analysis, Deferred Maintenance and Repairs, and Combining Statement of Budgetary Resources by Major Budget Accounts (hereinafter referred to as the RSI) be presented to supplement the financial statements. Such information is the responsibility of management and, although not a part of the basic financial statements, is required by OMB and the Federal Accounting Standards Advisory Board (FASAB), who consider it to be an essential part of financial reporting for placing the basic financial statements in an appropriate operational, economic, or historical context. We have applied certain limited procedures to the RSI in accordance with auditing standards generally accepted in the United States of America, which consisted of inquiries of management regarding the methods of preparing the information and comparing it for consistency with management's responses to our inquiries, the basic financial statements, and other knowledge we obtained during our audits of the basic financial statements. We do not express an opinion or provide any assurance on the information because the limited procedures do not provide us with sufficient evidence to express an opinion or provide any assurance.

Other Information

Management is responsible for the Other Information included in the AFR. The Other Information comprises the Summary of Financial Statement Audit and Management Assurances, Management Challenges, Payment Integrity Reporting, Fraud Reduction Report, Undisbursed Balances in Expired Grants Accounts, Grant Oversight and New Efficiency Act Requirements, Reduce the Footprint, Awards to Affiliated Institutions, Awards to Assistant Director Intergovernmental Personnel Act's Home Institutions, and Patents and Inventions Resulting from NSF Support, but does not include the financial statements and our auditor's report thereon. Our opinion on the financial statements does not cover the Other Information, and we do not express an opinion or any form of assurance thereon.

In connection with our audits of the financial statements, our responsibility is to read the Other Information and consider whether a material inconsistency exists between the Other Information and the financial statements or the Other Information otherwise appears to be materially misstated. If, based on the work performed, we conclude that an uncorrected material misstatement of the Other Information exists, we are required to describe it in our report.

Other Reporting Required by *Government Auditing Standards*

In accordance with *Government Auditing Standards* and OMB Bulletin No. 22-01, we have also issued reports, dated November 14, 2022, on our consideration of the NSF's internal control over financial reporting and on our tests of the NSF's compliance with provisions of applicable laws, regulations, contracts, and grant agreements, as well as other matters for the year ended September 30, 2022. The purpose of those reports is to describe the scope of our testing of internal control over financial reporting and compliance and the results of that testing, and not to

provide an opinion on internal control over financial reporting or on compliance and other matters. Those reports are an integral part of an audit performed in accordance with *Government Auditing Standards* and OMB Bulletin No. 22-01 and should be considered in assessing the results of our audits.

Alexandria, Virginia
November 14, 2022

KEARNEY& COMPANY

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INDEPENDENT AUDITOR'S REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING

To the Director and Inspector General of the National Science Foundation

We have audited, in accordance with auditing standards generally accepted in the United States of America; the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States; and Office of Management and Budget (OMB) Bulletin No. 22-01, *Audit Requirements for Federal Financial Statements*, the financial statements of the National Science Foundation (NSF) as of and for the year ended September 30, 2022, and the related notes to the financial statements, which collectively comprise the NSF's basis financial statements, and we have issued our report thereon dated November 14, 2022.

Report on Internal Control over Financial Reporting

In planning and performing our audit of the financial statements, we considered the NSF's internal control over financial reporting (internal control) as a basis for designing audit procedures that are appropriate in the circumstances for the purpose of expressing our opinions on the financial statements, but not for the purpose of expressing an opinion on the effectiveness of the NSF's internal control. Accordingly, we do not express an opinion on the effectiveness of the NSF's internal control. We limited our internal control testing to those controls necessary to achieve the objectives described in OMB Bulletin No. 22-01. We did not test all internal controls relevant to operating objectives as broadly defined by the Federal Managers' Financial Integrity Act of 1982 (FMFIA), such as those controls relevant to ensuring efficient operations.

A *deficiency in internal control* exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct, misstatements on a timely basis. A *material weakness* is a deficiency, or combination of deficiencies, in internal control, such that there is a reasonable possibility that a material misstatement of the entity's financial statements will not be prevented, or detected and corrected, on a timely basis. A *significant deficiency* is a deficiency, or combination of deficiencies, in internal control that is less severe than a material weakness, yet important enough to merit attention by those charged with governance.

Our consideration of internal control was for the limited purpose described in the first paragraph of this section and was not designed to identify all deficiencies in internal control that might be material weaknesses or significant deficiencies. Given these limitations, during our audit, we did not identify any deficiencies in internal control that we consider to be material weaknesses. However, material weaknesses may exist that have not been identified.

We noted certain additional matters involving internal control over financial reporting that we will report to the NSF's management in a separate letter.

KEARNEY& COMPANY

Purpose of this Report

The purpose of this report is solely to describe the scope of our testing of internal control and the results of that testing, and not to provide an opinion on the effectiveness of the NSF's internal control. This report is an integral part of an audit performed in accordance with *Government Auditing Standards* and OMB Bulletin No. 22-01 in considering the entity's internal control. Accordingly, this communication is not suitable for any other purpose.

Alexandria, Virginia
November 14, 2022

KEARNEY& COMPANY

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INDEPENDENT AUDITOR'S REPORT ON COMPLIANCE WITH LAWS, REGULATIONS, CONTRACTS, AND GRANT AGREEMENTS

To the Director and Inspector General of National Science Foundation

We have audited, in accordance with auditing standards generally accepted in the United States of America; the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States; and Office of Management and Budget (OMB) Bulletin No. 22-01, *Audit Requirements for Federal Financial Statements*, the financial statements of the National Science Foundation (NSF) as of and for the year ended September 30, 2022 and the related notes to the financial statements, which collectively comprise the NSF's basic financial statements, and we have issued our report thereon dated November 14, 2022.

Report on Compliance and Other Matters

As part of obtaining reasonable assurance about whether the NSF's financial statements are free from material misstatement, we performed tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements, noncompliance with which could have a direct and material effect on the determination of the financial statement, and provisions referred to in Section 803(a) of the Federal Financial Management Improvement Act of 1996 (FFMIA). We limited our tests of compliance to these provisions and did not test compliance with all laws, regulations, contracts, and grant agreements applicable to the NSF. However, providing an opinion on compliance with those provisions was not an objective of our audit; accordingly, we do not express such an opinion. The results of our tests disclosed no instances of noncompliance or other matters that are required to be reported under *Government Auditing Standards* and OMB Bulletin No. 22-01.

The results of our tests of compliance with FFMIA disclosed no instances in which the NSF's financial management systems did not comply substantially with the Federal financial management system's requirements, applicable Federal accounting standards, or application of the United States Standard General Ledger at the transaction level.

KEARNEY& COMPANY

Purpose of this Report

The purpose of this report is solely to describe the scope of our testing of compliance and the results of that testing, and not to provide an opinion on the effectiveness of the entity's compliance. This report is an integral part of an audit performed in accordance with *Government Auditing Standards* and OMB Bulletin No. 22-01 in considering the entity's compliance. Accordingly, this communication is not suitable for any other purpose.

Alexandria, Virginia
November 14, 2022

Attachment I –

National Science Foundation's Management Response

OFFICE OF BUDGET, FINANCE & AWARD MANAGEMENT

MEMORANDUM

Date: November 14, 2022

To: Allison Lerner, Inspector General

From: Janis Coughlin-Piester, Chief Financial Officer

Subject: Management's Response to Independent Auditor's Report for Fiscal Year (FY) 2022

I am pleased that the Independent Public Auditor's Report on the FY 2022 financial statements resulted in an unmodified opinion. This is a significant accomplishment that highlights the adaptability of NSF's staff in successfully navigating the challenges of the pandemic recovery while prioritizing the highest standards of financial stewardship. I have also been impressed with the innovation and professionalism that your staff and Kearney & Company (Kearney) demonstrated during the audit.

We look forward to collaborating with the Office of Inspector General and Kearney in future audits. If you have any questions or require additional information, please contact Mike Wetklow, Deputy Chief Financial Officer and Division Director for Financial Management at mwetklow@nsf.gov.

National Science Foundation

FINANCIAL STATEMENTS

As of and for the Fiscal Years ended
September 30, 2022 and 2021

National Science Foundation
Balance Sheet
As of September 30, 2022 and 2021
(Amounts in Thousands)

Assets	**2022**	**2021**
Intragovernmental		
Fund Balance With Treasury (Note 2)	$ 18,711,159	$ 17,856,554
Accounts Receivable, Net		
Assets for Custodial and Non-Entity Liabilities		
Other Than the General Fund of the US Government	10,827	8,747
Accounts Receivable, Net	6,782	10,855
Total Accounts Receivable, Net	17,609	19,602
Advances and Prepayments (Note 8B)	24,144	32,729
Total Intragovernmental	18,752,912	17,908,885
Other Than Intragovernmental		
Cash and Other Monetary Assets	25	16
Accounts Receivable, Net	2,426	900
General Property, Plant and Equipment, Net (Note 3)	477,798	439,079
Total Other Than Intragovernmental	480,249	439,995
Total Assets	**$ 19,233,161**	**$ 18,348,880**
Liabilities		
Intragovernmental		
Accounts Payable		
Accounts Payable	$ 61,120	$ 30,727
Total Accounts Payable	61,120	30,727
Other Liabilities		
Other Liabilities (Without Reciprocals)	2,428	2,810
Liability to the General Fund of US Government - for Custodial and Other Non-Entity Assets	2,037	837
Other Current Liabilities - Benefit Program Contributions Payable	1,399	2,881
Other Liabilities - Reimbursable Activities	2,526	2,781
Total Other Liabilities	8,390	9,309
Total Intragovernmental	69,510	40,036
Other Than Intragovernmental		
Accounts Payable	76,386	65,588
Federal Employee Benefits Payable	27,748	27,798
Environmental and Disposal Liabilities (Note 6)	13,139	13,006
Other Liabilities		
Accrued Grant Liabilities	524,199	506,525
Accrued Payroll	5,105	12,264
Liability for Non-Fiduciary Deposit Funds and Undeposited Collections (Note 2)	79,442	16
Total Other Liabilities	608,746	518,805
Total Other Than Intragovernmental	726,019	625,197
Total Liabilities	**$ 795,529**	**$ 665,233**

Net Position		
Unexpended Appropriations		
Unexpended Appropriations - Funds from Other Than Dedicated Collections	$ 17,249,150	$ 16,561,541
Total Unexpended Appropriations	17,249,150	16,561,541
Cumulative Results of Operations		
Cumulative Results of Operations - Dedicated Collections (Note 7)	715,947	657,863
Cumulative Results of Operations - Funds from Other Than Dedicated Collections	472,535	464,243
Total Cumulative Results of Operations	1,188,482	1,122,106
Total Net Position	**$ 18,437,632**	**$ 17,683,647**
Total Liabilities and Net Position	**$ 19,233,161**	**$ 18,348,880**

The accompanying notes are an integral part of these statements.

National Science Foundation
Statement of Net Cost
For the Fiscal Years Ended September 30, 2022 and 2021
(Amounts in Thousands)

Program Costs		**2022**		**2021**
Research and Related Activities				
Gross Costs	$	7,076,948	$	6,314,994
Less: Earned Revenue		(92,339)		(74,971)
Net Research and Related Activities	**$**	**6,984,609**	**$**	**6,240,023**
Education and Human Resources				
Gross Costs	$	921,660	$	843,324
Less: Earned Revenue		(6,131)		(5,545)
Net Education and Human Resources	**$**	**915,529**	**$**	**837,779**
Major Research Equipment and Facilities Construction				
Gross Costs	$	149,567	$	126,420
Less: Earned Revenue		-		-
Net Major Research Equipment and Facilities Construction	**$**	**149,567**	**$**	**126,420**
Donations and Dedicated Collections				
Gross Costs	$	140,556	$	172,116
Less: Earned Revenue		-		-
Net Donations and Dedicated Collections	**$**	**140,556**	**$**	**172,116**
Net Cost of Operations (Notes 10 and 12)	**$**	**8,190,261**	**$**	**7,376,338**

The accompanying notes are an integral part of these statements.

National Science Foundation
Statement of Changes in Net Position
For the Fiscal Year Ended September 30, 2022
(Amounts in Thousands)

	2022		
	Funds From Dedicated Collections (Note 7)	Funds from Other Than Dedicated Collections	Total
Unexpended Appropriations			
Beginning Balances	$ -	**$ 16,561,541**	**$ 16,561,541**
Appropriations Received	-	8,863,000	8,863,000
Other Adjustments (Canceled Authority)	-	(87,830)	(87,830)
Appropriations Used	-	(8,087,561)	(8,087,561)
Net Change in Unexpended Appropriations	**-**	**687,609**	**687,609**
Unexpended Appropriations, Ending	**$ -**	**$ 17,249,150**	**$ 17,249,150**
Cumulative Results of Operations			
Beginning Balances	**$ 657,863**	**$ 464,243**	**$ 1,122,106**
Adjustments			
Change in Accounting Principle (Note 2)	-	(48,717)	(48,717)
Beginning Balances, Adjusted	**657,863**	**415,526**	**1,073,389**
Appropriations Used	-	8,087,561	8,087,561
Non-Exchange Revenue	-	9	9
Donations	-	20,230	20,230
Transfers In / (Out) Without Reimbursment	189,940	2	189,942
Imputed Financing	-	14,439	14,439
Other	-	(6,827)	(6,827)
Net Cost of Operations (Notes 10 and 12)	(131,856)	(8,058,405)	(8,190,261)
Net Change in Cumulative Results of Operations	**58,084**	**57,009**	**115,093**
Cumulative Results of Operations, Ending	**$ 715,947**	**$ 472,535**	**$ 1,188,482**
Net Position (Note 12)	**$ 715,947**	**$ 17,721,685**	**$ 18,437,632**

The accompanying notes are an integral part of these statements.

National Science Foundation
Statement of Changes in Net Position
For the Fiscal Year Ended September 30, 2021
(Amounts in Thousands)

	2021		
	Funds From Dedicated Collections (Note 7)	Funds from Other Than Dedicated Collections	Total
Unexpended Appropriations			
Beginning Balances	**$ -**	**$ 14,830,495**	**$ 14,830,495**
Apporpriations Received	-	9,086,759	9,086,759
Other Adjustments (Canceled Authority)	-	(92,050)	(92,050)
Appropriations Used	-	(7,263,663)	(7,263,663)
Net Change in Unexpended Appropriations	**-**	**1,731,046**	**1,731,046**
Unexpended Appropriations, Ending	**$ -**	**$ 16,561,541**	**$ 16,561,541**
Cumulative Results of Operations			
Beginning Balances	**$ 616,843**	**$ 412,835**	**$ 1,029,678**
Appropriations Used	-	7,263,663	7,263,663
Non-Exchange Revenue	-	6	6
Donations	-	32,243	32,243
Transfers In / (Out) Without Reimbursment	162,485	60,008	222,493
Imputed Financing	-	13,483	13,483
Other	-	(63,122)	(63,122)
Net Cost of Operations (Notes 10 and 12)	(121,465)	(7,254,873)	(7,376,338)
Net Change in Cumulative Results of Operations	**41,020**	**51,408**	**92,428**
Cumulative Results of Operations, Ending	**$ 657,863**	**$ 464,243**	**$ 1,122,106**
Net Position (Note 12)	**$ 657,863**	**$ 17,025,784**	**$ 17,683,647**

The accompanying notes are an integral part of these statements.

National Science Foundation
Statement of Budgetary Resources
For the Fiscal Years Ended September 30, 2022 and 2021
(Amounts in Thousands)

	2022	2021
Budgetary Resources		
Unobligated Balance from Prior Year Budget Authority, Net	$ 1,054,941	$ 589,136
Appropriations	9,071,091	9,272,739
Spending Authority from Offsetting Collections	91,462	113,864
Total Budgetary Resources (Note 8C)	**$ 10,217,494**	**$ 9,975,739**
Status of Budgetary Resources		
New Obligations and Upward Adjustments (Note 8C)	$ 9,523,708	$ 9,018,208
Unobligated Balance, End of Year		
Apportioned, Unexpired (Note 2)	326,625	775,024
Unapportioned, Unexpired (Note 2)	183,877	15,121
Unobligated Balance, Unexpired, End of Year	510,502	790,145
Unobligated Balance, Expired, End of Year (Note 2)	183,284	167,386
Total Unobligated Balance, End of Year	693,786	957,531
Total Status of Budgetary Resources	**$ 10,217,494**	**$ 9,975,739**
Net Outlays (Notes 8C and 10)		
Net Outlays	$ 8,159,356	$ 7,389,780
Distributed Offsetting Receipts	(26,554)	(35,391)
Net Agency Outlays	**$ 8,132,802**	**$ 7,354,389**

The accompanying notes are an integral part of these statements.

NOTES TO THE PRINCIPAL FINANCIAL STATEMENTS

Note 1. Summary of Significant Accounting Policies

A. Reporting Entity

The National Science Foundation (NSF or "Foundation") is an independent federal agency created by the National Science Foundation Act of 1950, as amended (42 United States Code (U.S.C.) 1861-75). Its primary mission is to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense. NSF initiates and supports scientific research and research fundamental to the engineering process and programs to strengthen the Nation's science and engineering potential. NSF also supports critical education programs in science, technology, engineering, and mathematics (STEM) fields, which help prepare future generations of scientists and engineers. NSF funds research and education in science and engineering by awarding grants and contracts to educational and research institutions throughout the United States and its territories. NSF, by law, cannot operate research facilities except in the polar regions. NSF enters into relationships through awards to fund the research operations conducted by grantees. Information on NSF funding by institution can be found at https://www.fiscal.treasury.gov/files/reports-statements/combined-statement/cs2021/2021-cs-final.pdf.

NSF is led by a presidentially-appointed, Senate-confirmed Director and a 24-member National Science Board (NSB). As of September 30, 2022, there were 15 members serving on the NSB, including the Director. The NSB members represent a cross section of prominent leaders in science and engineering research and education, and are appointed by the President for 6-year terms. The NSF Director is an ex officio member of the Board. The NSF workforce, including staff in the NSB Office and the Office of the Inspector General, is comprised of approximately 1,500 federal employees and 200 scientists from research institutions in temporary positions. NSF provides the opportunity for scientists, engineers, and educators to join the Foundation as temporary program directors and advisors. These "rotators" provide input during the merit review process of proposals; provide insight for new directions in the fields of science, engineering, and education; and support cutting-edge interdisciplinary research. Rotators can come to NSF under multiple mechanisms. The largest numbers come on Intergovernmental Personnel Act assignments, or IPAs, and remain employees of their home institutions. NSF facilitates IPA assignments through grants to their institution as a reimbursement in whole or in part for salary and benefits, and that reimbursement is then paid by the institution to their employee. All rotators are subject to criminal conflict of interest statutes as well as the government-wide *Standards of Ethical Conduct of Employees of the Executive Branch*, which prohibit them from participating in NSF proposals and awards affecting themselves and their home organizations.

B. Basis of Presentation

These financial statements have been prepared to report the financial position and results of operations of NSF as required by the Chief Financial Officers Act of 1990, the Government Management Reform Act of 1994, the Reports Consolidation Act of 2000, and the Office of Management and Budget (OMB) Circular No. A-136, *Financial Reporting Requirements*, revised June 3, 2022. While the statements have been prepared from the books and records of NSF in accordance with United States Generally Accepted Accounting Principles (U.S. GAAP) for federal entities and the formats prescribed by OMB, the

statements are in addition to the financial reports used to monitor and control budgetary resources, which are prepared from the same books and records.

C. Basis of Accounting

The accompanying financial statements have been prepared in accordance with U.S. GAAP for federal entities using the accrual method of accounting. Under the accrual method, revenues are recognized when earned, and expenses are recognized when a liability is incurred, without regard to receipt or payment of cash. The accompanying financial statements also include budgetary accounting transactions that ensure compliance with legal constraints and controls over the use of federal funds.

In FY 2022, NSF implemented a prospective change in accounting principle to record and report foreign contributions in a Department of Treasury (Treasury) deposit fund account that were previously recorded in a Trust Fund account. NSF coordinated with OMB and Treasury to discuss the presentation and reporting requirements outlined in OMB Circular No. A-11, *Preparation, Submission, and Execution of the Budget*, OMB Circular No. A-136, *Financial Reporting Requirements*, and Statement of Federal Financial Accounting Standards (SFFAS) No. 21, *Reporting Corrections of Errors and Changes in Accounting Principles*. This preferred reporting resulted in adjustments to NSF's liability and budgetary accounts and balances, as reflected in the accompanying financial statements, including Note 2, *Fund Balance With Treasury*.

D. Budgetary Terms

The purpose of federal budgetary accounting is to control, monitor, and report on funds made available to Federal agencies by law and help ensure compliance with the law. The following Budgetary Terms are commonly used:

Appropriations are a provision of law authorizing the expenditure of funds for a given purpose. Usually, but not always, an appropriation provides budget authority.

Budgetary Resources are amounts available to incur obligations in a given year.

Offsetting Collections are payments to the Government that, by law, are credited directly to expenditure accounts and deducted from gross budget authority and outlays of the expenditure account, rather than added to receipts. Usually, offsetting collections are authorized to be spent for the purposes of the account without further action by Congress. Offsetting collections usually result from business-like transactions with the public, including payments from the public in exchange for goods and services, reimbursements for damages, and gifts or donations of money to the Government and from intragovernmental transactions with other Government accounts.

Offsetting Receipts are payments to the Government that are credited to offsetting receipt accounts and deducted from gross budget authority and outlays, rather than added to receipts. They are usually deducted at the level of the agency and subfunction, but in some cases they are deducted at the level of the Government as a whole. Offsetting receipts are not authorized to be credited to expenditure accounts. The legislation that authorizes the offsetting receipts may earmark them for a specific purpose and either appropriate them for expenditure for that

purpose or require them to be appropriated in annual appropriations acts before they can be spent. Like offsetting collections, offsetting receipts usually result from business-like transactions with the public, including payments from the public in exchange for goods and services, reimbursements for damages, and gifts or donations of money to the Government, and from intragovernmental transactions with other Government accounts.

Obligations are binding agreements that will result in outlays, immediately or in the future.

Outlays are payments to liquidate an obligation. Outlays generally are equal to cash disbursements but are also recorded for cash-equivalent transactions, such as the issuance of debentures to pay insurance claims, and in a few cases are recorded on an accrual basis such as interest on public issues of the public debt. Outlays are the measure of Government spending.

For further information about *Budgetary Terms* and concepts, please refer to the "Budget Concepts" chapter of the Analytical Perspectives volume of the President's Budget.
https://www.whitehouse.gov/omb/analytical-perspectives/

E. Revenues and Other Financing Sources

NSF receives a majority of its funding through appropriations contained in the Commerce, Justice, Science, and Related Agencies Appropriations Act. NSF receives annual, multi-year, and no-year appropriations that may be expended within statutory limits. NSF also receives funding via warrant from a receipt account for dedicated collections reported as Nonimmigrant Petitioner Account (H-1B) funds. Additional amounts are obtained from reimbursements for services provided to other federal agencies, and receipts to the NSF Donations Account. NSF also receives interest earned on overdue receivables, which is subsequently returned to Treasury at the end of each fiscal year.

In FY 2022, the Consolidated Appropriations Act, 2022 under Public Law (P.L. 117-103), provided funding for NSF's appropriations. In addition, the Science Appropriations Act, 2022 provided an administrative provision allowing NSF to transfer up to 5 percent of current year funding between appropriations, but no appropriation may be increased by more than 10 percent. Appropriations are recognized as a financing source at the time the related “funded” program or administrative expenditures are incurred. Donations are recognized as revenues when funds are received. Revenues from reimbursable agreements are recognized when the services are provided and the related expenditures are incurred. Reimbursable agreements are mainly for grant administrative services provided by NSF on behalf of other federal agencies.

In accordance with 42 U.S.C. 1862 Section 3 (a)(3), NSF has authority “to foster the interchange of scientific and engineering information among scientists and engineers in the United States and foreign countries” and in 42 U.S.C. 1870 Section 11 (f), NSF is authorized to receive and use funds donated by others. These funds must be donated without restriction other than that they must be used in furtherance of one or more of the general purposes of the Foundation and are made available for obligations as necessary to support NSF programs. Donations may be received from private companies, academic institutions, non-profit foundations, and individuals.

NSF accepts contributions from foreign governments in support of various NSF funded projects and the use of these funds is restricted to the awardee for which it is contributed. NSF does not retain

ownership of funds contributed by foreign governments and solely acts as an intermediary to transfer the funds from foreign partners to the awardee. In accordance with OMB Circular No. A-11, *Preparation, Submission, and Execution of the Budget*, funds received by NSF from foreign governments are deposited and held in a deposit fund account at Treasury.

F. Fund Balance With Treasury and Cash and Other Monetary Assets

Fund Balance With Treasury (FBWT) is composed of appropriated funds that are available to pay current liabilities and finance authorized purchase commitments and non-appropriated funding sources from donations and foreign contributions. Foreign contributions are considered non-entity assets and are used to support awardees pursuant to agreement between NSF and foreign governments. *Cash and Other Monetary Assets* consist of undeposited collections, which are funds received by NSF, but not remitted to Treasury by September 30. FBWT is an asset to NSF and a liability of the General Fund. FBWT is primarily increased by appropriations and decreased by disbursements. When disbursements are made, Treasury finances those disbursements in the same way it finances all other disbursements, using a combination of receipts, other inflows, and borrowing from the public (if there is a budget deficit). Cash receipts and disbursements are processed by Treasury.

G. Accounts Receivable, Net

Accounts Receivable, Net consists of amounts due from governmental agencies, private organizations, and individuals. It includes debts related to criminal restitutions adjudicated by the Department of Justice, where NSF is identified as the payee. Additionally, NSF has the right to conduct audits of awardees to verify billed amounts. These audits may result in monies owed back to NSF. Upon resolution of the amount owed by the awardee to NSF, a receivable is recorded.

NSF establishes an allowance for loss on accounts receivable that are deemed uncollectible in accordance with SFFAS 1, *Accounting for Selected Assets and Liabilities* and Federal Accounting Standards Advisory Board (FASAB) Technical Bulletin 2020-1, *Loss for Intragovernmental Receivables*. NSF analyzes each account independently to assess collectability and the need for an offsetting allowance or write-off. NSF writes off delinquent debt from non-federal sources that is more than 2 years old. NSF's intragovernmental receivables are not written off, but rather the allowance is used to present the net realizable value.

Assets for Custodial and Non-Entity Liabilities – Other Than the General Fund of the US Government consist of a receivable of sequestered H-1B funds due from the Department of Homeland Security.

H. Advances and Prepayments

Advances and Prepayments consist of advances to federal agencies which are issued when agencies are operating under working capital funds or are unable to incur costs on a reimbursable basis. Advances are reduced when documentation supporting expenditures is received. Payments are only made within the amount of the recorded obligation.

I. General Property, Plant and Equipment, Net

NSF capitalizes PP&E with costs exceeding $25 thousand and useful lives of 2 or more years; items not meeting these criteria are recorded as operating expenses. NSF currently reports capitalized PP&E at original acquisition cost; assets acquired from the General Services Administration (GSA) excess property schedules are recorded at the value assigned by the donating agency; and assets transferred in from other agencies are valued at the cost recorded by the transferring entity for the asset net of accumulated depreciation or amortization.

The PP&E balance includes Equipment, Aircraft and Satellites, Buildings and Structures, Leasehold Improvements, Construction in Progress, Internal Use Software, and Software in Development. These balances are comprised of PP&E maintained "in-house" by NSF to support operations and PP&E under the U.S. Antarctic Program (USAP). The majority of USAP property is under the custodial responsibility of the NSF prime contractor for the program. The USAP is undergoing a multi-year modernization project initiated in FY 2019.

Depreciation expense is calculated using the straight-line method with a half-year convention. The half-year convention recognizes one-half of the annual depreciation expense in both the first and last years of an asset's useful life regardless of when it is placed in service. The economic useful life classifications for capitalized assets are as follows:

Equipment

5 years	Computers and peripheral equipment, fuel storage tanks, laboratory equipment, and vehicles
7 years	Communications equipment, office furniture and equipment, pumps and compressors
10 or 15 years	Generators, air traffic control, weather forecasting aids, and landing systems equipment
20 years	Movable buildings (e.g., trailers)

Aircraft and Satellites

7 years	Aircraft, aircraft standardizations, and satellites

Buildings and Structures

31.5 years	Buildings and structures placed in service prior to 1994
39 years	Buildings and structures placed in service after 1993

Leasehold Improvements

NSF's headquarters is leased through GSA under a non-cancelable occupancy agreement. Leasehold improvements performed by GSA are financed with NSF appropriated funds. Amortization is calculated using the straight-line half-year convention upon transfer from construction in progress.

Construction in Progress

Costs incurred for construction projects are accumulated and tracked as construction in progress until the asset is placed in service. Beneficial Occupancy is the point in time when the facility is ready for safe occupancy and use by NSF. Items that pertain to the safety and health of

any future occupants of the facility must be corrected before a Beneficial Occupancy is granted and the facility occupied. All construction efforts at the construction site may not be completed (e.g., punch list items or other minor construction activities may still be required for construction to be considered complete), but the facility space can be used for its intended purpose. When Beneficial Occupancy is granted, the project is transferred from construction in progress to real property and depreciated over the respective useful life of the asset.

Internal Use Software and Software in Development

NSF controls, values, and reports purchased or developed software as tangible property assets, in accordance with the Statement of Federal Financial Accounting Standards (SFFAS) No. 10, *Accounting for Internal Use Software*. NSF identifies software investments as capital property for items that, in the aggregate, cost $500 thousand or more to purchase, develop, enhance, or modify a new or existing NSF system, or configure a government-wide system for NSF needs. Software projects that are not completed at year end and are expected to exceed the capitalization threshold are recorded as software in development. All internal use software meeting the capitalization threshold is amortized over a 5-year period using the straight-line half-year convention.

J. General Property, Plant and Equipment in the Custody of Other Entities

NSF awards grants, cooperative agreements, and contracts to various organizations, including colleges and universities, non-profit organizations, state and local governments, Federally Funded Research and Development Centers (FFRDCs), and private entities. The funds provided may be used in certain cases to purchase or construct PP&E to be used for operations or research on projects or programs sponsored by NSF. In these instances, NSF funds the acquisition of property, but transfers custody of the assets to these entities. NSF's authorizing legislation specifically prohibits the Foundation from operating such property directly.

In practice, NSF's ownership interest in such PP&E is similar to a reversionary interest. To address the accounting and reporting of these assets, specific guidance was sought by NSF and provided by the FASAB. This guidance stipulates that NSF should disclose the value of Federally Owned Property (FOP) held by others in its financial statements based on information contained in the audited financial statements of these entities (if available). Entities that separately present the book value of NSF-owned property in their audited financial statements are listed in Note 4, *General Property, Plant and Equipment in the Custody of Other Entities*, along with the book value of the property held. Entities which hold FOP but do not separately present the book value of NSF-owned property in their audited financial statements are also listed in Note 4, *General Property, Plant and Equipment in the Custody of Other Entities*, with an unavailable note.

K. Accounts Payable

Accounts Payable consists of liabilities to commercial vendors, contractors, and federal agencies. Accounts Payable are expenses for goods and services received but not yet paid for by NSF. At year end, NSF accrues for the amount of estimated unpaid expenses to vendors and contractors for which invoices have not been received, but goods and services have been delivered and performed.

L. Other Intragovernmental Liabilities

Other Intragovernmental Liabilities consist primarily of the employer portion of payroll taxes and benefits, payroll taxes associated with unfunded leave, unfunded Federal Employees' Compensation Act (FECA), and liabilities for non-entity assets. A liability is recorded for payments made for workers' compensation pursuant to the FECA because NSF will reimburse the U.S. Department of Labor (DOL) 2 years after the payment of expenses. Liabilities for non-entity assets are recorded to offset accounts receivable balances associated with canceled appropriations. *Other Liabilities - Reimbursable Activities* consists of a rental credit liability.

M. Other Liabilities (Other Than Intragovernmental)

Other Liabilities (Other Than Intragovernmental) consist of *Accrued Grant Liabilities*, *Accrued Payroll*, and a L*iability for Non-Fiduciary Deposit Funds* and *Undeposited Collections*.

Accrued Grant Liabilities consist of estimated liabilities to grantees for expenses incurred but not reported (IBNR) by September 30. For standard grants and cooperative agreements, NSF's grant accrual methodology utilizes a linear regression model based on the statistical correlation between prior year unliquidated obligations and prior year expenses IBNR.

Accrued Grant Liabilities also consist of an accrual specifically for Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants. SBIR and STTR awards have unique terms and conditions compared to standard NSF grants and cooperative agreements. This methodology calculates any SBIR and STTR funds approved for payment, but not yet disbursed to the grantee as of September 30.

Accrued Payroll relates to services performed by NSF employees and the Department of Interior's Business Center is NSF's payroll service provider. NSF accrues the amount of salaries earned but not paid as of the end of the reporting period.

Liability for Non-Fiduciary Deposit Funds and Undeposited Collections consists of foreign contributions and undeposited collections. NSF does not own or use the funds contributed by its foreign partners. NSF acts solely as an intermediary to transfer the funds from the foreign partner to the awardee which manages the applicable project. The *Liability for Non-Fiduciary Deposit Funds* does not have budgetary impacts. At year end, NSF also records *Undeposited Collections* which are funds received by NSF, but not remitted to Treasury by September 30.

N. Federal Employee Benefits Payable

Federal Employee Benefits Payable consists of liabilities for actuarial FECA and unfunded employee leave. An actuarial liability is recorded for estimated future payments for workers' compensation pursuant to the FECA. The actuarial FECA liability is the present value of estimated future payments calculated by DOL and is recorded as an unfunded liability. Future appropriations will be used for DOL's estimated reimbursement.

Annual leave is accrued as it is earned, and the accrual is reduced as leave is taken. Each quarter, the balance in the accrued annual leave account is adjusted to reflect changes. To the extent current and prior year appropriations are not available to fund annual leave earned but not taken, funding will be obtained from future appropriations. Sick leave and other types of non-vested leave are expensed as taken.

O. Liabilities Not Covered by Budgetary Resources

Liabilities Not Covered by Budgetary Resources may include liabilities associated with future environmental cleanup, legal claims, FECA, unfunded leave, and a rental credit liability.

NSF cannot pay for liabilities unless authorized by law and covered by budgetary resources. Liabilities covered by budgetary resources are those for which appropriated funds are available as of the Balance Sheet date and include new budget authority, unobligated balances of budgetary resources, spending authority from offsetting collections, and recoveries of budget authority through downward adjustments of prior year obligations.

P. Net Position

Net Position is the residual difference between assets and liabilities and is composed of unexpended appropriations and cumulative results of operations, presented separately by dedicated collections and all other funds. *Unexpended Appropriations* represent the amount of undelivered orders and unobligated balances of budget authority. Unobligated balances are the amount of appropriations or other authority remaining after deducting the cumulative obligations from the amount available for obligation. *Cumulative Results of Operations* represent the net results of NSF's operations since the Foundation's inception.

Q. Retirement Plan

In FY 2022, approximately 2 percent of NSF employees participated in the Civil Service Retirement System (CSRS), to which NSF matches contributions up to 7 percent of pay. The majority of NSF employees are covered by the Federal Employees Retirement System (FERS) and Social Security. A primary feature of FERS is the thrift savings plan to which NSF automatically contributes 1 percent of pay. The maximum NSF matching contribution is 5 percent of employee pay, of which 3 percent is fully matched, and 2 percent is matched at 50 percent. NSF also contributes to the employer's matching share for Social Security for FERS participants.

Although NSF funds a portion of the benefits under FERS and CSRS relating to its employees and withholds the necessary payroll deductions, the Foundation has no liability for future payments to employees under these plans, nor does NSF report CSRS, FERS, Social Security assets, or accumulated plan benefits on its financial statements. Reporting such amounts is the responsibility of the Office of Personnel Management (OPM) and the Federal Retirement Thrift Investment Board.

SFFAS No. 5, *Accounting for Liabilities of the Federal Government*, requires employing agencies to recognize the cost of pensions and other retirement benefits during their employees' active years of service. OPM actuaries determine pension cost factors by calculating the value of pension benefits

expected to be paid in the future, and provide these factors to the agency for current period expense reporting. Information is also provided by OPM regarding the full cost of health and life insurance benefits on OPM's Benefit Administration website: https://www.opm.gov/retirement-services/publications-forms/benefits-administration-letters/2022/22-303.pdf.

R. Contingencies and Possible Future Costs

Contingencies - Claims and Lawsuits: NSF is a party to various legal actions and claims brought against it. In the opinion of NSF management and legal counsel, the ultimate resolution of these actions and claims will not materially affect the financial position or operations of the Foundation. NSF recognizes the contingency in the financial statements when claims are probable, expected to result in a material loss, and the payment amounts can be reasonably estimated, whether from NSF's appropriations or the Judgment Fund, administered by the Department of Justice under Section 1304 of Title 31 of the U.S.C. There are some cases where the likelihood of loss is deemed reasonably possible. A contingent liability is not required to be recorded but the estimated loss must be disclosed in the footnotes. In addition, there are cases where the likelihood of loss is deemed remote. A contingent liability is not required to be recorded or disclosed for these cases.

Claims and lawsuits can also be made and filed against awardees of the Foundation by third parties. NSF is not a party to these actions and NSF believes there is no possibility that NSF will be legally required to satisfy such claims. Judgments or settlements of the claims against awardees that impose financial obligation on them may be claimed as costs under the applicable contract, grant, or cooperative agreement and thus may affect the allocation of program funds in future fiscal years. In the event that the claim becomes probable and amounts can be reasonably estimated, the claim will be recognized.

Contingencies – Unasserted Claims: For claims and lawsuits that have not been made and filed against the Foundation, NSF management and legal counsel determine, in their opinion, whether resolution of the actions and claims they are aware of will materially affect the Foundation’s financial position or operations. NSF recognizes a contingency in the financial statements if unasserted claims are probable of assertion, and if asserted, would be probable of an unfavorable outcome and expected to result in a measurable loss, whether from NSF’s appropriations or the Judgment Fund. NSF discloses unasserted claims if the loss is more likely than not to occur, but the materiality of a potential loss cannot be determined.

Termination Claims: NSF engages organizations, including FFRDCs, in cooperative agreements and contracts to manage, operate, and maintain research facilities for the benefit of the scientific community. As part of these agreements and contracts, NSF funds on a pay-as-you-go basis certain employee benefit costs (accrued vacation and other employee related liabilities, severance pay and medical insurance), long-term leases, and vessel usage and drilling. In some instances, an award decision is made to continue operation of a facility with a different entity performing operation and management duties. In such an occurrence, NSF does not classify the facility as terminated. Claims submitted by the previous managing entity for expenditures not covered by the indirect cost rate included in the initial award are subject to audit and typically paid with existing program funds.

Agreements with FFRDCs include a clause that commits NSF to seek appropriations for termination expenses, if necessary, in the event a facility is terminated. NSF considers termination of these facilities only remotely possible. Should a facility be terminated, NSF is obligated to seek termination expenses

for FFRDCs in excess of the limitation of funds set forth in the agreements, including any Post-Retirement Benefit liabilities, from Congress. Nothing in these agreements can be construed as implying that Congress will appropriate funds to meet the terms of any claims. Termination costs that may be payable to an FFRDC operator cannot be estimated until such time as the facility is terminated.

Environmental and Disposal Liabilities: NSF assesses the likelihood of required cleanup and establishes its environmental liability estimates in accordance with the requirements of the SFFAS No. 5, *Accounting for Liabilities of the Federal Government*, and as amended by SFFAS No. 12, *Recognition of Contingent Liabilities Arising from Litigation*, and SFFAS No. 6, *Accounting for Property, Plant, and Equipment*, and the Federal Financial Accounting and Auditing Technical Release No. 2, *Determining Probable and Reasonably Estimable for Environmental Liabilities in the Federal Government*.

Special attention is paid to USAP to ensure compliance with the Antarctic Conservation Act requirements for environmental cleanup in Antarctica. NSF continually monitors USAP in regard to environmental issues. While NSF is not legally liable for environmental cleanup costs in the Antarctic, there are occasions when the NSF Office of Polar Programs chooses to accept responsibility and commit funds toward cleanup efforts of various sites as resources permit. Decisions to commit funds are in no way driven by concerns of probable legal liability for failure to engage in such efforts, but rather a commitment to environmental stewardship of Antarctic natural resources. Environmental cleanup projects started and completed during the year are reflected in NSF's financial statements as expenses for the current fiscal year. An estimated cost would be accrued for approved projects that are anticipated to be performed after the fiscal year end or will take more than one fiscal year to complete.

S. Use of Estimates

Management has made certain estimates and assumptions when reporting assets, liabilities, revenues, expenses, and note disclosures. Estimates underlying the accompanying financial statements can include accounting for grant liabilities, accounts payable, environmental liabilities, payroll, and PP&E. Actual results may differ from these estimates, and the difference will be adjusted for and included in the financial statements of the following quarter.

T. Permanent Indefinite Appropriations

NSF maintains permanent indefinite appropriations for Research and Related Activities (R&RA), Education and Human Resources (EHR), and Major Research Equipment and Facilities Construction (MREFC). The R&RA appropriation is used for polar research and operations support, reimbursements to other federal agencies for operational and science support, and logistical and other related activities for USAP. The EHR appropriation is used to support science and engineering education, and human resources programs and activities. The MREFC appropriation supports the procurement and construction of unique national research platforms, major research equipment, and USAP modernization projects.

U. Classified Activities

Accounting Standards require all reporting entities to disclose that accounting standards allow certain presentations and disclosures to be modified, if needed, to prevent the disclosure of classified information.

Note 2. Fund Balance With Treasury

Fund Balance With Treasury (FBWT) consists of the following components as of September 30, 2022 and 2021:

(Amounts in Thousands)	2022
Obligated, Not Yet Disbursed	$ 17,937,943
Unobligated Available, Unexpired	326,625
Unobligated Unavailable, Unexpired	183,877
Unobligated Unavailable, Expired	183,284
Add: Non-Budgetary FBWT and Donations Sequestration	79,430
Total FBWT	$ 18,711,159

(Amounts in Thousands)	2021
Obligated, Not Yet Disbursed	$ 16,899,010
Unobligated Available, Unexpired	775,024
Unobligated Unavailable, Unexpired	15,121
Unobligated Unavailable, Expired	167,386
Add: Non-Budgetary FBWT and Donations Sequestration	13
Total FBWT	$ 17,856,554

Obligated, Not Yet Disbursed balances include obligations for which outlays have not been made. *Unobligated Available* balances include current period amounts available for obligation or commitment. *Unobligated Unavailable* balances include recoveries of prior year obligations and other unobligated expired funds that are unavailable for new obligations. *Non-Budgetary FBWT and Donations Sequestration* includes sequestered amounts totaling $13 thousand recorded from FY 2018 through FY 2020. *Non-Budgetary FBWT* includes a non-fiduciary deposit fund account for foreign contributions, which was established in FY 2022 as a result of a change in accounting principle. The deposit fund account is a liability to NSF totaling $79 million as of September 30, 2022, of which $49 million related to foreign contributions received in prior fiscal years. *Non-Budgetary FBWT and Donations Sequestration* are considered non-entity assets.

Note 3. General Property, Plant and Equipment, Net

To support the Financial Report of the United States Government (FR) compilation process, the General Property, Plant, and Equipment, Net reconciliation as of September 30, 2022 and 2021 is below:

(Amounts in Thousands)	2022	2021
	Net PP&E	Net PP&E
Balance Beginning of Fiscal Year	$ 439,079	$ 377,862
Capitalized Acquisitions	56,948	77,640
Dispositions/Revaluations	123	735
Depreciation Expense	(18,352)	(17,158)
Balance as of September 30, 2022 and 2021	$ 477,798	$ 439,079

The components of *General Property, Plant and Equipment, Net* as of September 30, 2022 and 2021 are shown below. As of September 30, 2022, NSF determined that scheduled maintenance or repairs on one item of Antarctic capital equipment in poor condition was not completed and was deferred or delayed for a future period. Further details on asset impairments and deferred maintenance are included in the Required Supplementary Information.

(Amounts in Thousands)	2022		
	Acquisition Value	Accumulated Depreciation/ Amortization	Net PP&E
Equipment	$ 183,571	$ (157,388)	$ 26,183
Aircraft and Satellites	13,180	(13,180)	-
Buildings and Structures	376,365	(186,597)	189,768
Leasehold Improvements	29,729	(10,808)	18,921
Construction in Progress	120,967	-	120,967
Internal Use Software	87,642	(87,642)	-
Software in Development	121,959	-	121,959
Total PP&E	$ 933,413	$ (455,615)	$ 477,798

(Amounts in Thousands)	2021		
	Acquisition Value	Accumulated Depreciation/ Amortization	Net PP&E
Equipment	$ 177,053	$ (150,569)	$ 26,484
Aircraft and Satellites	115,806	(115,806)	-
Buildings and Structures	319,629	(177,767)	141,862
Leasehold Improvements	29,729	(8,816)	20,913
Construction in Progress	143,445	-	143,445
Internal Use Software	87,642	(87,531)	111
Software in Development	106,264	-	106,264
Total PP&E	$ 979,568	$ (540,489)	$ 439,079

Note 4. General Property, Plant and Equipment in the Custody of Other Entities

NSF received a ruling from FASAB on accounting for non-USAP PP&E owned by NSF but in the custody of and used by others (see Note 1H. *General Property, Plant and Equipment, Net*). The FASAB guidance requires NSF Federally Owned Property (FOP) in the custody of others be excluded from NSF PP&E as

defined in the SFFAS No. 6, *Accounting for Property, Plant and Equipment*. NSF is required to disclose the dollar amount of PP&E held by others for any entity which separately discloses NSF property in the most recently issued audited financial statements of the organization holding the assets.

Major facilities with significant FOP are required to disclose in their audited financial statements the value of FOP in their custody. With the exception of these major facilities, other entities which received NSF funding are not required to report FOP separately in their audited financial statements. For entities which hold FOP but do not disclose the book value in their audited financial statements, the value of FOP will be listed as unavailable below.

(Amounts in Thousands)

Entities with Audited and Separately Reported NSF Federally Owned Property	Amount	Fiscal Year Ending
National Radio Astronomy Observatory - AUI	$ 281,435	09/30/2021
Association of Universities for Research in Astronomy, Inc - AURA	$ 1,171,195	09/30/2021
California Institute of Technology	Unavailable	09/30/2021
Dartmouth College	Unavailable	06/30/2021
Incorporated Research Institutions for Seismology - IRIS	Unavailable	06/30/2021
Oregon State University	Unavailable	06/30/2021
SRI International	Unavailable	12/25/2021
UNAVCO, Inc.	Unavailable	12/31/2020
University Corporation for Atmospheric Research	Unavailable	09/30/2021
University of Alaska	$ 136,300	06/30/2021
University of California	Unavailable	06/30/2021
University of Central Florida	Unavailable	06/30/2021
University of Rhode Island	Unavailable	06/30/2021
University of Wisconsin	Unavailable	06/30/2021
Woods Hole Oceanographic Institution	Unavailable	12/31/2021

Note 5. Leases

NSF currently has an occupancy agreement with GSA for its headquarters in Alexandria, VA. This agreement is non-cancelable and active through 2032. In addition, this agreement contains escalation clauses tied to operating expenses and taxes. The following is a schedule of future minimum rental payments for the NSF headquarters:

(Amounts in Thousands)

Fiscal Year	Building Operating Lease Amount (Federal)
2023	25,001
2024	25,125
2025	25,254
2026	25,386
2027	25,522
2028 through 2032	127,225
Total Minimum Non-Cancelable Lease Payments	$ 253,513

NSF also has an occupancy agreement with GSA for warehouse space in Springfield, Virginia that will expire in 2029. The cancellation clauses with the agreements allow NSF to terminate use with 120-day notice. This agreement contains an escalation clause tied to operating expenses. In addition, the Springfield agreement contains a contingent rental based on re-appraised rental rates.

Note 6. Environmental and Disposal Liabilities

Restoration Projects

After an extensive evaluation process, NSF decided to cease scientific observations from the Sondrestrom Research Facility, a geophysical observatory in Kangerlussuaq, Greenland and to proceed with actions to restore the location. In FY 2019, NSF recorded an initial total estimated liability for the restoration project costs of $2 million to decommission and decontaminate the site. The estimated liability was $1 million and $2 million, respectively, as of September 30, 2022 and 2021.

In June 2022, wildfires damaged NSF-owned structures at Kitt Peak National Observatory located in southern Arizona. Due to the extent of the damages as well as the remote location and geography of Kitt Peak, the damage and cost assessments are still in progress. As of September 30, 2022, NSF anticipates that all maintenance and restoration costs will be minimal and may be covered by existing obligations.

Asbestos

Pursuant to FASAB Technical Bulletin 2006-1, *Recognition and Measurement of Asbestos-Related Cleanup Costs*, federal entities are required to recognize a liability for federal property asbestos cleanup costs. Some NSF owned buildings and structures used to support USAP have been identified as having, or expecting to have, friable and non-friable asbestos containing material.

As required by SFFAS No. 6, *Accounting for Property, Plant and Equipment*, NSF works with the current USAP contractor through the Antarctic Support Contract (ASC) to determine the need for asbestos liability adjustments based on actual asbestos costs incurred on an annual basis. Actual asbestos remediation costs are submitted by the ASC and the asbestos liability is adjusted for the impact. Changes to NSF's estimated asbestos liability consisted of the impact of asbestos remediation cost re-estimates since FY 2021. The asbestos liability was $12 million and $11 million, respectively, as of September 30, 2022 and 2021.

Note 7. Funds from Dedicated Collections

In FY 1999, Title IV of the American Competitiveness and Workforce Improvement Act of 1998 (P.L. 105-277) established the H-1B Nonimmigrant Petitioner Account in the General Fund of the U.S. Treasury. Funding is established from fees collected for alien, nonimmigrant status petitions. This law requires that a prescribed percentage of the funds in the account be made available to NSF for the following activities:

- Scholarships in Science, Technology, Engineering, and Mathematics
- Grants for Mathematics, Engineering, or Science Enrichment Courses
- Systemic Reform Activities

The H-1B Nonimmigrant Petitioner fees are available to the Director of NSF until expended. The funds may be used for scholarships to low-income students, or to carry out a direct or matching grant program to support private and/or public partnerships in K-12 education. The H-1B fund is set up as a permanent indefinite appropriation by NSF. These funds are described in the Budget of the United States Government (President's Budget). *Funds from Dedicated Collections* are accounted for in a separate Treasury Account Symbol (TAS), and the budgetary resources are recorded as *Funds from Dedicated Collections Transferred In / (Out)*. *Funds from Dedicated Collections* are reported in accordance with SFFAS No. 43, *Funds from Dedicated Collections: Amending Statement of Federal Financial Accounting Standards 27, Identifying and Reporting Earmarked Funds*. As of September 30, 2022 and 2021, NSF was subject to H-1B sequestrations of $11 million and $9 million, respectively, for each year.

(Amounts in Thousands)	2022	2021
Balance Sheet as of September 30, 2022 and 2021		
Assets		
Intragovernmental		
Fund Balance With Treasury	$ 723,813	$ 663,976
Accounts Receivable, Net		
Asset for Custodial and Non-Entity Liabilities -		
Other Than the General Fund of the US Government	10,827	8,747
Total Accounts Receivable, Net	10,827	8,747
Total Intragovernmental	734,640	672,723
Total Assets	**$ 734,640**	**$ 672,723**
Liabilities		
Other Than Intragovernmental		
Accounts Payable	$ 262	$ 171
Other Liabilities		
Accrued Grant Liabilities	18,431	14,689
Total Other Liabilities	18,431	14,689
Total Other Than Intragovernmental	$ 18,693	$ 14,860
Total Liabilities	**$ 18,693**	**$ 14,860**
Net Position		
Cumulative Results of Operations	$ 715,947	$ 657,863
Total Net Position	**$ 715,947**	**$ 657,863**
Total Liabilities and Net Position	**$ 734,640**	**$ 672,723**

(Amounts in Thousands)	**2022**	**2021**
Statement of Net Cost For the Fiscal Years Ended September 30, 2022 and 2021		
Gross Costs	$ 131,856	$ 121,465
Less: Earned Revenue	-	-
Net Cost of Operations	**$ 131,856**	**$ 121,465**
Statement of Changes in Net Position For the Fiscal Years Ended September 30, 2022 and 2021		
Net Position, Beginning	**$ 657,863**	**$ 616,843**
Transfer In / (Out) Without Reimbursement	189,940	162,485
Net Cost of Operations	(131,856)	(121,465)
Net Change in Cumulative Results of Operations	58,084	41,020
Net Position, Ending	**$ 715,947**	**$ 657,863**

Note 8. Notes Related to the Statement of Budgetary Resources

A. Adjustments to Unobligated Balances Brought Forward

In accordance with SFFAS No. 7, *Accounting for Revenue and Other Financing Sources and Concepts for Reconciling Budgetary and Financial Accounting*, NSF is required to disclose adjustments made during the current reporting period to budgetary resources available at the beginning of the year. In FY 2022, NSF recorded adjustments totaling $32 million that are reflected in the "Unobligated Balance from Prior Year Budget Authority, Net" line on the Statement of Budgetary Resources. These adjustments are also reflected on NSF's SF-133, *Report on Budget Execution and Budgetary Resources*.

A $27 million adjustment resulted from a prospective change in accounting principle which reclassified the receipt and obligation of foreign contributions to a deposit fund account at Treasury.

In FY 2021, NSF received $600 million in funding from the American Rescue Plan (ARP) Act of 2021 (P.L. 117-2) necessary to support and respond to the Coronavirus. In FY 2022, NSF reallocated $5 million from the Major Research Equipment and Facilities Construction (MREFC) account to the Research and Related Activities (R&RA) account. The reallocation of funds did not impact the total funds provided to NSF by the ARP.

B. Undelivered Orders at the End of the Year

In accordance with SFFAS No. 7, *Accounting for Revenue and Other Financing Sources*, the amount of budgetary resources obligated for undelivered orders for the years ended September 30, 2022 and 2021 amounted to $17 billion and $16 billion, respectively.

(Amounts in Thousands)	2022	2021
Undelivered Orders as of September 30, 2022 and 2021		
Undelivered Orders, Unpaid - Non-Federal	$ 17,166,067	$ 16,229,160
Undelivered Orders, Paid - Federal	24,144	32,729
Undelivered Orders, Unpaid - Federal	222,380	175,273
Total Undelivered Orders - Federal	246,524	208,002
Total Undelivered Orders	$ 17,412,591	$ 16,437,162

C. Explanation of Differences between the Statement of Budgetary Resources and the Budget of the United States Government

SFFAS No. 7, *Accounting for Revenue and Other Financing Sources and Concepts for Reconciling Budgetary and Financial Accounting*, requires explanations of material differences between amounts reported in the Statement of Budgetary Resources (SBR) and the actual balances published in the President's Budget. The FY 2024 President's Budget will include FY 2022 budget execution information and is scheduled for publication in the spring of 2023 and can be found upon publication on the OMB website at: http://www.whitehouse.gov/omb.

Balances reported in the FY 2021 SBR and the related President's Budget are shown in a table below for Budgetary Resources, New Obligations and Upward Adjustments, Distributed Offsetting Receipt, and Net Outlays, and any related differences. The differences reported are due to differing reporting requirements for expired and unexpired appropriations between the Treasury guidance used to prepare the SBR and the OMB guidance used to prepare the President's Budget. The SBR includes both unexpired and expired appropriations, while the President's Budget presents only unexpired budgetary resources that are available for new obligations. Additionally, the Distributed Offsetting Receipts amount on the SBR includes donations, while the President's Budget does not.

(Amounts in Thousands)

Fiscal Year 2021	Budgetary Resources	New Obligations and Upward Adjustments	Distributed Offsetting Receipts	Net Outlays
Combined Statement of Budgetary Resources	$ 9,975,739	$ 9,018,208	$ 35,391	$ 7,389,780
Expired Accounts	$ (239,584)	$ (72,197)	$ -	$ -
Other	$ -	$ -	$ (391)	$ -
Budget of the U.S. Government	$ 9,736,155	$ 8,946,011	$ 35,000	$ 7,389,780

Note 9. Awards to Affiliated Institutions

NSB members may be affiliated with institutions that are eligible to receive grants and awards from NSF. NSF made awards totaling $846 million to Board member affiliated institutions as of September 30, 2022. The Board does not review all NSF award actions; however the following require NSB approval for the NSF Director to take action under delegated authority:

- Proposed awards where the average annual award amount is the greater of 1 percent of the prior year current plan of the awarding directorate/office, or 0.1 percent of the prior year enacted NSF budget level;
- Major Research Equipment and Facilities Construction (MREFC) awards;
- Amendments to awards and procurement actions specifying a dollar amount in the Board resolution, if the amended award exceeds the lesser of $10 million dollars or 20 percent of the amount specified in the Board resolution; and
- In the case of procurements when no amount was specified in the Board resolution, if the amended amount exceeds the lesser of $10 million dollars or 20 percent of the contract ceiling award amount.

The Director will continue to consult with the NSB on programs which represent a significant, long-term investment, particularly those which will be funded as an ongoing NSF-wide activity or which involve substantive policy, interagency, or international issues.

The Director's Review Board (DRB) reviews proposed actions for evaluation adequacy and documentation, and compliance with Foundation policies, procedures and strategies. Items requiring DRB action include large awards and Requests for Proposal that meet or exceed a threshold of 2.5 percent of the prior year Division or Subactivity Plan. In addition, the DRB reviews all items requiring NSB action as well as NSB information items prior to submission.

NSF may fund awards meeting the above requirements to institutions affiliated with Board members. Federal conflict-of-interest rules prohibit NSB members from participating in matters where they have a conflict of interest or there is an impartiality concern without prior authorization from the Designated Agency Ethics Official (DAEO) or delegee. Prior to Board meetings, all NSB action items are screened for conflict-of-interest/impartiality concerns by the NSB Counsel (Deputy Ethics Official/Ethics Counselor) and a Legal Administrative Specialist (Deputy Ethics/Reviewing Official) in the National Science Board Office. Members who have conflicts are either recused from the matter or receive a waiver from the Deputy Ethics Official to participate. Following NSF and NSB conflict of interest procedures, in FY 2022, the NSB authorized the Director to make an award in which a Board member affiliated institution was a sub-contractor.

Note 10. Reconciliation of Net Cost to Net Outlays (Budget to Accrual Reconciliation)

The Reconciliation of Net Cost to Net Outlays reconciles the net costs for a federal entity's programs and operations to the net outlays for that entity. The reconciliation validates the relationship between budgetary and proprietary accounting information. Examples of the reconciling items identified are: (1) transactions which resulted in an outlay but did not result in a cost; (2) unpaid expenses included in the net cost in this reporting period but not yet included in outlays; and (3) other temporary timing differences such as special adjustments including prior period adjustments due to correction of errors.

(Amounts in Thousands)	2022		
	Federal	**Public**	**Total**
Net Cost	**$ 215,562**	**7,974,699**	**8,190,261**
Components of Net Cost Not Part of Net Agency Outlays			
Property, Plant, and Equipment Depreciation Expense	-	(18,352)	(18,352)
Applied Overhead / Cost Capitalization Offset	-	57,071	57,071
Increase / (Decrease) in Assets:			
Accounts Receivable, Net	(4,074)	1,527	(2,547)
Other Assets	(8,584)	9	(8,575)
(Increase) / Decrease in Liabilities:			
Accounts Payable	(28,656)	(28,472)	(57,128)
Environmental and Disposal Liabilities	-	(133)	(133)
Federal Employee and Veteran Benefits Payable	-	50	50
Other Liabilities	383	7,149	7,532
Financing Sources:			
Imputed Costs	(14,439)	-	(14,439)
Total Components of Net Cost Not Part of Net Agency Outlays	**(55,370)**	**18,849**	**(36,521)**
Components of Net Agency Outlays Not Part of Net Cost			
Donated Revenue	-	(20,230)	(20,230)
Transfers Out (In) Without Reimbursement	(2)	-	(2)
Total Components of Net Agency Outlays Not Part of Net Cost	**(2)**	**(20,230)**	**(20,232)**
Miscellaneous Items			
Custodial / Non-Exchange Revenue	(706)	-	(706)
Total Miscellaneous Items	**(706)**	**-**	**(706)**
Net Agency Outlays	**$ 159,484**	**7,973,318**	**8,132,802**

Related Amounts on the Statement of Budgetary Resources	
Net Outlays	$ 8,159,356
Distributed Offsetting Receipts	(26,554)
Net Agency Outlays	**$ 8,132,802**

(Amounts in Thousands)	2021		
	Federal	**Public**	**Total**
Net Cost	**$ 147,514**	**7,228,824**	**7,376,338**
Components of Net Cost Not Part of Net Outlays			
Property, Plant, and Equipment Depreciation	-	(17,158)	(17,158)
Applied Overhead / Cost Capitalization Offset	-	78,389	78,389
Increase/(Decrease) in Assets:			
Accounts Receivable	(553)	(9)	(562)
Other Assets	(4,095)	(50)	(4,145)
(Increase)/Decrease in Liabilities Not Affecting Net Outlays:			
Accounts Payable	(11,705)	(18,504)	(30,209)
Federal Employee and Veteran Benefits Payable	-	(1,491)	(1,491)
Environmental and Disposal Liabilities	-	(76)	(76)
Other Liabilities	(211)	(752)	(963)
Other Financing Sources:			
Imputed Financing	(13,483)	-	(13,483)
Total Components of Net Cost Not Part of the Net Outlays	**(30,047)**	**40,349**	**10,302**
Components of Net Outlays Not Part of Net Cost			
Donated Revenue	-	(32,243)	(32,243)
Transfers Out (In) Without Reimbursement	(8)	-	-
Total Components of Net Outlays Not Part of Net Cost	**(8)**	**(32,243)**	**(32,251)**
Miscellaneous Items			
Custodial / Non-Exchange Revenue	-	-	-
Total Miscellaneous Items	**-**	**-**	**-**
Net Agency Outlays	**$ 117,459**	**7,236,930**	**7,354,389**

Related Amounts on the Statement of Budgetary Resources	
Net Outlays	$ 7,389,780
Distributed Offsetting Receipts	(35,931)
Net Agency Outlays	**$ 7,354,389**

Note 11. COVID-19 Activity

As part of the ARP Act of 2021, NSF received $600 million "to fund or extend new and existing research grants, cooperative agreements, scholarships, fellowships, and apprenticeships, and related administrative expenses to prevent, prepare for, and respond to coronavirus." In addition, NSF used funding from its base appropriation, the Consolidated Appropriations Act, 2021 (P.L. 116-260), H-1B Nonimmigrant Petitioner Fees, and Reimbursable Authority to support COVID-19-related research and other activity. The table below reflects NSF's FY 2021 allocation of funding. In FY 2022, $5 million was reallocated from the Major Research Equipment and Facilities Construction account to the Research and Related Activities account.

The allocation of ARP Act funds as of September 30, 2022 and 2021:

(Amounts in Thousands)	2022	2021
NSF by Account	Amount	Amount
Research and Related Activities	$ 472,000	$ 467,000
Education and Human Resources	61,000	61,000
Major Research Equipment and Facilities Construction	55,000	60,000
Agency Operations and Award Management	12,000	12,000
Total	$ 600,000	$ 600,000

The status of budgetary resources for ARP Act funds as of September 30, 2022 and 2021:

(Amounts in Thousands)	2022	2021
Budgetary Resources: Unobligated (and unexpired) Balance Carried Forward from PY	$ 359,516	$ -
New Budget Authority (+)	-	600,000
Recoveries of Prior Year Obligations (+)	1,253	-
Budgetary Resources Obligated (-)	360,649	240,484
Budgetary Resources: Ending Unobligated (and unexpired) Balance to be Carried	120	359,516
Outlays, Net (Total)	$ 87,360	$ 18,349

NSF uses R&RA resources to support new grant and fellowship awards as well as issue supplements to existing awards to support individuals and institutions disproportionally impacted by the coronavirus pandemic. In particular, NSF structured the investments to: (i) reach the most strongly affected groups; (ii) support individuals at vulnerable career transition points; and (iii) ensure broad distribution.

Like the intent of the R&RA funds, EHR supports new and existing research grants, fellowships, and education activities that align with the three identified emphasis areas. These investments were awarded across both FY 2022 and FY 2021.

NSF currently has several major multi-user research facility projects under construction with funding appropriated under the MREFC account. Some of these projects, all funded through cooperative agreements, have seen significant delays and concomitant cost increases caused by the COVID-19 pandemic. The primary impacts have been the inability to conduct construction work at remote sites

and the impacts of social distancing on the efficiency of construction. NSF uses ARP resources in accordance with NSF policy and practice to cover impacts that are out of control of the Project. In addition, NSF uses MREFC funds to cover similar impacts to Midscale-Research Infrastructure, Track 2 projects.

NSF faced increased costs across all aspects of agency operations and award management due to coronavirus. The $12 million provided to the Agency Operations and Award Management (AOAM) supported additional program officers and grant specialists, and expanded the agency's use of virtual technologies and collaboration tools that sustained remote operations. NSF relied on the use of these technologies to enable virtual merit review panels to make timely ARP funded awards which went beyond the needs for obligation of base appropriations. Remaining increased administration costs supported financial management for the increased number of fellows expected from ARP funding, system configurations, and attendant technical support inside NSF and for awardees.

Obligations for COVID-19 activities, by funding source, as of September 30, 2022 and 2021:

(Amounts in Thousands)	2022			
NSF by Account	ARP Act[1]	Base Appropriation	H-1B Fees Mandatory + Reimbursable	Amount
Research and Related Activities	$277,114	$ 814,172	$ 2,662	$ 1,093,948
Education and Human Resources	37,005	180,150	27,085	244,240
Major Research Equipment and Facilities Construction	46,529	21	-	46,550
Agency Operations and Award Management	-	2	-	2
Total	$360,648	$ 994,345	$ 29,747	$ 1,384,740

[1]Obligation amounts include new obligations of recovered funds from prior de-obligations.

(Amounts in Thousands)	2021			
NSF by Account	ARP Act	Base Appropriation	H-1B Fees Mandatory + Reimbursable	Amount
Research and Related Activities	$195,542	$ 1,215,995	$ 4,464	$ 1,416,001
Education and Human Resources	23,995	267,428	45,995	337,418
Major Research Equipment and Facilities Construction	8,947	1,534	-	10,481
Agency Operations and Award Management	12,000	23	-	12,023
Total	$240,484	$ 1,484,980	$ 50,459	$ 1,775,923

Budget authority provided by the ARP Act of 2021 was available to NSF for obligation through September 2022. Unobligated balances for each year ending September 30 are shown below:

(Amounts in Thousands)	2022	2021
NSF by Account	ARP Act Amount	ARP Act Amount
Research and Related Activities	$ 119	$ 271,458
Education and Human Resources	-	37,005
Major Research Equipment and Facilities Construction	1	51,053
Agency Operations and Award Management	-	-
Total	$ 120	359,516

Note 12. Reclassification of Financial Statement Line Items for FR Compilation Process

To prepare the FR, the Treasury requires agencies to submit an adjusted trial balance, which is a listing of amounts by U.S. Standard General Ledger account that appear in the financial statements. Treasury uses the trial balance information reported in the Governmentwide Treasury Account Symbol Adjusted Trial Balance System (GTAS) to develop a Reclassified Statement of Net Cost, and a Reclassified Statement of Changes in Net Position for each agency, which are accessed using GTAS. Treasury eliminates all intragovernmental balances from the reclassified statements and aggregates lines with the same title to develop the FR statements. This note shows the NSF's financial statements and the NSF's reclassified statements prior to elimination of intragovernmental balances and prior to aggregation of repeated FR line items. A copy of the 2021 FR can be found on the FR website and a copy of the 2022 FR will be posted to this site as soon as it is released. https://www.fiscal.treasury.gov/reports-statements/

The term "Non-Federal" is used to refer to transactions with non-federal entities. These include transactions with individuals, businesses, non-profit entities, and State, local, and foreign governments.

Reclassification of Statement of Net Cost (SNC) to Line Items Used for the Government-wide SNC for the Period Ending September 30, 2022 (Amounts in Thousands)

FY 2022 National Science Foundation SNC		Line Items Used to Prepare FY 2022 Government-wide SNC			
Financial Statement Line	Amounts	Dedicated Collections	All Other	Total	Reclassified Financial Statement Line
GROSS COSTS					**GROSS COSTS**
Research and Related Activities	$ 7,076,948	$ 131,856	7,849,660	$ 7,981,516	Non-Federal Gross Cost
		131,856	7,849,660	7,981,516	Total Non-Federal Gross Cost
Education and Human Resources	921,660	-	50,882	50,882	Benefit Program Costs
Major Research Equipment and Facilities Construction	149,567	-	14,439	14,439	Imputed Costs
Donations and Dedicated Collections	140,556	-	226,684	226,684	Buy/Sell Costs
		-	15,210	15,210	Other Expenses (Without Reciprocals)
		-	307,215	307,215	Total Federal Gross Cost
TOTAL GROSS COSTS	**$ 8,288,731**	**$ 131,856**	**8,156,875**	**$ 8,288,731**	**TOTAL GROSS COSTS**
EARNED REVENUE					**EARNED REVENUE**
Research and Related Activities	$ (92,339)	$ -	(6,817)	$ (6,817)	Non-Federal Earned Revenue
		-	(6,817)	(6,817)	Total Non-Federal Earned Revenue
Education and Human Resources	(6,131)	-	(91,653)	(91,653)	Buy/Sell Revenue (Exchange)
		-	(91,653)	(91,653)	Total Federal Earned Revenue
TOTAL EARNED REVENUE	**$ (98,470)**	**$ -**	**(98,470)**	**$ (98,470)**	**TOTAL EARNED REVENUE**
NET COST OF OPERATIONS	**$ 8,190,261**	**$ 131,856**	**8,058,405**	**$ 8,190,261**	**NET COST OF OPERATIONS**

Reclassification of Statement of Changes in Net Position (SCNP) to Line Items Used for the Government-wide Statement of Operations and Changes in Net Position for the Period Ending September 30, 2022
(Amounts in Thousands)

FY 2022 National Science Foundation SCNP		Line Items Used to Prepare FY 2022 Government-wide SCNP			
Financial Statement Line	Amounts	Dedicated Collections	All Other	Total	Reclassified Financial Statement Line
UNEXPENDED APPROPRIATIONS					
Beginning Balance	$ 16,561,541	$ 657,863	17,025,784	$ 17,683,647	Net Position, Beginning of Period (Includes Cumulative Results of Operations, Beginning Balance)
Appropriations Received	8,863,000	-	8,775,170	8,775,170	Appropriations Received as Adjusted
Other Adjustments (Canceled Authority)	(87,830)				
Appropriations Used	(8,087,561)	-	(8,087,561)	(8,087,561)	Appropriations Expended
Net Change in Unexpended Appropriations	687,609				
UNEXPENDED APPROPRIATIONS, ENDING	**17,249,150**				
CUMULATIVE RESULTS OF OPERATIONS					
Beginning Balance	$ 1,122,106				
Change in Accounting Principle	(48,717)	-	(48,717)	(48,717)	Change in Accounting Principle
Beginning Balance, Adjusted	**1,073,389**			**17,634,930**	**Net Position, Beginning of Period - Adjusted (Includes Net Position, Beginning of Period above plus Change in Accounting Principle AND excluded from Total Net Position below)**
Appropriations Used	8,087,561	-	8,087,561	8,087,561	Appropriations Expended
Non-Exchange Revenue	9	-	20,230	20,230	Other Taxes and Receipts
Donations	20,230				
Other (1 of 2)	(9)				
Total Non-Exchange Revenues	20,230	-	20,230	20,230	Total Non-Federal Non-Exchange Revenues
		2,080	-	2,080	Accruals for Entity Amounts to be Collected in a TAS Other Than the General Fund of the U.S. Government - Non-Exchange
		-	2	2	Expenditure Transfers-In of Financing Sources
		198,687	-	198,687	Appropriation of Unavailable Special/Trust Fund Receipts Transfers-In
		(10,827)	-	(10,827)	Appropriation of Unavailable Special/Trust Fund Receipts Transfers-Out
Transfers In / (Out) Without Reimbursement	189,942	189,940	2	189,942	Total Appropriation of Unavailable Special/Trust Fund Receipts Transfers-In
Imputed Financing	14,439	-	14,439	14,439	Imputed Financing Sources
		-	706	706	Collections Transferred into a TAS Other Than the General Fund of the U.S. Government
		-	(6,324)	(6,324)	Non-Entity Collections Transferred to the General Fund
		-	(1,200)	(1,200)	Accrual for Non-Entity Amounts to be Collected and Transferred to the General Fund
Other (2 of 2)	(6,818)	-	(6,818)	(6,818)	Total Non-Entity Collections and Accrual for Non-Entity Amounts to be Collected
Net Cost of Operations	**8,190,261**	**(131,856)**	**(8,058,405)**	**(8,190,261)**	Net Cost of Operations
Net Change in Cumulative Results of Operations	**115,093**				
CUMULATIVE RESULTS OF OPERATIONS,	**$ 1,188,482**				
TOTAL NET POSITION	**$ 18,437,632**	**$ 715,947**	**17,721,685**	**$ 18,437,632**	**TOTAL NET POSITION**

REQUIRED SUPPLEMENTARY INFORMATION

Deferred Maintenance and Repairs

For the Fiscal Years ended September 30, 2022 and 2021

Deferred Maintenance and Repairs

NSF performs condition assessment surveys in accordance with SFFAS No. 42, *Deferred Maintenance and Repairs,* for capitalized general PP&E, including fully depreciated general personal property to determine if any maintenance and repairs are needed to keep an asset in an acceptable condition or restore an asset to a specific level of performance. NSF considers deferred maintenance and repairs to be any maintenance and repairs that are not performed on schedule, unless it is determined from the condition of the asset that scheduled maintenance does not have to be performed. Deferred maintenance and repairs also include any other type of maintenance or repair that, if not performed, would render the PP&E non-operational. Circumstances such as non-availability of parts or funding are considered reasons for deferring maintenance and repairs.

NSF considered whether any scheduled maintenance or repair necessary to keep fixed assets of the agency in an acceptable condition was deferred at the fiscal years ended September 30, 2022 and 2021. Assets deemed to be in excellent, good, or fair condition are considered to be in acceptable condition. Assets in poor or very poor condition are in unacceptable condition and the deferred maintenance and repairs required to get them to an acceptable condition are reported. NSF determines the condition of an asset in accordance with standards comparable to those used in the private industry. Due to the environment and remote location of Antarctica, all deferred maintenance and repairs on assets in poor or very poor condition are considered critical in order to maintain operational status.

In accordance with SFFAS No. 42, NSF discloses the beginning and ending balances for the fiscal year ending September 30, 2022. At September 30, 2022, NSF determined that scheduled maintenance or repairs on one item of Antarctic capital equipment in poor condition was not completed and was deferred or delayed for a future period. The dollar amount of deferred maintenance for this item was $300 thousand. The item was heavy mobile equipment and was considered critical to NSF operations.

At September 30, 2021, NSF determined that there was no scheduled maintenance or repairs on Antarctic capital equipment in poor or very poor condition that was not completed and was deferred or delayed for a future period.

REQUIRED SUPPLEMENTARY INFORMATION

Combining Statement of Budgetary Resources by Major Budget Accounts

In the following tables, NSF budgetary information for the fiscal years ended September 30, 2022 and 2021, as presented in the Statement of Budgetary Resources, is disaggregated for each of NSF's major budget accounts.

The Consolidated Appropriations Act, 2022

2022

(Amounts in Thousands)

	Research and Related Activities	Education and Human Resources	Major Research Equipment	OIG, AOAM, and NSB	Special and Donated	Total
Budgetary Resources						
Unobligated Balance from Prior Year Budget Authority, Net	$ 556,200	82,820	255,790	7,460	152,671	$ 1,054,941
Appropriations	6,999,520	1,149,460	266,520	448,500	208,091	9,071,091
Spending Authority from Offsetting Collections	79,242	4,950	-	7,270	-	91,462
Total Budgetary Resources	**$ 7,634,962**	**1,237,230**	**521,310**	**463,230**	**360,762**	**$ 10,217,494**
Status of Budgetary Resources						
New Obligations and Upward Adjustments	$ 7,400,190	1,196,006	190,581	451,426	285,505	$ 9,523,708
Unobligated Balance, End of Year:						
Apportioned, Unexpired	78,870	4,735	175,745	5,279	61,996	326,625
Unapportioned, Unexpired	8,755	6,877	154,984	-	13,261	183,877
Unobligated Balance, Unexpired, End of Year	87,625	11,612	330,729	5,279	75,257	510,502
Unobligated Balance, Expired, End of Year	147,147	29,612	-	6,525	-	183,284
Total Unobligated Balance, End of Year	234,772	41,224	330,729	11,804	75,257	693,786
Total Status of Budgetary Resources	**$ 7,634,962**	**1,237,230**	**521,310**	**463,230**	**360,762**	**$ 10,217,494**
Net Outlays						
Net Outlays	$ 6,573,104	872,450	155,535	427,119	131,148	$ 8,159,356
Distributed Offsetting Receipts	-	-	-	-	(26,554)	(26,554)
Net Agency Outlays	**$ 6,573,104**	**872,450**	**155,535**	**427,119**	**104,594**	**$ 8,132,802**

The Consolidated Appropriations Act, 2021

2021

(Amounts in Thousands)

	Research and Related Activities	Education and Human Resources	Major Research Equipment	OIG, AOAM, and NSB	Special and Donated	Total
Budgetary Resources						
Unobligated Balance from Prior Year Budget Authority, Net	$ 237,391	43,461	129,426	17,269	161,589	$ 589,136
Appropriations	7,347,479	1,029,000	301,000	409,280	185,980	9,272,739
Spending Authority from Offsetting Collections	103,815	4,416	-	5,633	-	113,864
Total Budgetary Resources	**$ 7,688,685**	**1,076,877**	**430,426**	**432,182**	**347,569**	**$ 9,975,739**
Status of Budgetary Resources						
New Obligations and Upward Adjustments	$ 7,246,601	1,003,479	170,216	425,462	172,450	$ 9,018,208
Unobligated Balance, End of Year:						
Apportioned, Unexpired	306,304	40,590	260,190	1,022	166,918	775,024
Unapportioned, Unexpired	4,278	2,622	20	-	8,201	15,121
Unobligated Balance, Unexpired, End of Year	310,582	43,212	260,210	1,022	175,119	790,145
Unobligated Balance, Expired, End of Year	131,502	30,186	-	5,698	-	167,386
Total Unobligated Balance, End of Year	442,084	73,398	260,210	6,720	175,119	957,531
Total Status of Budgetary Resources	**$ 7,688,685**	**1,076,877**	**430,426**	**432,182**	**347,569**	**$ 9,975,739**
Net Outlays						
Net Outlays	$ 5,885,636	800,746	152,601	384,538	166,259	$ 7,389,780
Distributed Offsetting Receipts	-	-	-	-	(35,391)	(35,391)
Net Agency Outlays	**$ 5,885,636**	**800,746**	**152,601**	**384,538**	**130,868**	**$ 7,354,389**

Chapter 3

Appendices (Other Information)

SUMMARY OF FY 2022 FINANCIAL STATEMENT AUDIT AND MANAGEMENT ASSURANCES

Table 3.1 – Summary of Financial Statement Audit

Effectiveness of Internal Control over Financial Reporting (FMFIA § 2)					
Audit Opinion	*Unmodified*				
Restatement	*No*				
Material Weaknesses	Beginning Balance	New	Resolved	Consolidated	Ending Balance
Total Material Weaknesses	*0*	-	-	-	*0*

Table 3.2 – Summary of Management Assurances

Effectiveness of Internal Control over Financial Reporting (FMFIA § 2)						
Statement of Assurance	*Unmodified*					
Material Weaknesses	Beginning Balance	New	Resolved	Consolidated	Reassessed	Ending Balance
Total Material Weaknesses	*0*	-	-	-	-	*0*
Effectiveness of Internal Control over Operations (FMFIA § 2)						
Statement of Assurance	*Unmodified*					
Material Weaknesses	Beginning Balance	New	Resolved	Consolidated	Reassessed	Ending Balance
Total Material Weaknesses	*0*	-	-	-	-	*0*
Conformance with Federal Financial Management System Requirements (FMFIA § 4)						
Statement of Assurance	*Systems conform to financial management system requirements*					
Non-Conformances	Beginning Balance	New	Resolved	Consolidated	Reassessed	Ending Balance
Total non-conformances	*0*	-	-	-	-	*0*
Compliance with Section 803(a) of the Federal Financial Management Improvement Act (FFMIA)						
	Agency	Auditor				
Federal Financial Management System Requirements	*No lack of compliance noted*					
Applicable Federal Accounting Standards	*No lack of compliance noted*					
USSGL at Transaction Level	*No lack of compliance noted*					

Management Challenges for the National Science Foundation in Fiscal Year 2023

AT A GLANCE

Management Challenges for the National Science Foundation
in Fiscal Year 2023
October 14, 2022

WHY WE DID THIS REPORT

The *Reports Consolidation Act of 2000* (Pub. L. No. 106-531) requires us to annually update our assessment of the National Science Foundation's "most serious management and performance challenges facing the agency … and the agency's progress in addressing those challenges."

WHAT WE FOUND

Each year, we identify NSF's most serious challenges based on our audit and investigative work, knowledge of NSF's operations, independent sources such as U.S. Government Accountability Office reports and NSF's advisory committees, and discussions with NSF senior staff and contractors. This year, we identified eight areas representing the most serious management and performance challenges facing NSF:

- Increasing Diversity in Science & Engineering Education and Employment
- Overseeing the United States Antarctic Program (USAP)
- Overseeing Grants in a Changing Environment
- Managing the Intergovernmental Personnel Act Program
- Overseeing NSF-Funded Research Infrastructure
- Mitigating Threats to Research Security
- Mitigating Threats Posed by the Risk of Cyberattacks
- Addressing Harassment in the Academic Community

We are encouraged by NSF's progress in its efforts to address critical management and performance challenges. Effective responses to these challenges will promote the integrity of NSF-funded projects, help ensure research funds are spent effectively and efficiently, and help maintain the highest level of accountability over taxpayer dollars.

AGENCY RESPONSE TO *MANAGEMENT CHALLENGES FOR FISCAL YEAR 2022*

Following the issuance of this report, NSF will include its Management Challenges Progress Report and its response to *Management Challenges for the National Science Foundation in Fiscal Year 2022* in its Agency Financial Report.

FOR FURTHER INFORMATION, CONTACT US AT OIGPUBLICAFFAIRS@NSF.GOV.

National Science Foundation • Office of Inspector General
2415 Eisenhower Avenue, Alexandria, Virginia 22314

MEMORANDUM

DATE: October 14, 2022

TO: Dr. Dan Reed
Chair
National Science Board

Dr. Sethuraman Panchanathan
Director
National Science Foundation

FROM: Allison C. Lerner Allison C. Lerner
Inspector General
National Science Foundation

SUBJECT: Management Challenges for the National Science Foundation in Fiscal Year 2022

Attached for your information is our report*, Management Challenges for the National Science Foundation in Fiscal Year 2023*. The *Reports Consolidation Act of 2000* (Pub. L. No. 106-531) requires us to annually update our assessment of the "most serious management and performance challenges facing the agency … and the agency's progress in addressing those challenges." A summary of the report will be included in the National Science Foundation Agency Financial Report.

We appreciate the courtesies and assistance NSF staff provided during the completion of this report.

If you have questions, please contact me at 703.292.7100.

Attachment

Table of Contents

Introduction

The National Science Foundation is an independent federal agency that supports fundamental research and education in all the non-medical fields of science and engineering. With a budget of approximately $8.8 billion (FY 2022), NSF funds about 25 percent of all federally supported basic research at the Nation's colleges and universities, and supports about 200,000 scientists, engineers, educators, and students each year. NSF's goals include advancing the frontiers of knowledge, cultivating a broadly inclusive science and engineering workforce, expanding the scientific literacy of all citizens, building the nation's research capability through investments in advanced instrumentation and facilities, and supporting excellence in science and engineering research and education.

The *Reports Consolidation Act of 2000* (Pub. L. No. 106-531) requires us to annually update our assessment of NSF's "most serious management and performance challenges … and the agency's progress in addressing those challenges." Each year, we identify these challenges based on our audit and investigative work, knowledge of the Foundation's operations, independent sources such as U.S. Government Accountability Office reports and NSF's advisory committees, and discussions with NSF senior staff and contractors. We identify management challenges as those that meet at least one of the following criteria:

- The issue involves an operation that is critical to an NSF core mission.[1]
- The issue presents a risk of fraud, waste, or abuse to NSF or other government assets.
- The issue involves strategic alliances with other agencies, the Office of Management and Budget, the Administration, Congress, or the public.
- The issue is related to key initiatives of the President.

It is important to note that identifying an issue as a "management challenge" does not necessarily mean NSF is having difficulty addressing it; instead, it means we identify the issue as one of the top challenges facing NSF and report on NSF's progress in addressing it, as required by the Act.

This year, we have identified eight areas representing the most serious management and performance challenges facing NSF:

- Increasing Diversity in Science & Engineering Education and Employment
- Overseeing the United States Antarctic Program (USAP)
- Overseeing Grants in a Changing Environment
- Managing the Intergovernmental Personnel Act Program
- Overseeing NSF-Funded Research Infrastructure
- Mitigating Threats to Research Security
- Mitigating Threats Posed by the Risk of Cyberattacks
- Addressing Harassment in the Academic Community

This year, we are introducing one new challenge area, Addressing Harassment in the Academic Community. We added this challenge because recent reports and legislation indicate harassment is pervasive in institutions of higher education and a deterrent to participation in science, technology, engineering, and mathematics (STEM) fields.

[1] The *National Science Foundation Act of 1950* (Pub. L. No. 81-507) sets forth the mission: "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes."

In addition, we renamed two prior challenge areas to better reflect the challenges they describe: "Overseeing NSF-Funded Research Infrastructure" expands the prior challenge "Overseeing Major Multi-User Research Facilities" to include overseeing mid-scale research infrastructure. "Mitigating Threats to Research Security" expands upon the challenge titled "Mitigating Threats Posed by Foreign Government Talent Recruitment Programs" in prior years.

Finally, we did not include last year's challenge "Managing Transformational Change" in this year's report; instead, we have included information about NSF's progress in managing transformational change in the other challenge areas.

NSF has continued to demonstrate its ability to achieve its mission in an ever-changing environment. As the agency moves into FY 2023 and beyond, it is well positioned to address both familiar and new challenges it may face with acuity, agility, and adaptability.

This computer cluster provides the main hardware resource for the Apt, an NSF-funded precursor to CloudLab, located at University of Utah's Downtown Data Center. *Credit: Chris Coleman, School of Computing, University of Utah*

Increasing Diversity in Science & Engineering Education and Employment

Increasing diversity in science and engineering education and employment continues to be a high-priority goal of NSF, the National Science Board (NSB), the Executive Branch of the federal government, and Congress. In *Vision 2030*, the NSB emphasized the need to develop more diverse STEM talent to remain competitive globally. In the *FY 2022-2026 NSF Strategic Plan*, NSF listed as its top goal the empowerment of STEM talent to fully participate in science and engineering. In addition, Congress authorized initiatives in the *CHIPS and Science Act of 2022* (CHIPS Act, Pub. L. No. 117-167) to promote diversity, equity, inclusion, and accessibility (DEIA) in STEM, and the Administration has issued multiple Executive Orders[2] to enhance DEIA government wide.

NSF has taken steps to increase participation in STEM among populations that have been under-resourced and under-served. For example, NSF:

- Expanded its Broadening Participation in STEM portfolio, including the NSF Eddie Bernice Johnson INCLUDES program;
- Responded to the NSB's February 2021 resolutions to broaden participation[3] by offering training videos on unconscious bias and other topics to merit review panelists, and by piloting the inclusion of Broader Impacts experts in Committees of Visitors; and
- Requested $247 million in its FY 2023 Budget Request — a 23.5 percent increase over the actual funding in FY 2021 — for its Established Program to Stimulate Competitive Research (EPSCoR) program, which seeks to enhance research competitiveness in jurisdictions (U.S. states, territories, and the Commonwealth of Puerto Rico) that have historically received a small share of NSF grant dollars by strengthening STEM capability and capacity.

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission.
- Increasing diversity in science and engineering education and employment continues to be a high-priority goal of NSF, the NSB, and the federal government.
- NSF requested 23.5 percent more funding in FY 2023 for EPSCoR, a program that seeks to enhance research competitiveness in jurisdictions that have historically received a small share of NSF grant dollars by strengthening STEM capability and capacity.
- NSF is addressing known barriers in growing research capacity for emerging research institutions.

NSF convened a Racial Equity Task Force to examine the potential for racial barriers and recommend how NSF can address such barriers both internally, for the NSF workforce, and externally, for program delivery. In addition, NSF prepared a DEIA strategic plan in response to Executive Order 14035 to improve DEIA internally.

As NSF recognizes, "It is more important now than ever that we measure and evaluate our outcomes and analyze and distill this evidence to … create a clear data-driven picture of what's working …."[4] In evaluating outcomes, it will need to determine the baseline goals and metrics to assess progress[5] and obtain relevant, reliable data. In FY 2023, we will monitor NSF's progress in measuring and evaluating the

[2] Relevant Executive Orders include 13985, 13988, 14020, and 14035.
[3] NSB-2021-10, NSB-2021-11
[4] *Enhancing Mission Success through Evidence: Perspectives from NSF Leaders*, April 25, 2021
[5] NSB Meeting, May 19, 2021, Vision 2023, Implementation

A research project at the University of Nebraska-Lincoln, supported by an NSF EPSCoR award, focuses on ensuring global food security by improving crop resilience. *Credit: University Communication / University of Nebraska-Lincoln*

outcomes of its policies and programs to increase diversity in the NSF workforce, as well as for program delivery, in areas such as merit review.

Key Completed Actions

- Issued FY 2022-2026 Strategic Plan with Strategic Goal 1, "to promote inclusion in the research community and STEM workforce, access to STEM learning and training and widespread STEM literacy."
- Issued FY 2022-2026 Learning Agenda and FY 2023 Annual Evaluation Plan to measure progress in achieving the FY 2022-2026 Strategic Plan Goal 1.
- Staff-convened Racial Equity Task Force released report with recommendations to increase racial equity internally and externally.
- Issued NSF's Diversity, Equity, Inclusion and Accessibility Strategic Plan 2022-2024.
- Expanded NSF Eddie Bernice Johnson INCLUDES program and its other broadening participation portfolios.

Key Ongoing Actions

- Implementing NSF's Diversity, Equity, Inclusion and Accessibility Strategic Plan, 2022-2024.
- Addressing recommendations from staff-led Racial Equity Task Force's report.
- Addressing known barriers in growing research capacity for emerging research institutions.
- Fostering geographic diversity with the NSF Engines and expanded EPSCoR programs.
- Piloting and assessing initiatives to provide merit review panelists with a video on broader impacts and unconscious bias, and including broader impacts experts in Committees of Visitors.

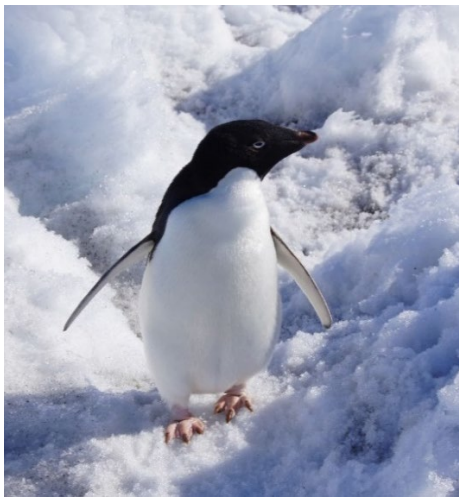
Overseeing the United States Antarctic Program (USAP)

NSF, through the United States Antarctic Program (USAP), manages U.S. scientific research in Antarctica. Leidos Innovations Corporation holds the Antarctic Support Contract for USAP logistical support. It is NSF's largest and most visible contract, valued at $2.3 billion over 13 years. Through this and other contracting vehicles, NSF is also starting a long-range infrastructure investment program across the program, including the three U.S. Antarctic stations (McMurdo, Palmer, and South Pole). The Office of Polar Programs (OPP) monitors performance of the contract, with several other NSF offices collaborating to manage the USAP more broadly.

The COVID-19 global pandemic added unprecedented complexity and uncertainty to USAP operations and construction projects, which were already hampered by Antarctica's remote location, extreme environment, and the short period each year during which the continent is accessible. For example, deployments in the 2020–2021 and 2021–2022 seasons were limited to only those necessary for health and safety or to preserve long-term data sets. In addition, construction at McMurdo under the Antarctic Infrastructure Modernization for Science (AIMS) project and the Information Technology and Communications primary addition was put on hold. NSF plans to resume construction in October 2022, and it has worked to re-baseline the Information Technology and Communications primary addition and the first two components of AIMS, as well as to implement a new approach that will use NSF's Antarctic Infrastructure Recapitalization program to address needed long-term infrastructure improvements, including consideration of the unfunded components of AIMS.

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- The Antarctic Support Contract is NSF's largest and most visible contract, valued at $2.3 billion over 13 years.
- Due to COVID-19, construction at McMurdo under the AIMS project and the Information Technology and Communications primary addition was put on hold.
- Recent information security audit findings have identified challenges.
- NSF commissioned a sexual assault and sexual harassment risk assessment in the USAP environment.



Additionally, recent information security audit findings[6] have identified challenges in USAP's implementation of authentication and incident response requirements. These findings, first identified in FY 2019, demonstrate the extended time needed to fully enact security measures for the USAP network consistent with those of NSF. OPP is working with various NSF offices to identify and enact the right approach for personnel screening and to issue contract modifications and procure solutions as necessary. For example, OPP has modified its process to follow federal requirements for vetting and credentialing contractors that require elevated access to USAP systems and data.

Adelie penguin just out of the ocean.
Credit: Elaine Hood, NSF

[6] FISMA *Audit of NSF's Information Security Program for FY 2020*, November 20, 2020

In addition, OPP is working to address audit recommendations related to incident detection and monitoring, as well as implementation of Personal Identity Verification (PIV) for USAP contractors. OPP has also added technical resources to support its monitoring program and worked with the contractor to develop a Cybersecurity Roadmap. However, due to the challenges of operating in this remote environment and the time necessary to implement changes to USAP contracts, USAP remains at an increased risk of negative impacts to personnel, systems, and data.

Finally, the recently issued assessment[7] of the risk for sexual assault and sexual harassment in the USAP environment further demonstrates the wide-ranging challenges facing NSF as it continues to manage the USAP.

Key Completed Actions

- Accepted new AIMS baseline; unfunded components to be evaluated along with other infrastructure priorities.
- Established a Project Execution Plan to implement PIV for non-privileged access to USAP applications.
- Cleared the backlog of NSF personnel security adjudications for contractors in elevated risk positions.
- Identified a critical need to 1) improve communication, 2) increase engagement, 3) enhance education and training, 4) strengthen reporting infrastructure and accountability, 5) provide support to victims, and 6) probe more deeply into policies and mechanisms aimed at prevention of sexual assault/harassment.

Key Ongoing Actions

- Monitoring AIMS via the NSF Office of the Director's Watch List.
- Implementing the risk-based Cybersecurity Road Map to address audit findings.
- Implementing a new process for NSF adjudication of all Antarctic support contractors.
- Distributing PIV cards to employees with privileged access to USAP systems and employees who do not require privileged access.
- Implementing enforcement of PIV credentials for USAP locations outside the U.S.
- Hosting a series of listening sessions to get community feedback on sexual assault/harassment prevention and reporting.
- Identifying ways to provide additional support to victims of sexual assault/harassment.
- Establishing a Sexual Assault/Harassment Prevention and Response Support Office to (i) provide necessary resources including on-the-ground personnel in Antarctica, (ii) support deployed personnel on matters relating to sexual assault and harassment, and (iii) remove barriers, as well as provide an independent line of reporting for victims of sexual assault/harassment matters in the USAP.

[7] Department of the Interior's Federal Consulting Group, NSF/OPP/USAP Sexual Assault/Harassment Prevention and Response (SAHPR) Final Report, June 22, 2022

Overseeing Grants in a Changing Environment

Making grants to support promising scientific research is a key element of NSF's mission. Among other things, the CHIPS Act officially authorized the Directorate for Technology, Innovation and Partnerships (TIP); requires significant expansion of programs aimed at increasing the diversity of participation in STEM; and authorizes NSF's budget to more than double within 5 years from $8.8 billion to nearly $19 billion.

TIP, the agency's first new directorate in more than three decades, will strive to accelerate the pace of innovation and translation in emerging technologies, address the societal and economic challenges facing the nation, and engage diverse talents nationwide. TIP also seeks to ensure the nation remains at the forefront of competitiveness by establishing partnerships across a broad array of stakeholders: other federal agencies; state, local, and tribal governments; academics; the private sector; nonprofits; civil society; and investors. By FY 2024, TIP's budget is authorized at $3.35 billion, which accounts for more than 21 percent of NSF's total authorization.

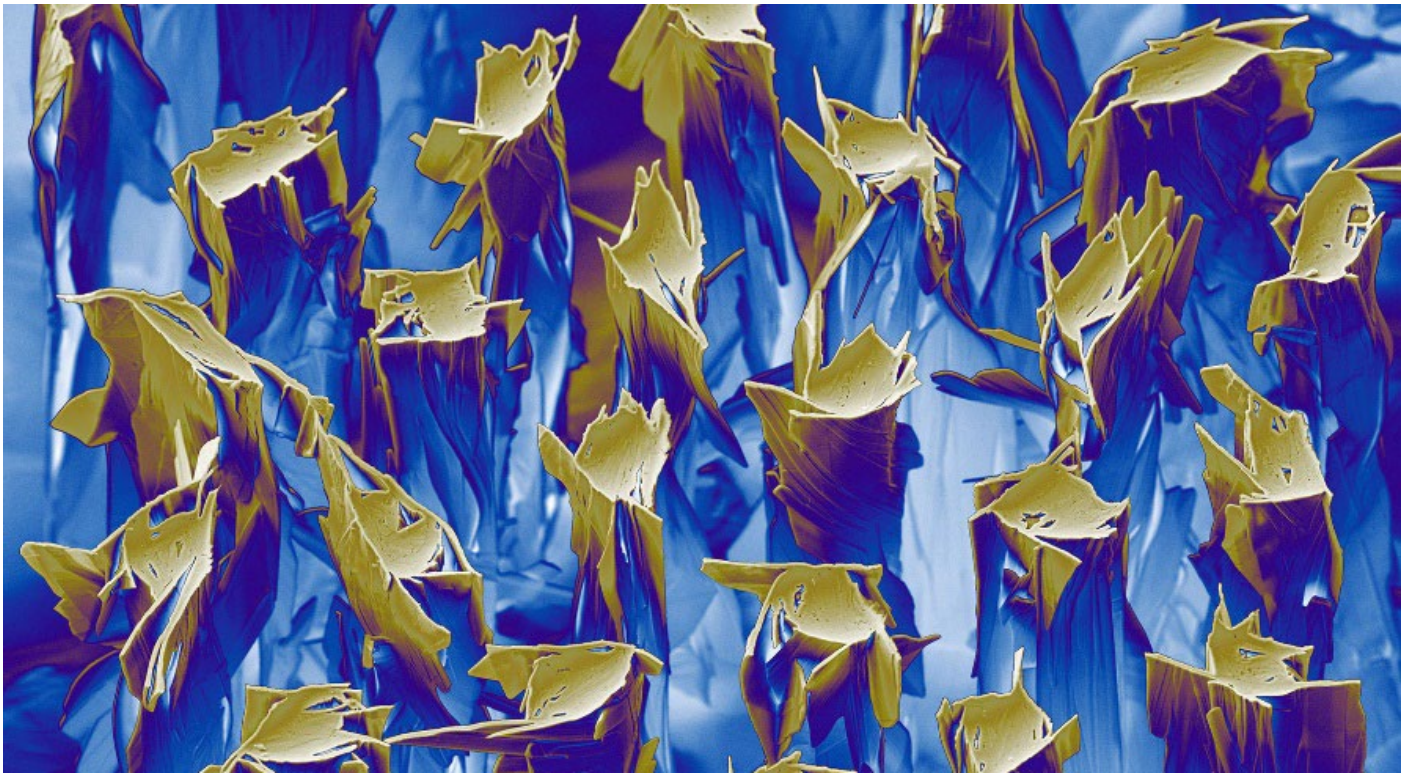
KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- The CHIPS Act authorized the Technology, Innovation, and Partnerships Directorate, requires significant expansion of programs aimed at increasing diversity in STEM, and authorizes NSF's budget to more than double within 5 years, to nearly $19 billion.

TIP represents a transformational change to NSF's traditional mission by expanding its emphasis on applied and use-inspired research and includes the authority for NSF to use new funding methods. A dramatic increase in funding coupled with new award vehicles and a new mission will bring inherent challenges in ensuring proper stewardship and accountability of award funds.

The CHIPS Act also creates new requirements related to the long-time NSF priority of increasing diversity in the STEM workforce and expanding both the institutional and geographic diversity of federal award recipients. As previously discussed, NSF's EPSCoR is directed to grow — from about 12 percent in FY 2021 to 15.5 percent of NSF's budget in FY 2023 and to up to 20 percent by FY 2029. The Act also directs NSF to establish a program to build research capacity at institutions outside the top 100 recipients of federal research funding over the prior 3 years and for NSF to expand its investment in improving STEM instruction in rural schools. In addition, it requires NSF to further the overall goal of increasing diversity in the STEM workforce. Finally, the CHIPS Act also builds upon the research security requirements established by *National Security Presidential Memorandum 33* (NSPM-33) and creates additional obligations for NSF and its award recipients.

The Act established funding targets over the next 5 years that seek to eventually double NSF's budget. However, future appropriated funds might not match authorized amounts, creating fiscal uncertainty and challenges in meeting some of the Act's goals. NSF must continue to adapt to effectively manage this complex and changing environment over the next several years.



Macrosocopic look at superconducting wire Bi-2212. *Credit: Peter J. Lee*

Key Completed Actions

- Assembled the Project Reporting Improvement Team to implement actions to improve compliance on the timely submission of grant project reports across the agency.
- Implemented a suite of awardee self-assessment tools and fact sheets on subrecipient monitoring and participant support costs.
- Continued emphasis on its enterprise risk management process to enhance monitoring and oversight of award recipients.
- Completed triennial Payment Integrity Information Act risk assessment.

Key Ongoing Actions

- Assessing new and ongoing requirements of the CHIPS Act.
- Monitoring portfolio composition and potential increases of small and mid-size award recipients.
- Refining enterprise risk profiles around the NSF grants portfolio to account for future environment changes.
- Executing annual advanced monitoring site visits and desk reviews.
- Conducting annual baseline payments testing.

Managing the Intergovernmental Personnel Act Program

As part of its workforce strategy, NSF provides scientists, engineers, and educators the opportunity to temporarily serve as NSF program directors, advisors, and senior leaders. Most non-permanent staff members are individuals assigned under the *Intergovernmental Personnel Act* (5 U.S.C. §§ 3371 – 3376), who are not federal employees but are funded through grants and remain employees of their home institutions. These individuals — referred to as IPAs or rotators — bring in fresh perspectives from all fields of science and engineering to support NSF's mission. As we have previously reported, IPAs may have a higher risk of conflicts of interest while working at NSF because most come from institutions receiving NSF awards.[8] In addition, IPAs can spend up to 50 days each year on Independent Research/Development, and their salaries are not subject to federal pay and benefits limits.[9]

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- IPAs or rotators are non-federal employees who temporarily serve as NSF staff.
- IPAs bring in fresh perspectives but may have a higher risk of conflicts of interest because most come from institutions receiving NSF-funded awards.
- Our ongoing audit work has found challenges with the IPA vetting and hiring process. In response, NSF established a working group to improve the vetting of IPAs.

Our ongoing audit work shows that challenges remain with IPA program oversight. Increased coordination across the varying offices involved in the vetting and hiring process would further reduce the risks inherent to the IPA program and strengthen the control environment. This includes reducing the risk of hiring individuals who are ineligible to serve as IPAs, verifying IPA salary and employment history before appointment, and promptly adjudicating suitability and fitness determinations. In response to our audits, NSF has established an IPA Candidate Vetting Working Group to make recommendations to the NSF Chief Operating Officer regarding the approach to vetting candidates for IPA positions at NSF. It has also made changes intended to improve the process for vetting IPA candidates for Assistant Director positions.

We previously reported on NSF's pilot and implementation of its cost share policy, effective January 31, 2020, requiring that institutions provide at least 10 percent cost share for every full-time IPA agreement. NSF reported that in FY 2020, 90 percent of all IPA assignments had a cost share. NSF continues to seek ways to improve its management of the IPA program and monitor the costs of and participation in the Independent Research/Development program. NSF also continues to evaluate the cost and effectiveness of the IPA program, such as through its Evaluation and Assessment Capability Section's June 2022 report.[10]

[8] OIG Report No. 17-2-008, NSF Controls to Mitigate IPA Conflicts of Interest, June 8, 2017
[9] Management Challenges for the National Science Foundation in Fiscal Year 2018, October 12, 2017
[10] Freyman, Christina. 2022. Rotator Study. Alexandria, VA: National Science Foundation.

NSF headquarters in Alexandria, VA. *Credit: Maria B. Barnes/NSF*

Key Completed Actions

- Established IPA Candidate Vetting Working Group.
- Made changes to improve the process for vetting IPA candidates for Assistant Director positions.
- Migrated Program Director and Executive IPAs to the USA Performance system for managing performance plans.
- Submitted the IPA Program Annual Report covering the prior fiscal year to NSF Director.

Key Ongoing Actions

- Addressing potential national and economic security threats, conflicts of interest, and improving the overall vetting process through the IPA Candidate Vetting Working Group.
- Continuing to develop and monitor internal controls related to the Independent Research/Development Program, including clear communication about program participation and policies.
- Applying enterprise risk management concepts to the IPA Steering Committee's risk environment to monitor metrics related to participation, demographic characteristics, annual costs, and cost share value.

Overseeing NSF-Funded Research Infrastructure

As part of its mission, NSF funds the development, design, construction, operation, and disposition[11] of research infrastructure; see Figure 1. Such awards include major multi-user research facilities (major facilities), like telescopes and ships, which cost more than $100 million to construct or acquire, and mid-scale research infrastructure (mid-scale) projects, including equipment and upgrades to major facilities, which cost between $4 and $100 million.

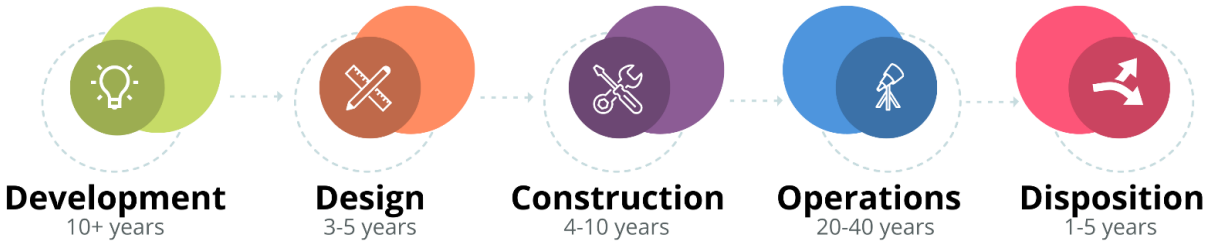
Major facilities and mid-scale projects are inherently risky because the infrastructure is one-of-a-kind and technically complex, and construction and operating costs are high. In FY 2021, NSF spent more than $160 million constructing and $967 million operating major facilities, and more than $180 million on mid-scale projects.

KEY FACTS

- This challenge involves an operation that is critical to an NSF core mission. It also presents a risk of fraud, waste, or abuse of NSF or other government assets.
- Major facilities and mid-scale projects are risky because of their uniqueness, complexity, and high costs.
- With a decade of corrective actions implemented, NSF's major facilities program is a model program.
- NSF is applying some of its major facility controls to its mid-scale projects.

As we reported in *Management Challenges for the National Science Foundation in FY 2022*, NSF has cemented its major facilities program as a model program, implementing corrective actions over the past decade. NSF's centralized investment in mid-scale projects is newer, however, with the first awards issued in FY 2019. NSF's Office of Budget, Finance, and Award Management is developing the capacity needed to oversee these awards, and it is drawing upon its experience in the management of major facility projects to develop the appropriate approaches for mid-scale projects. NSF is taking a more flexible approach in applying some of the major facility controls to its mid-scale projects as deemed appropriate. We will continue to review management requirements in mid-scale solicitations, controls for mid-scale projects, and training and experience of NSF staff responsible for making and overseeing mid-scale awards.

Figure 1. Major Facilities Life Cycle



Source: NSF OIG-depiction of NSF-provided data

[11] NSF previously referred to the disposition stage as "divestment."

Key Completed Actions

- Finished the Major Facilities Oversight Reviews standard operating guidance.
- Produced reports to track COVID-19 impacts on facilities' construction and operations.
- Implemented standard operating guidance on oversight and monitoring of property in the custody of recipients.
- Completed the major facilities portfolio workforce gap analysis.

Key Ongoing Actions

- Continuing to develop and implement the Program Management Improvement Accountability Act Course Curriculum Tool.
- Continuing to evaluate title to property (federally owned versus recipient-titled) and develop property transition plans, as necessary.
- Developing policies and processes to improve the planning and management of facility dispositions.

Star trails take shape around the 14-story Mayall Telescope dome at Kitt Peak National Observatory, a program of NSF's National Optical-Infrared Astronomy Research Laboratory (NOIRLab), in this long-exposure image.
Credit: NRAO/AUI/NSF, Jeff Hellerman (Creative Commons Attribution 3.0 Unported -- CC BY 3.0)

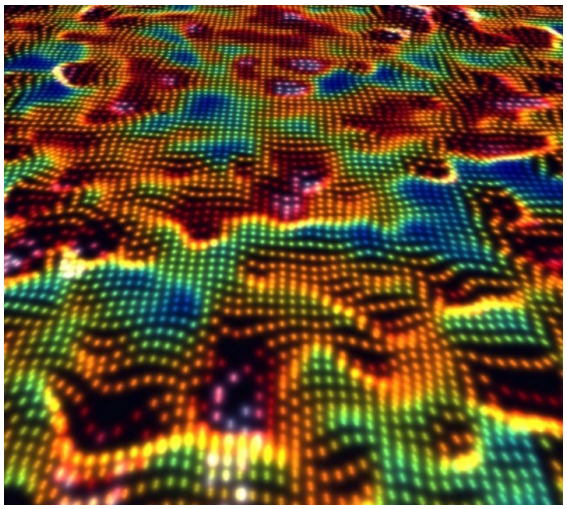
Mitigating Threats to Research Security

Safeguarding the U.S. research enterprise from threats of inappropriate foreign influence continues to be of critical importance. While significant challenges remain, U.S. funding agencies and academia have made progress in combating undue foreign influence, while maintaining an open research environment that fosters collaboration, transparency, and the free exchange of ideas.

NSF, and other agencies that fund research, continue to face challenges from foreign talent recruitment programs. According to the Office of Science and Technology Policy, a foreign government-sponsored talent program is an effort directly or indirectly organized, managed, or funded by a foreign government to recruit science and technology professionals in targeted fields. Nondisclosure of relationships with any such program adversely affects NSF decision-making on proposals. Although some of these programs are legitimate, many encourage or direct unethical and criminal behaviors, including the deliberate nondisclosure of the recruit's foreign position and associated foreign scientific funding. Contracts for participation in some programs include language that creates conflicts of commitment and/or conflicts of interest for researchers, such as requirements to attribute U.S.-funded work to a foreign institution; recruit or train other talent recruitment program members; circumvent merit-based processes; and replicate or transfer U.S.-funded work to another country.

KEY FACTS

- The issue presents a risk of fraud, waste, and abuse of NSF or other government assets.
- Federal agencies and academia have made progress in combating undue foreign influence on the U.S. research enterprise.
- NSF has worked to mitigate these threats, such as by developing guidelines for strengthening research security and created an Office of Research Security Strategy and Policy.
- NSF also has expanded research security training and educated the research community.



Electrons in a semiconductor distribute on surface in fractal patterns. *Credit: Roushan/Yazdani Research Group*

Over the past 4 years, NSF has taken meaningful action to mitigate threats posed by these programs. It strengthened disclosure requirements and processes is working to develop guidelines to strengthen research security. NSF has also provided compliance recommendations to U.S. academic institutions to ensure accurate disclosures to U.S. funding agencies. Further, it created an Office of Research Security Strategy and Policy, which has taken a leading role in the efforts of the federal government to combat this threat. It has expanded research security training and educated the research community. NSF should continue to assess and refine its controls in this area and ensure that it has sufficient staff and resources to address this challenge.

Key Completed Actions

- Created a Chief of Research Security Strategy and Policy (CRSSP) position in 2020, which was codified in the CHIPS Act.
- Created Chief Data Officer position.
- Launched the Research Security Strategy and Policy Group. Developed and implemented research security data analytics capability that captures nondisclosure of foreign affiliations, sources of funding, and collaborations that present conflicts of commitment or capacity.
- Communicated express prohibition of Foreign Talent Plan membership for all NSF staff, including rotators.
- Developed and implemented mandatory research security training for staff and rotators in direct communication with recipient organizations and principal investigators.
- Educated the research community about risks and compliance with NSF's policies and procedures.
- Strengthened disclosure requirements and processes, including implementing two new vehicles for submitting post-award information.
- Revised term and condition for foreign collaboration considerations in major facilities.
- Developed and implemented a new award term and condition for previously undisclosed information.
- Served as steward of the development of harmonized disclosure requirements for proposers and grantees that have been adopted by the U.S. government interagency community.
- Increased collaboration with NSF OIG, the Federal Bureau of Investigations, and other relevant stakeholders.

Key Ongoing Actions

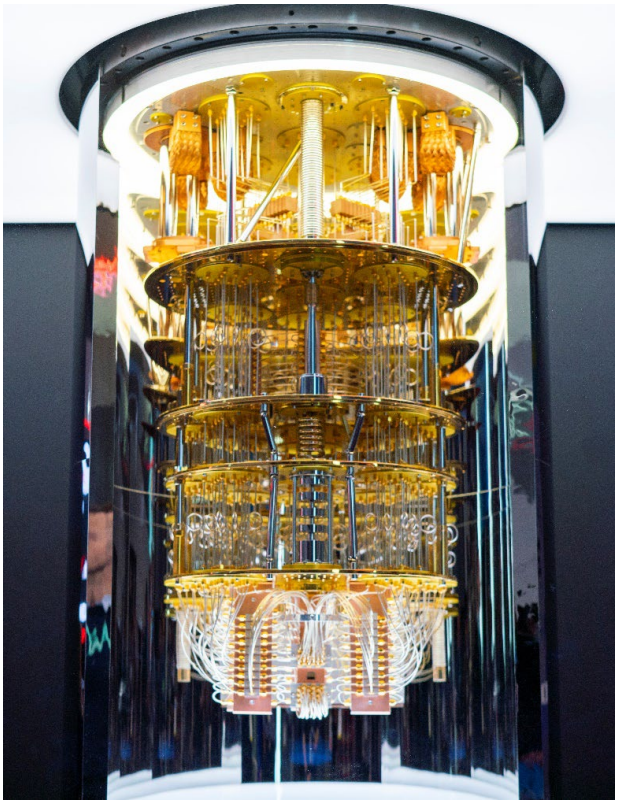
- Overseeing operations of the Research Security Strategy and Policy Group.
- Capturing nondisclosure of foreign affiliations, sources of funding, and collaborations that present conflicts of commitment or capacity.
- Continuing to conduct and monitor mandatory research security training for staff and rotators in direct communication with recipient organizations and principal investigators.
- Continuing education of the research community about risks presented by foreign talent recruitment programs and the importance of compliance with NSF policies and procedures.
- Continuing stewardship of harmonized disclosure requirements for proposers and grantees that have been adopted by the U.S. government interagency community.
- Maintaining collaborative relationships with NSF OIG, the Federal Bureau of Investigations, and other relevant stakeholders.
- Developing guidelines for strengthening research security.

Mitigating Threats Posed by the Risk of Cyberattacks

Federal agencies need information technology (IT) systems and electronic data to carry out operations and to process, maintain, and report essential information. The security of these systems and data is vital to public confidence and national security, prosperity, and well-being. NSF continues to make progress on improving the security of its data and systems and implementing a zero-trust architecture (ZTA) in response to EO 14028.[12] However, new cybersecurity risks remain on the horizon. For example, recent developments in quantum computing have created threats to long-trusted public key cryptography. Decryption that used to take traditional supercomputers more than 2 days can now be accomplished by quantum computers in about 3 minutes. With the large-scale increase in NSF's resources and staffing authorized by the CHIPS Act, as well as more personal devices connecting to the NSF network due to the post-pandemic shift to hybrid workspaces, NSF will need increasingly effective measures to ensure the availability, integrity, and confidentiality of data.

KEY FACTS

- This challenge is related to key initiatives of the President.
- The security of IT systems and data is vital to national security.
- NSF continues to make progress on improving IT security and implementing a zero-trust architecture, but new cybersecurity risks remain.
- Growing use of personal devices that connect to the NSF network may increase security risks.



Researchers programmed an IBM quantum computer to become a type of material called an exciton condensate. *Credit: Photo by Andrew Lindemann/IBM*

The U.S. Department of Homeland Security has provided guidance[13] to agencies to begin preparing for a transition to post-quantum cryptography. NSF could further prepare for this transition by identifying critical data and cryptographic technologies, identifying which public key cryptography is quantum vulnerable, and prioritizing systems for replacement based on mission requirements.

Our FISMA[14] audits have found that NSF has an effective information security program under current standards. NSF, however, could enhance its cybersecurity by implementing a Security Information and Event Management solution for its USAP network; implementing the use of PIV cards by USAP contractors; implementing security controls related to untrusted removable media devices; implementing a

[12] *Improving the Nation's Cybersecurity*, May 12, 2021
[13] *Policy Directive 140-15*, September 17, 2021
[14] *Federal Information System Modernization Act of 2014*, Pub. L. No. 113-283

formal monitoring program for the USAP employee screening process; and fully automating the annual recertification process for its service accounts.

Also, as NSF increases staffing in response to the CHIPS Act and continues to develop its post-pandemic hybrid approach to workspaces, it should assess its Virtual Private Network (VPN) and Virtual Desktop Infrastructure (VDI) capabilities to determine if changes or enhancements are needed to improve the availability, integrity, and confidentiality of NSF data.

Key Completed Actions

- Identified critical software.
- Implemented Login.gov as a multi-factor authentication option for external customers using Research.gov.
- Developed counterfeit detection awareness training for employees and contractors responsible for hardware and software acquisitions.
- Ensured USAP contractors who need privileged access to the USAP network are fully vetted.

Key Ongoing Actions

- Implementing a password review tool and updating the password policy.
- Identifying and analyzing potential vendors that can provide additional controls to prevent downloading, storing, and transferring sensitive data, including Personally Identifiable Information, to removable storage devices.
- Vetting and credentialing USAP contractors who need non-privileged access to the USAP network.
- Enforcing PIV use in all USAP locations.

Addressing Harassment in the Academic Community

Recently issued legislation and reports identify harassment in science as a pervasive issue, affecting participation in STEM. The CHIPS Act requires NSF to:

> expand research efforts to better understand the factors contributing to, and consequences of, sex-based and sexual harassment affecting individuals in the STEM workforce, including students and trainees; and to examine approaches to reduce the incidence and negative consequences of such harassment. The goal of this and other requirements is to combat harassment in science.[15]

The legislation includes findings from a National Academies of Sciences, Engineering, and Medicine 2018 report titled *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine*, which concluded that "sexual harassment is pervasive in institutions of higher education."

Additionally, as previously discussed, NSF received a report it commissioned, titled *Sexual Assault/Harassment Prevention and Response*, in June 2022, which detailed a needs assessment and recommended an implementation plan to address sexual harassment and sexual assault in the USAP. The report highlights a concern that providing effective oversight of awardee compliance may be particularly difficult for NSF in Antarctica and its associated research vessels and field sites due to lack of trust and reporting mechanisms.

KEY FACTS

- This issue involves an operation that is critical to an NSF core mission.
- The issue is related to key initiatives of the President.
- Recent reports and legislation indicate harassment is pervasive in institutions of higher education and a deterrent to participation in STEM.
- NSF commissioned a report highlighting concerns about providing effective oversight of awardee compliance in the USAP due to lack of trust and reporting mechanisms.
- NSF has taken additional action, such as implementing an award term and condition about reporting harassment or sexual assault; developing a USAP Code of Conduct; and setting expectations that research organizations establish and maintain clear and unambiguous standards of behavior.

NSF has stated it expects all research organizations to establish and maintain clear and unambiguous standards of behavior to ensure harassment-free workplaces wherever science is conducted.

NSF has taken additional action to address harassment by issuing statements to the academic community that harassment will not be tolerated and by implementing an award term and condition, effective October 22, 2018, requiring award recipients to notify the agency of any findings/determinations of sexual harassment, other forms of harassment, or sexual assault by an NSF funded Principal Investigator or co-Principal Investigator.[16] Additionally, NSF has developed a USAP Code of Conduct, and its current *Proposal & Awards Policies &Procedures Guide* states that NSF expects all research organizations to establish and maintain clear and unambiguous standards of behavior to ensure harassment-free workplaces.

[15] Subtitle D, SEC. 10534, (a)
[16] This term and condition is being evaluated by the Evaluation and Assessment Capability Section, as stated in Focus Area #1 of the NSF Equity Action Plan, "Efforts to Address Sexual and Other Forms of Harassment."

Sunset on the Weddell Sea in Antarctica. *Credit: Photo by Mia Wege*

It is imperative that NSF continue working to address harassment in the academic community and undertake prevention and response efforts. As previously discussed, this will also help ensure NSF meets its strategic goal to empower STEM talent to fully participate in science and engineering.[17]

Key Completed Actions

- Implemented terms and conditions requiring institutions report to NSF findings of harassment or assault by an NSF funded principal investigator or co-principal investigator.
- Reaffirmed/reinforced NSF's stance on sexual harassment in the awardee community.
- Developed USAP Code of Conduct.
- Updated Proposal & Awards Policies & Procedures Guide.

Key Ongoing Actions

- Reviewing policies and procedures to identify areas for improvement.
- Identifying next steps based on the developed implementation plan.
- Evaluating terms and conditions as part of its Focus Area #1 of the NSF Equity Action Plan.

[17] NSF Strategic Plan for Fiscal Years (FY) 2022-2026

Additional Resources

Introduction/Multiple Challenges

- NSF, FY 2023 Budget Request to Congress, May 2022
- NSF, Draft FY 2022 Progress Report on OIG Management Challenges, Undated
- NSF OIG, Management Challenges for the National Science Foundation in FY 2022, October 12, 2021
- NSF, FY 2021 Agency Financial Report, November 2021

Increasing Diversity in Science & Engineering Education and Employment

- NSF, Diversity, Equity, Inclusion, and Accessibility (DEIA) Strategic Plan 2022-2024
- NSF, NSF Strategic Plan for Fiscal Years (FY) 2022-2026, March 28, 2022
- NSF, National Science Foundation Learning Agenda FY 2022-FY 2026, March 2022
- NSF, National Science Foundation Annual Evaluation Plan, FY 2023, March 2022
- NSB-2020-15, Vision 2030, May 2020

Overseeing the United States Antarctic Program (USAP)

- NSF OD-22-18, Establishment of a Director's Task Force for Implementation of Measures to Combat Sexual Assault and Harassment in the United States Antarctic Program (USAP), October 3, 2022
- NSF Director Statement on USAP SAHPR Report and Follow-on Actions, undated
- NSF Action Plan (in response to SAHPR report), September 27, 2022
- Department of the Interior's Federal Consulting Group, NSF/OPP/USAP Sexual Assault/Harassment Prevention and Response (SAHPR) Final Report, June 22, 2022
- NSF OIG Report No. 22-6-004, NSF Vetting of United States Antarctic Program Contractors, March 18, 2022
- NSF OIG Report No. 22-2-003, Performance Audit of NSF's Information Security Program for FY 2021, November 17, 2021

Overseeing Grants in a Changing Environment

- Pub. L. No. 117-167, HR 4346 – CHIPS and Science Act of 2022, August 9, 2022

Managing the Intergovernmental Personnel Act Program

- OIG Report No. 17-2-008, NSF Controls to Mitigate IPA Conflicts of Interest, June 8, 2017
- NSF OIG, Management Challenges for the National Science Foundation in Fiscal Year 2018, Oct. 12, 2017
- Freyman, Christina. 2022. Rotator Study. Alexandria, VA: National Science Foundation.

Overseeing NSF-Funded Research Infrastructure

- NSF OIG Report No. 22-2-006, Audit of NSF's Divestment of Major Facilities, Sept. 2, 2022
- NSF 21-107, Research Infrastructure Guide, December 2021
- NSF OIG Report No. 20-2-007, Audit of NSF's Monitoring of Government-Owned Equipment Purchased on NSF Awards, August 26, 2020

Mitigating Threats to Research Security

- U.S. Government Accountability Office (GAO), Protecting Federal Research from Foreign Influence, January 2021
- GAO-21-130, Federal Research: Agencies Need to Enhance Policies to Address Foreign Influence, December 2020
- The White House Office of Science and Technology Policy, Enhancing the Security and Integrity of America's Research Enterprise, June 2020

Mitigating Threats Posed by the Risk of Cyberattacks

- Pub. L. No. 117-167, HR 4346 – CHIPS and Science Act of 2022, August 9, 2022
- The White House, National Security Memorandum on Promoting United States Leadership in Quantum Computing While Mitigating Risks to Vulnerable Cryptographic Systems, May 4, 2022
- Thomas Corbett and Peter W. Singer, China May Have Just Taken the Lead in the Quantum Computing Race, April 14, 2022
- 22-2-003, Performance Audit of NSF's Information Security Program for FY 2021, Nov. 17, 2021
- Department of Homeland Security Policy Directive 140-15, Preparing for Post-Quantum Cryptography, September 17, 2021
- The White House, Executive Order on Improving the Nation's Cybersecurity, May 12, 2021

Addressing Harassment in the Academic Community

- NSF OD-22-18, Establishment of a Director's Task Force for Implementation of Measures to Combat Sexual Assault and Harassment in the United States Antarctic Program (USAP), October 3, 2022
- NSF Director Statement on USAP SAHPR Report and Follow-on Actions
- NSF Action Plan (in response to SAHPR report), September 27, 2022
- Department of the Interior's Federal Consulting Group, NSF/OPP/USAP Sexual Assault/Harassment Prevention and Response (SAHPR) Final Report, June 22, 2022
- NSF, NSF Strategic Plan for Fiscal Years (FY) 2022-2026, March 28, 2022
- NSF OIG Report No. 22-6-004, NSF Vetting of United States Antarctic Program Contractors, March 18, 2022
- NSF 2201, Proposal & Award Policies & Procedures Guide, Effective Oct. 4, 2021
- NSF, National Science Foundation Agency Equity Action Plan
- National Academies of Sciences, Engineering, and Medicine. 2018. Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine. *Washington, DC: The National Academies Press.*
- OOP-POL_6000.01, National Science Foundation Office of Polar Programs Polar Code of Conduct, Effective July 2018

Staff Acknowledgments

Key contributors to this report include Mark Bell (Assistant Inspector General for Audits), Elizabeth Argeris Lewis (Executive Officer and Communications Analyst), Kevin Brown, Heather Gallagher, Javier Inclán, Elizabeth Kearns, Bill Kilgallin, Ken Lish, Melissa Woolson Prunchak, Laura Rainey, Kelly Stefanko, Lisa Vonder Haar, Megan Wallace, Nacole White, Emily Woodruff, and Vashti Young.

About NSF OIG

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National Science Foundation
Office of The Director

MEMORANDUM

DATE: October 19, 2022

TO: Ms. Allison Lerner, Inspector General, National Science Foundation

FROM: Dr. Sethuraman Panchanathan, Director, National Science Foundation

SUBJECT: Acknowledgment of the Inspector General's Fiscal Year (FY) 2023 Management Challenges Report and Transmittal of NSF's Progress Report for the FY 2022 Management Challenges

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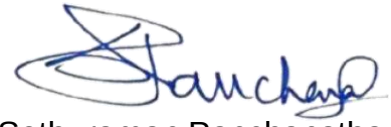
As Director of the National Science Foundation (NSF), I work each day to realize the agency's vision of, "a nation that leads the world in science and engineering research and innovation, to the benefit of all, without barriers to participation." I recognize the importance of assessing and mitigating risks and properly stewarding taxpayer dollars to the success of this work. The statutorily required report on Management Challenges that the Office of Inspector General (OIG) issues annually illustrates both the obstacles NSF faces in achieving its mission and vision, such as threats to research security and cyberattacks, as well as the strong processes the agency has in place to appropriately manage risk. The attached Progress Report for OIG Management Challenges for Fiscal Year (FY) 2022 outlines many of these processes and expresses our continued commitment to address challenges going forward, including in response to the FY 2023 OIG Management Challenges that your office shared October 14, 2022, as follows:

- Increasing Diversity in Science & Engineering Education and Employment
- Overseeing the United States Antarctic Program (USAP)
- Overseeing Grants in a Changing Environment
- Managing the Intergovernmental Personnel Act Program
- Overseeing NSF-Funded Research Infrastructure
- Mitigating Threats to Research Security
- Mitigating Threats Posed by the Risk of Cyberattacks
- Addressing Harassment in the Academic Community

The COVID-19 pandemic provided a stress-test for NSF's established risk management processes, which proved effective in addressing both ongoing and unforeseen risks. NSF pivoted to performing oversight of awards through virtual site visits and desk reviews, and developed new analytic approaches to identify potential oversight issues. It is through this same adaptability, innovation, and steadfast commitment to stewardship that NSF will effectively oversee new programs and awards resulting from the landmark CHIPS and Science Act of 2022 and the new Directorate for Technology, Innovation and Partnerships.

NSF will maintain its strong performance in oversight and management of awards, the Intergovernmental Personnel Act (IPA) program and research infrastructure, as we redouble our efforts on continued improvement in areas such as increasing diverse representation in science and preventing sexual assault and harassment. Among my highest priorities for NSF are ensuring accessibility and inclusivity, and creating a safe, harassment-free workspace and collegial culture in which research can thrive.

As always, NSF remains committed to serving the research community effectively, to continually improving stewardship across the agency, and to safeguarding Federal funds awarded by NSF in support of the agency's mission. We look forward to continuing to work with your office to achieve those goals.



Sethuraman Panchanathan

Attachments

cc: Chair, National Science Board
Chair, National Science Board, Committee on Oversight
Chief Financial Officer

National Science Foundation (NSF)
FY 2022 Progress Report on OIG Management Challenges

MANAGEMENT CHALLENGE 1: Increasing Diversity in Science and Engineering Education and Employment

NSF Leads: Sylvia Butterfield, Deputy Assistant Director, Directorate for Education & Human Resources[1] and Alicia Knoedler, Office Head, Office of Integrative Activities

Summary of OIG Identified Challenge

NSF's April 2021 *Women, Minorities, and Persons with Disabilities* report[2] stated that women, persons with disabilities, and certain minority groups are underrepresented in the nation's science and engineering education and workforce. The National Science Board (NSB)'s *Vision 2030* report[3], echoed this, noting that for the U.S. to lead globally in science and engineering (S&E), and to remain competitive, by 2030 the number of women in the S&E workforce must nearly double, the number of Black or African Americans must more than double, and the number of Hispanics or Latinos must triple compared to the respective numbers in the 2020 S&E workforce.

To address this challenge, NSF created the Racial Equity Task Force in September 2020 to focus on the missing millions in science, technology, engineering, and mathematics (STEM). In addition, NSF has taken numerous steps to address requirements in multiple Executive Orders on diversity, equity, inclusion, and accessibility (DEIA), including creation of an Equity Team of 14 agency leaders and providing input to a government-wide gender strategy. NSF maintains a comprehensive portfolio of programs to increase diversity in S&E. In doing so, there are opportunities to monitor NSF's efforts to develop strategies and programs to increase diversity in science and engineering education and employment, as well as measure their effectiveness over time. As discussed in OIG's Management Challenge on "Managing Transformational Change," NSF must also continue to provide resources and opportunities to strengthen and advance DEIA across its own employees as it transitions to a hybrid workforce model and grows as an agency.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

In his introduction to the new NSF Strategic Plan, the NSF Director, Dr. Sethuraman Panchanathan, notes: "while NSF has long invested in efforts to broaden participation in STEM, it is more important now than ever to underscore that the inclusion of all people in STEM is vital to the nation's health, security and global

[1] The name Directorate for Education and Human Resources (EHR) was changed to Directorate for STEM Education (EDU) in FY 2023.

[2] Women, Minorities, and Persons with Disabilities in Science and Engineering, available at https://ncses.nsf.gov/pubs/nsf21321/

[3] The NSB *Vision 2030* report outlines efforts to increase support for and impact of investments in fundamental science and engineering and a STEM-educated workforce. The full report can be accessed at https://www.nsf.gov/nsb/NSBActivities/vision-2030.jsp

leadership. We need young inspiring scientists from every background to be part of a STEM community full of diverse perspectives that can drive the research enterprise to new breakthroughs and innovations and help solve our most pressing challenges."[4]

Since its founding[5], NSF has recognized the importance of increasing diversity in science and engineering education and employment. Today, these efforts warrant unprecedented urgency given the national and economic concerns, and the global science and engineering trends outlined in the NSB's *Vision 2030* report, which note that "women and underrepresented minorities remain inadequately represented in science and engineering relative to their proportions in the U.S. population." NSF also recognizes the grand scale of these issues and the pressing need to recognize and embrace the full scope of challenges they bring. This will require the agency to leverage its broad sphere of influence and to act deliberately when developing and deploying all available strategies and programs. As such, NSF will intensify its efforts to ensure all sectors of society have the opportunity to contribute to the scientific enterprise. To underscore this, the new NSF Strategic Plan explicitly incorporates its commitment to ensuring accessibility and inclusivity into the agency's vision statement.[6] The Strategic Plan also establishes a new Agency Priority Goal that seeks to increase proposal submissions from investigators underrepresented in STEM and underserved institutions.[7]

In addition, the first strategic goal in the new plan is: "Empower STEM talent to fully participate in science and engineering," which aligns directly with this management challenge. This strategic goal emphasizes that to accelerate the advancement of discovery and learning and prepare for a world in which work is increasingly reliant upon scientific and technological skills, all citizens must share in the benefits that flow from research, and we must promote inclusion in the research community and STEM workforce, access to STEM learning and training, and widespread STEM literacy.

NSF takes a proactive, strategic management approach to its efforts to address the OIG Management Challenge of Increasing Diversity in Science and Engineering Education and Employment. Top agency leadership is addressing this challenge, dedicating resources to multiply capacity and demonstrate accountability and progress.

Top Leadership Commitment

The NSF Director has articulated and demonstrated a strong commitment to addressing this Management Challenge. He was the architect of the new NSF vision that centers accessibility and inclusivity. In FY 2022 the Director convened an NSF Leadership Retreat on broadening participation in the STEM enterprise. Dr. Panchanathan's actions have ensured that NSF's Leadership Team is coordinating the agency's numerous external activities, internal actions, and programmatic thrusts that exist across the agency. This has led to the formal framing of the "NSF Equity Ecosystem," which encompasses efforts to significantly impact equity and achieve demonstrable outcomes for broadening participation.[8] Through this framework, Dr. Panchanathan has appointed senior leaders responsible for how NSF policies, staff, and programs intersect

[4] NSF's Strategic Plan for FY 2022-2026, *Leading the World in Discovery and Innovation, STEM Talent Development Delivery of Benefits from Research* may be accessed at https://www.nsf.gov/pubs/2022/nsf22068/nsf22068.pdf

[5] Chapter 4 of the NSF blueprint, *Science: The Endless Frontier* (https://nsf.gov/od/lpa/nsf50/vbush1945.htm), identifies "The Renewal of Our Scientific Talent" as a priority for the then-nascent foundation, with a specific focus on removing the barriers that prevent major segments of society from participating in the scientific enterprise.

[6] The NSF Strategic Plan for FY 2022-2026 may be accessed at https://www.nsf.gov/pubs/2022/nsf22068/nsf22068.pdf; the vision and pillars are on page 9.

[7] Information on this Agency Priority Goal is available at: https://www.performance.gov/agencies/NSF/apg/goal-1/

[8] An NSB presentation of NSF top leadership explaining the Equity Ecosystem may be accessed at https://youtu.be/A643zjcFb1o?t=3707

and how the agency leverages shared knowledge, advocacy, and decades of Broadening Participation research[9] and practice.

Capacity

To be successful in supporting all who are underrepresented in STEM, including NSF employees and the broader STEM community, an expansion of champions and leaders is critical and must encompass those who can thrive in complex environments while navigating NSF's goals of supporting the workforce and delivering on the mission. NSF has similarly harmonized its activities at the program level by establishing an agency-wide knowledge sharing group focused on broadening participation that includes over 100 program officers and other officials and enables them to share best practices for broadening participation in STEM. The group's responsibilities include keeping the Broadening Participation website current and increasing internal awareness of upcoming activities and events. Similarly, NSF INCLUDES[10], an initiative to catalyze the STEM enterprise to work collaboratively for inclusive change, has continued to leverage its national network of awardees, other programs in the NSF Broadening Participation portfolio, other federal agencies and private sector institutions across the nation to fortify NSF capacity in this regard.

Demonstrated Progress

By building upon analysis and understanding of root causes and drivers, NSF has established clear performance measures and other mechanisms for strategic monitoring and oversight. For example, the FY 2022-2026 Learning Agenda[11] and associated FY 2023 Annual Evaluation Plan[12] identify relevant assessment and evaluation questions that relate to this challenge, and they provide detailed information about technical approaches for building the evidence needed to monitor progress and determine success. In addition, the NSF INCLUDES Shared Measures platform[13] presents findings and lessons learned from the national effort to broaden participation in STEM. By documenting the achievements and progress of the STEM community, this resource identifies noteworthy best practices and raises the visibility of NSF INCLUDES and other STEM Broadening Participation initiatives. It also documents, at a project level, the use of design elements in collaborative infrastructure and provides an inventory of broadening participation, institutional transformation, and system change indicators.

Managing Transformational Change

While NSF is striving for the types of transformational changes needed to increase diversity in the S&E community more broadly, the agency is also taking steps to improve DEIA among NSF staff and applicants. The NSF Racial Equity Task Force report developed a set of recommendations aimed at improving DEIA among NSF's workforce, and NSF is building upon this work as it responds to Executive Order 14035,

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[9] The Broadening Participation research portfolio consists of funding opportunities across all Directorates, which use different approaches to build STEM education and research capacity, catalyze new areas of STEM research, and develop strategic partnerships and alliances. For more information see: https://beta.nsf.gov/funding/initiatives/broadening-participation

[10] Information on NSF INCLUDES may be accessed https://beta.nsf.gov/funding/opportunities/inclusion-across-nation-communities-learners-underrepresented-discoverers#:~:text=The%20NSF%20INCLUDES%20National%20Network%20is%20composed%20of%3A,of%20society%20to%20build%20an%20inclusive%20STEM%20workforce.

[11] The NSF Learning Agenda for fiscal years 2022-2026 may be accessed at https://www.nsf.gov/od/oia/eac/PDFs/NSF_FY22-FY26%20Learning%20Agenda%20Final.pdf

[12] The NSF FY2023 Agency Evaluation Plan can be accessed at https://www.nsf.gov/od/oia/eac/PDFs/NSF%20Annual%20Evaluation%20Plan%20FY2023%20Final.pdf

[13] The NSF INCLUDES Shared Measures Platform can be accessed at https://networksharedmeasures.org/

"Diversity, Equity, Inclusion, and Accessibility in the Federal Workforce." In addition, NSF has recently published a DEIA Strategic Plan[14].

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

- NSF has taken a variety of budgetary approaches to broaden participation across its many programs with investments ranging from capacity building, research centers, partnerships and alliances to the use of co-funding or supplements to existing awards in the core research programs.[15]
- Provided robust funding for programs in FY 2021 to broaden participation, totaling $1.19 billion.[16]
- Developed and provided annually to Congress the Report on Funding to Minority-Serving Institutions, as required by the NSF Authorization Act of 2002 (P.L. 107-368).[17]
- Established the Racial Equity Task Force in June 2020, charged to identify institutional and other barriers to full inclusion in STEM and to make recommendations to eliminate those barriers – both inside NSF and in the community it serves.
- Conducted dissemination activities related to the *Women, Minorities, and Persons with Disabilities in Science and Engineering* reports.
- Supported the NSF INCLUDES National Network via a five-year cooperative agreement to the NSF INCLUDES Coordination Hub. The Hub collaborates with NSF to connect broadening participation stakeholders across the nation who are engaging in systems change to advance diversity, equity, and inclusion in STEM education and careers; catalyze collaborative action; and curate resources, measures, research findings, and expertise. The goal is to build Network members' capacity to effect change toward the goal of a more diverse, equitable, inclusive STEM workforce.
- Co-chaired the Federal Coordination in STEM Interagency Working Group on Inclusion in STEM and contributed to the publication "Best Practices for Diversity and Inclusion in STEM Education and Research: A Guide by and for Federal Agencies."[18]
- Provided data and program information to Committee of Equal Opportunities in Science and Engineering (CEOSE)[19] for their 2019-2020 biennial report, Making Visible the Invisible, that was transmitted to Congress in September 2021, recommending that NSF demonstrate, support, and reward bold leadership actions to create, integrate, and make visible efforts, promising practices,

[14] The NSF Diversity, Equity, Inclusion, and Accessibility (DEIA) Plan can be accessed at https://www.nsf.gov/od/oecr/reports/DEIA_Strategic_Plan_2022.pdf

[15] The full Broadening Participation Portfolio is available at https://www.nsf.gov/od/broadeningparticipation/bp_portfolio_dynamic.jsp

[16] The annual NSF Programs to Broaden Participation Budget Summary Table for the FY 2023 Budget Request to Congress can be accessed at https://www.nsf.gov/about/budget/fy2023/tables.jsp

[17] Annual reports to Congress on Funding to Minority-Serving Institutions may be accessed at https://www.nsf.gov/od/broadeningparticipation/bp_investments.jsp.

[18] The National Science and Technology Council's Committee on STEM Education via the IWGIS FC-STEM education subcommittee published the "Best Practices for Diversity and Inclusion in STEM Education and Research: A Guide by and for Federal Agencies" report in September 2021. It can be accessed at https://www.whitehouse.gov/wp-content/uploads/2021/09/091621-Best-Practices-for-Diversity-Inclusion-in-STEM.pdf

[19] CEOSE is a Congressionally mandated advisory committee, established in 1980 to advise NSF on policies and programs to encourage the full participation by women, underrepresented minorities, and persons with disabilities within all levels of America's science, technology, engineering, and mathematics (STEM) enterprise. Every two years the Committee prepares and submits a report to the NSF Director who transmits the report to Congress. More information on CEOSE can be accessed at https://www.nsf.gov/od/oia/activities/ceose/index.jsp

and impacts within and across its programs to broaden participation of groups underrepresented in STEM.

Demonstrated Progress Through Agency Actions Taken in FY 2022

- Released NSB Policy Brief, *The U.S. is a Keystone of Global Science & Engineering*, January 2022.[20]
- Released new strategic plan for fiscal years 2022-2026 on March 28, 2022, which explicitly incorporates accessibility and inclusivity into the NSF vision as its central pillar.
- Continued to respond to 2021 Executive Orders by complying with all requirements set forth in Executive Orders 13985, 13988, 14020, and 14035. Additionally, to further these Executive Orders and agency priorities, NSF
    - submitted an action plan[21] to address inequitable barriers in agency policies and programs (Executive Order 13985),
    - finalized and distributed within NSF the Racial Equity Task Force report in fall 2021, comprised of employee perspectives, recommendations, ideas, and potential strategies for racial equity growth and development, both internal and external to NSF;
    - reviewed the applicable documentation (Executive Order 13988);
    - Participates in the White House Gender Policy Council and has submitted input to the Government-wide Gender strategy (Executive Order 14020);
    - Published a DEIA strategic plan (Executive Order 14035);
- Took steps toward enhancing the merit review process and strengthening the broadening participation element of the Broader Impacts criterion by initiating pilots/exploratory work that:
    - Offers a "reviewer orientation" video available to all reviewers, which provides tips on structuring analytical reviews, information on the Broader Impacts review criterion, and ways to reduce the impact of unconscious cognitive associations;
    - The Division of Civil, Mechanical and Manufacturing Innovation (CMMI) in the Directorate for Engineering is piloting a reviewer training program called Game Changer Academies for Advancing Research Innovation. It aims to improve group dynamics during panel discussions, increase awareness of bias and identity, and enhance understanding of high-risk, high-reward ideas. Once trained, "Panel Fellows" will bring enhanced skills and awareness when they participate in panel discussions during NSF merit review. The Game Changer Academies grew out of a 2019 NSF-funded pilot project aimed at increasing reviewer risk tolerance.
    - In FY 2022, CMMI conducted an analysis to explore whether watching the reviewer orientation video improves the quality of reviews written by reviewers and trained over 300 panelists in the first two cohorts of CMMI Panel Fellows.
    - Launched a pilot to add Broader Impacts experts to Committees of Visitors (COVs).[22] The pilot will be ongoing throughout the remainder of FY 2022 and into FY 2023. Organizations conducting COVs during the pilot are asked to include at least one Broader Impacts expert on the COV. NSF is also providing COV members with an analysis of the proposed Broader Impacts for the proposals covered by the four-year period under review by the COV and conducting a post-COV survey of COV members. At the end of the pilot, NSF will do a

[20] The Keystone Policy Brief may be accessed at https://www.nsf.gov/pubs/2020/nsb20222/nsb20222.pdf
[21] The NSF Equity Action Plan Summary is available at https://www.whitehouse.gov/wp-content/uploads/2022/04/NSF-EO13985-equity-summary.pdf
[22] More information on NSF's Committee of Visitors process is available at https://www.nsf.gov/od/oia/activities/cov/

comparative analysis of COV reports submitted prior to the pilot and during the pilot. Progress in FY 2022 includes:

- Finalized development of a repeatable method for analyzing the distribution of proposed Broader Impacts in a portfolio.
- Collaborated with eight divisions to plan FY 2022-23 pilot COVs.
- Developed COV member survey.
- Conducted two pilot COVs to date with 3 more scheduled in FY 2022.

- Published the NSF Learning Agenda for FY 2022-2026 in March 2022 to ensure that evidence-building efforts pursued across the agency inform the extent to which the goals and objectives of the strategic plan are achieved. Specific to this challenge is Strategic Goal 1, to empower STEM talent to fully participate in science and engineering, and the corresponding guiding question – how can NSF help grow STEM talent and opportunities for all Americans most equitably?
- Convened CEOSE meetings three times per year and received key biennial reports and recommendations.
    - Publicly shared NSF's response to CEOSE's recommendations focused on implementing a shared accountability framework for NSF INCLUDES and increasing support for co-creation of research projects from diverse communities.
- Expanded the NSF INCLUDES portfolio with additional alliances focused on increasing equity and broadening participation in STEM; enhanced Build and Broaden 2.0 by clarifying eligibility requirements to increase the extent to which underrepresented groups and organizations may be engaged; and expanded the Broadening Participation portfolio with new funding opportunities:[23]
    - Inclusion across the Nation of Communities of Learners of Underrepresented Discovers in Engineering and Science (NSF 22-622)
    - Improving Undergraduate STEM Education: Hispanic-Serving Institutions (HSI) (NSF 22-611)
    - HSI Program Network Resource Centers and Hubs (HSI-Net) (NSF 22-602)
    - Dear Colleague Letter: Supporting Impactful Research, Undergraduate Education and Capacity Building at Historically Black Colleges and Universities (HBCUs) (NSF 22-069)
    - Build and Broaden 3.0 (NSF 22-530)
    - Computer and Information Science and Engineering Minority Serving Institutions Research Expansion Program (NSF 22-518)
    - Partnerships for Research and Education in Chemistry (NSF 21-620)
    - Cultural Transformation in the Geoscience Community (NSF 22-562)
    - MPS-Ascend External Mentoring (NSF 22-524)
    - Building Research Capacity of New Faculty in Biology (NSF 22-500)
    - Emerging Frontiers in Research and Innovation Planning Grants to Promote Diverse Participation (NSF 22-019)
    - Racial Equity Program Description (PD 21-191Y)
    - Dear Colleague Letter: Persons with Disabilities – STEM Engagement and Access (NSF 21-110)
    - Dear Colleague Letter: Research to Improve STEM Teaching, Learning, and Workforce Development for Persons with Disabilities (NSF 21-114)
    - Advancing Informal STEM Learning (AISL) (NSF 22-626) (re-released as Broadening Participation Focused Program)

[23] The full Broadening Participation Portfolio is available at https://www.nsf.gov/od/broadeningparticipation/bp_portfolio_dynamic.jsp

- Delivered a presentation to NSB in February 2022 on the Equity Ecosystem at NSF[24] and initiated strategic discussions to define and develop outcome and impact goals for NSF around the Missing Millions.
- Released *2022 Science & Engineering Indicators: The State of U.S. Science & Engineering*, on January 18, 2022, showing that strengthening the U.S. S&E enterprise is critical to maintaining the U.S. position as a lead performer and collaborator of science and technology activities globally.[25]
- Completed a Strategic Review about the new Growing Research Access for Nationally Transformative Equity and Diversity Initiative and presented to NSF Leadership on April 28, 2022.
- Conducted listening sessions with 259 individuals across 143 MSIs, two-year colleges, and primarily undergraduate universities to "design in" considerations of DEIA in programming for the new Directorate for Technology, Innovation and Partnerships.

NSF's Ongoing Actions

NSF management developed the following anticipated milestones in consideration of NSF's strategic and operational objectives and the previous actions NSF has already taken as described above:

- Implement, strategically monitor and oversee the FY 2022-2023 Agency Priority Goal Action Plan, which will improve representation in the scientific enterprise by making changes that will lead to an increase in proposal submissions from applicants underrepresented in STEM and underserved communities.
- Leverage the expertise of the Broadening Participation Knowledge Sharing Group via a sharing of best practices and offering solutions to mitigate risk in efforts to broaden participation.
- Initiate the new Growing Research Access for Nationally Transformative Equity and Diversity (GRANTED) initiative, which aims to improve the Nation's research support and service capacity at emerging and underserved research institutions. The GRANTED initiative will use a variety of mechanisms to further NSF's reach in advancing the geography of innovation and engaging groups underrepresented in STEM.
- The NSF Regional Innovation Engines (NSF Engines) program will further the goals of the geography of innovation by boosting capacity at specific institutions and in specific regions that have been underfunded to date.[26]
- Adopt the NSF Learning Agenda study plans designed to 1) inform how NSF can increase the participation of underrepresented groups in the STEM workforce and 2) elucidate the ways in which the COVID-19 pandemic influenced the participation of different groups in the NSF portfolio of programs and activities.
- Continue the work of the NSF Racial Equity Task Force, including planning implementation of the recommendations made. Efforts will also include further barrier analysis to include data challenges. The recommendations currently under development include, but are not limited to, procurement of a civil rights case management system, a non-discrimination clause included in the *Proposal & Award Policies & Procedures Guide*, and removing supervisory approval as a requirement to apply for internal details.

[24] The Equity Ecosystem NSB presentation may be accessed at https://youtu.be/A643zjcFb1o?t=3707

[25] Science and Engineering Indicators 2022 may be accessed at https://ncses.nsf.gov/pubs/nsb20221

[26] More information on the NSF Engines program is available at https://beta.nsf.gov/funding/initiatives/regional-innovation-engines/resources-and-contact-information#:~:text=Learn%20about%20NSF's%20Regional%20Innovation,creation%2C%20and%20cultivate%20regional%20talent.

- Continue the work of NCSES and EAC to examine the challenges of limited data in terms of studying small groups of people who are underrepresented in STEM, as well as less studied groups, e.g., sexual orientation/gender identification, who may be underrepresented and would enhance diversity in the science and engineering workforce.
- Evolve and continue outreach to and engagement with tribal communities and tribal governments through the Tribal Consultation and Engagement Working Group. In FY22, the working group defined recommendations for internal resourcing and clarifications to NSF policies and procedures and worked to develop externally-facing resources to enable greater access and inclusion of tribal communities to NSF opportunities.
- NSF considers geographic diversity as part of our Broadening Participation DEIA work and part of our ongoing work is to receive input from the research community about increasing research and learning capacity in US states and territories that are underfunded throughout NSF's portfolio. In FY 2022, NSF has received a report on the Future of NSF EPSCoR through the CEOSE advisory committee, which provides recommendations to NSF around future directions for the NSF EPSCoR program as well as opportunities for geographic engagement and innovation throughout NSF.

MANAGEMENT CHALLENGE 2: Overseeing the United States Antarctic Program (USAP)

NSF Lead: Roberta Marinelli, Director, Office of Polar Programs

Summary of OIG Identified Challenge

NSF, through the United States Antarctic Program (USAP), manages U.S. scientific research in Antarctica. Leidos Innovations Corporation (Leidos) currently holds the Antarctic Support Contract (ASC) for USAP logistical support, valued at $2.3 billion over 13 years. Through this and other contracting vehicles, NSF is also implementing a long-range infrastructure investment program across the three U.S. Antarctic stations (McMurdo, Palmer, and South Pole). The Office of Polar Programs (OPP) monitors Leidos' performance under the contract, with several other NSF offices, including the Office of Budget, Finance, and Award Management (BFA) and the Office of Information and Resource Management (OIRM).

The onset of COVID-19 in 2020 added unprecedented complexity and uncertainty to USAP operations, including limiting deployments to only those deemed most critical, and halting on-ice construction at McMurdo for the Antarctic Infrastructure Modernization for Science (AIMS) project and the Information Technology and Communications (IT&C) primary addition project. Additionally, recent information security audit findings have identified challenges in USAP's implementation of authentication and incident response requirements and the onboarding and vetting process for ASC contractors.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

Antarctica's remote location, extreme environment, and the short period of time each year during which the continent is accessible present challenges above and beyond those typically encountered for domestic construction projects and science operations. COVID-19 dramatically increased these challenges. Throughout the pandemic, USAP ensured the safety of deployers, prevented any cases of COVID-19 infection from reaching NSF stations, avoided the loss of many millions of dollars related to research infrastructure investments, and maintained the integrity of decades-long data sets.

USAP's recovery from the drastic curtailment of activity during the pandemic is now underway along three lines of thrust – executing a temporary surge in logistics support to clear the backlog of delayed science and construction work, replanning major construction projects to establish new cost and schedule baselines for monitoring contractor performance, and pivoting our recapitalization approach to an enduring program rather than a single major effort. To provide effective government oversight of these activities, the Antarctic Infrastructure and Logistics Section in OPP continues to mature financial management, performance monitoring, and planning processes.

Regarding information security, USAP has been working towards modernizing our processes, resources, and tools following a period of less-than-adequate investment. Some of these efforts have included a monthly cyber security risk discussion with USAP leadership that is based on formal metrics with trend analysis, a more robust Acceptance of Risk program, addition of technical resources to support government oversight

of contractor performance, implementation of personal identity verification (PIV) credentialing, and increased rigor in vetting of elevated-risk contractors.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

For ongoing operations, USAP's risk mitigation approach for the last two years was based on applying the best available medical advice to guide agency deployment decisions, and then working closely with authorities in the logistics gateways – New Zealand and Chile – to implement those decisions. The OPP brought on-board a medical doctor and a gateway liaison who were vital throughout the pandemic. Through a combination of reductions in the number of deployers and pre-departure testing and quarantine protocols, two seasons were successfully completed with no COVID-19 infections at U.S. stations.

For construction projects, deployment of crews to McMurdo during the pandemic presented too great a risk for a COVID-19 outbreak that could have led to severe, long-term health and safety consequences on the continent. Instead, with close collaboration between OPP and BFA, the major projects – AIMS and IT&C primary addition – were put on hold and are now being re-baselined. Safe deployment of construction workers to Palmer Station was possible, and the Palmer Pier Reconstruction Project moved forward.

For information security, with close collaboration between OPP and OIRM, the primary actions that reduced risk were formalizing monthly metrics and trend analysis with the ASC, increasing the breadth and rigor of USAP's Acceptance of Risk program, and establishing a risk-based project execution plan for implementing PIV credentialing.

Demonstrated Progress Through Agency Actions Taken in FY 2022

- Included an increase in the Antarctic logistics budget in the President's FY 2023 request to fund a surge in logistics support for the post-COVID-19 operational recovery effort.
- Accepted a new AIMS project baseline following an external panel review, an independent cost assessment by the US Army Corps of Engineers (USACE), and successful Earned Value Management System (EVMS) acceptance and surveillance reviews.
- Improved audit logging capability to support acquisition of security information and event monitoring tools for the USAP network.
- Documented an Acceptance of Risk and Corrective Action Plan for contractor vetting concerns identified by the OIG and cleared the backlog of over one hundred contractors in elevated risk positions requiring NSF adjudication.
- Achieved initial and final operating capability for enforcing PIV credentials in the Denver-based offices of Leidos and at our inter-agency partner, NIWC. Achieved initial operating capability for USAP locations outside the U.S.
- Began implementation of a new process for NSF adjudication of all contractors on the ASC.

NSF's Ongoing Actions

NSF management developed the following anticipated actions in consideration of NSF's strategic and operational objectives and the previous actions NSF has already taken as described above:

- Continue monitoring and oversight of the AIMS project in accordance with established internal management and project execution plans, including external panel reviews and EVMS surveillance reviews.
- Leverage the expertise within the USACE to provide quality assurance through design and constructability technical reviews, on-ice construction observation, cost estimating services, and schedule and cost review.
- To augment NSF oversight activities, AIMS has been added to the Office of the Director's Watch List which elevates visibility and monitoring of this important project as it goes through the crucial period of returning to construction.
- USAP has begun initiating an Antarctic Infrastructure Recapitalization program that will allow ongoing renewal of critical infrastructure with a well-defined annual budget and according to priorities established by USAP stakeholders. The program may include AIMS work not funded under the re-baselined project scope, as well as critical infrastructure needs across all stations and logistical gateways. The program is managed according to an Internal Management Plan and in collaboration with a dedicated NSF Integrated Project Team.
- Cybersecurity improvements will continue to be implemented, using a risk-based prioritization approach that ensures effective cybersecurity in the unique environment of the USAP network. Activities will include executing an acquisition strategy to procure a managed security service provider to automatically detect malicious network events, continuing personnel screening adjudication of unprivileged and non-sensitive positions and update the Leidos ASC Section H to include appropriate security and privacy requirements, establishing a project to address removable media concerns within the USAP network environment (depending on FY 2023 project approval), and continuing to implement a trusted internet connection for the USAP network.

MANAGEMENT CHALLENGE 3: Overseeing Grants in a Changing Environment

NSF Lead: Janis Coughlin-Piester, Chief Financial Officer and Office Head, Budget, Finance, and Award Management

Summary of OIG Identified Challenge

Although NSF executed a strong response to measure and mitigate the impacts of the pandemic, institutions continue to confront mounting fiscal constraints, related in part to lower-than-anticipated tuition revenue and declining support from state governments, endowments, or other funding sources. These factors could influence awardees' abilities to comply with award terms and conditions and exercise proper stewardship of federal funds.

NSF is focused on growing the STEM workforce and increasing participation from currently underrepresented groups. This could increase the proportion of small to mid-size institutions, which may have less experience managing federal funds, or may need to strengthen their controls to account for more funding. This evolving grants management environment may increase the risk that recipients will misuse funds, which in turn, would increase the need for NSF to strengthen the community's understanding of grant management guidance and monitor how the community responds to these risks.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

Overview

NSF's current advanced monitoring activities and Enterprise Risk Management (ERM) programs provide a strong foundation for effective oversight over the agency's grant portfolio. ERM provides a framework for NSF to objectively evaluate the need for new or enhanced controls by monitoring potential changes in portfolio composition, or other emerging risks in the research community, such as fiscal constraints and student enrollment challenges. NSF is currently assessing the risk and control environment related to grants award, oversight and monitoring, and closeout processes to confirm controls are operating effectively against the evolving risk environment. Testing will help uncover any areas of weakness where controls should be added or strengthened to help ensure ongoing compliance with award terms and conditions and proper use of federal funds.

A summary of completed and ongoing actions is presented in the below subsections.

Strong Foundational Improper Payment Compliance and Controls

The NSF OIG recently completed its performance audit for the Payment Integrity Information Act of 2019 (PIIA). NSF conducted both qualitative and quantitative risk assessments over its grant and cooperative agreement program to assess improper payment risk, with particular focus over heightened risks due the COVID-19 pandemic. In the final PIIA audit report, the independent auditor determined that NSF's risk assessment conclusion that the overall low improper payment risk level for its grant and cooperative agreement programs was reasonable, and also determined that NSF adequately concluded the programs have low risk of making improper payments above the statutory threshold. There were no findings and

recommendations within the draft report, and this audit serves as a strong baseline for assessing future changes in portfolio composition—e.g., an increase in small to mid-size grantees—or new risks to fiscal stewardship in the external grantee environment, and will inform how NSF can monitor how such change may impact improper payment risk. In FY 2022, NSF also conducted exploratory payment testing over its Graduate Research Fellowship Program (GRFP), in consultation and collaboration with the Directorate for Education and Human Resources (EHR).[27] NSF conducted this exploratory testing to assist in estimating the rate of improper payments within GRFP and evaluating the current control environment. NSF concluded from this testing that GRFP also had low risk of improper payments above the statutory threshold.

Enhanced Project Reporting Oversight

To further enhance its portfolio oversight, NSF assembled the Project Reporting Improvement Team (PRIT) to implement actions to improve compliance on the timely submission of grant project reports across the agency. Bringing together expertise in policy, NSF business systems, award monitoring, and project reporting, the PRIT's significant collaborative efforts have included data analytics; listening sessions with university system senior administrators through the Federal Demonstration Partnership (FDP); pilot testing new processes, systems, and outreach mechanisms; and direct communications with the research community. The PRIT has worked collaboratively to increase compliance with NSF's project reporting requirements using a multi-pronged approach that includes communications and preventative strategies. Severely overdue reports (i.e., those more than 120 days overdue) have proven particularly difficult to obtain. However, since December 2021, Top 20 institutions have submitted over 400 reports that were at least 120 days overdue. Over 100 of these were over a year overdue. Overdue reports on awards that ended more than a year ago decreased overall by 15 percent since December 2021, but the Top 20 institutions accounted for 62 percent of the observed reduction in this category. In June 2022, NSF issued a second round of Top 20 notices that resulted in another nearly 400 reports submitted to date. NSF has also started to direct some targeted communications to recipients on an award-by-award basis to encourage their compliance with the reporting requirements in 2 CFR 200.344 Closeout. Additionally, the PRIT has recommended policy and procedure clarifications regarding project reporting. These implemented enhancements will solidify NSF's controls around result-oriented accountability, enabling the agency to better scale its processes to integrate additional small and medium institutions under future, more substantial budget increases and increased emphasis on awards to currently underrepresented groups.

Grant Recipient Assessment and Monitoring Tools

NSF has recently implemented a suite of awardee self-assessment tools and fact sheets on subrecipient monitoring and participant support costs along with additional fact sheets on various topics. These tools allow awardee organizations to independently self-assess compliance in the areas of participant support and sub-recipient risk assessment and monitoring. Additional business assistance tools are in progress including the development of FAQs to support recipient oversight and management of subawards. In addition, enhancements to the participant support self-assessment tool will provide recipients with additional guidance on cost allowability.

Enterprise Risk Management

Effective oversight and support of grant awards that enables grantees to effectively manage their award portfolios are critical to accomplishing the agency's mission. NSF continues to leverage its strong control environment and ERM governance structure to identify opportunities that will enhance monitoring and

[27] The name Directorate for Education and Human Resources (EHR) was changed to Directorate for STEM Education (EDU) in FY 2023.

oversight. The release of the NSF 2022-2026 Strategic Plan provided an opportunity to reflect on the linkage between strategy and risk and revisit the agency's risk profile for "Overseeing Grant Awardees." The risk profile articulates how NSF is considering risks related to the effectiveness of grantee monitoring. This year, the agency has updated the profile to capture both the approach to mitigating threats to effective monitoring and pursuing opportunities to enhance the agency's interactions with grantees. The profile is a tool that spurs productive dialogue on current and proposed risk responses and enhances coordination across the agency's organizational units. For example, through collaboration on the risk profile updates, the ERM Risk Captains identified the opportunity to collaborate on a roadshow for grantees on lessons learned from a recent OIG review that could improve effectiveness in the management of fellowship funding.

Managing Transformational Change

NSF will continue to emphasize data analytics and evidenced-based decision making in the monitoring of its grant portfolio. As part of its ERM program, NSF launched a quarterly series of Program Integrity & Data Science Touchpoints. These collaborative discussions between BFA and research directorates will provide a forum to discuss emerging risks and demonstrate analytic tools to monitor these risks.

As the challenge is written prospectively on the potential increased risks due to a change in portfolio composition of small and mid-size awardees, NSF continues to monitor these changes through its normal award monitoring processes and procedures, with planned enhancements to monitor portfolio composition through analytics. To further enhance this, NSF is creating an integrated and collaborative effort around supporting the new types of awardee institutions anticipated under programs for the Directorate for Technology, Innovation and Partnerships (see response to Management Challenge 8, below), as well as for individuals underrepresented in STEM and underserved institutions. NSF's new Agency Priority Goal to, "improve representation in the scientific enterprise" by making changes that will lead to an increase in proposal submissions from applicants and communities that are underrepresented and underserved offers a strong mechanism for managing this transformational change. NSF is pursuing this emphasis even under existing resources and is also exploring other authorities to reach these groups underrepresented in STEM. NSF is also analyzing the CHIPS and Science Act of 2022 and its potential impacts to portfolio composition and grant oversight, which will continue into FY 2023.[28]

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

- Completed triennial PIIA risk assessment, including a quantitative and qualitative risk assessment over the entire NSF grant portfolio. Assessment results indicated a low risk of improper payments.
- Established oversight controls over Coronavirus Aid, Relief, and Economic Security (CARES) Act and American Rescue Plan supplemental funding.
- Assembled the Project Reporting Improvement Team (PRIT) to implement actions to improve compliance on the timely submission of grant project reports across the agency.

Demonstrated Progress Through Agency Actions Taken in FY 2022

- Developed monitoring to observe changes and trends in portfolio composition related to small and mid-sized grantees.

[28] The CHIPS and Science Act, Public Law 117-167 was enacted August 8, 2022 and authorizes various new programs and activities at NSF. https://www.congress.gov/bill/117th-congress/house-bill/4346/text

- Implemented a suite of awardee self-assessment tools and fact sheets on subrecipient monitoring and participant support costs along with additional fact sheets on various topics.
- Established quarterly Program Integrity & Data Science Touchpoints to discuss emerging risks and demonstrate analytic tools to monitor these risks.
- Continued to implement enhancements to improve the timely submission of grant project reports.
- Completed 24 site visits and 103 desk reviews under NSF's advanced award monitoring and oversight program. An additional 22 desk reviews are planned for submission by September 30, 2022.
- The NSF OIG's independent PIIA performance audit report supported NSF's conclusion in its FY 2021 risk assessment that its grant and cooperative agreement programs have low risk of making improper payments above the statutory threshold.
- Completed exploratory payment testing of the GRFP program to assess the control environment and risk of improper payments.

NSF's Ongoing Actions

NSF management will continue to execute the following monitoring activities in consideration of NSF's strategic and operational objectives, which expand upon the previously completed agency actions described above.

- Execute annual advanced monitoring site visits and desk reviews.
- Proactively monitor portfolio composition and potential increases of small and mid-size grantees.
- Refine enterprise risk profiles around the NSF grants portfolio to account for future environment changes.
- Develop additional grantee self-assessment and monitoring tools for publication to further educate the research community on sound oversight.
- Execute annual PIIA compliance activities to measure changes to NSF's current baseline low risk of improper payments and conduct annual baseline payments testing.

MANAGEMENT CHALLENGE 4: Managing the Intergovernmental Personnel Act Program

NSF Leads: Wonzie Gardner, Chief Human Capital Officer, and Office Head, Office of Information and Resource Management; and Joanne Tornow, Assistant Director, Directorate for Biological Sciences

Summary of OIG Identified Challenge

NSF provides the opportunity for scientists, engineers, and educators to rotate into the agency as temporary Program Directors, advisors, and leaders. Rotators bring fresh perspectives from across the country and across all fields of science and engineering supported by NSF, helping influence new directions for research in science, engineering, and education, including emerging interdisciplinary areas. Many of these rotators remain involved in their professional research and development activities while working at NSF through participation in the independent research/development (IR/D) program, which is overseen by the NSF IR/D Council. Risks associated with rotators include conflicts of interest, frequent turnover, and salaries not subject to federal pay and benefits limits.

Over the past several years, NSF has taken steps to address these risks. NSF has implemented a cost share policy requiring that institutions provide a minimum 10 percent cost share for every full-time Intergovernmental Personnel Act (IPA) agreement. Additionally, NSF facilitated a focus group for IPAs who onboarded during the pandemic to help identify unique challenges associated with onboarding in a remote-work environment. NSF has also continued to strengthen its policies around the IR/D program, potential conflicts of interest, performance management and managing turnover.

NSF's current focus is the vetting and hiring processes related to the IPA program. The goal is to further reduce the risks inherent to the IPA program and strengthen NSF's control environment while maintaining diligent oversight and monitoring of the continuing IPA challenges.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

NSF takes a proactive approach in the management of the IPA program to appropriately consider and mitigate inherent risks associated with its execution. The IPA Steering Committee is charged with ensuring NSF is best utilizing the IPA hiring authority. It advises the agency's senior leadership on matters that directly concern policy on the use of the IPA program, and on common approaches to budgeting and implementation of the program. It also regularly reports on its oversight and stewardship of the IPA program, including costs associated with the program, to the NSF Director and Chief Operating Officer, the Office of Management and Budget (OMB), and Congress, pursuant to the American Innovation and Competitiveness Act (AICA).

Monitoring Program Challenge Progression

NSF continues to monitor the use of IPA assignments on an ongoing basis, providing a data-driven summary to NSF senior leadership via an annual review of metrics related to participation, demographic characteristics, annual costs, and cost share value. Analyses of these data have demonstrated positive trends in increasing demographic diversity and reductions in annual costs. In FY 2021, NSF saved $2 million in costs by using the IPA program to fill key scientific positions, in comparison to the average comparable

Federal rate. It is with such talent that NSF is better positioned to promote the progress of science. NSF's scientific community and the American taxpayer all benefit from a regular influx of scientists and engineers with exceptional expertise and experience.

NSF has taken steps to ensure the IPA program fully supports the mission of the agency and the nation's interests. For example, NSF has addressed the management challenges identified by the OIG as well as other agency-identified risks and challenges by integrating program and executive level IPAs into the USAPerformance system to enhance its ability to monitor supervisory oversight of IPA performance. NSF is also engaging in continuous improvement of its management of the IPA program and participation in the IR/D program. Indeed, NSF believes that the steps taken to date have reduced the inherent risk substantially, such that the residual risk is acceptable to the agency.

Managing Transformational Change

Based on the preemptive measures discussed above and continuous management improvements of the IPA program, NSF feels it is prepared to effectively manage transformational change and support the agency's expected growth and overall human capital strategy.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

NSF has completed many actions over the last several years regarding the oversight and monitoring of the IPA program. Many policies and practices have been put into place that have successfully mitigated the identified risks related to the IPA program. NSF will continue to maintain the excellent management practices that have been acknowledged by the OIG.

Some of the major actions NSF has taken to address this challenge in prior years include:

- Resolved and closed the recommendations from the OIG report, "NSF Controls to Mitigate IPA Conflicts of Interest."[29] NSF effectively minimized the inherent risk of IPA conflicts of interest while working at NSF (as most IPAs come from institutions receiving NSF grants).
- Established a Steering Committee for Policy and Oversight of the IPA Program (IPA Steering Committee) to serve as the primary body for considering policy on NSF's use of IPAs, and to oversee common approaches to budgeting and implementation of the IPA program.
- After a successful pilot period, NSF implemented the required cost share as policy, requiring that institutions provide a minimum of 10 percent cost share for every full-time IPA agreement. The total amount of cost share by institutions increased by over $1 million due to the implementation of this policy, and 90 percent of IPA agreements include cost sharing. The cost share mechanism continues to maximize taxpayer value.

Demonstrated Progress Through Agency Actions Taken in FY 2022

NSF has identified the need to better vet incoming IPAs via the recent OIG audit on the agency's internal processes. To address concerns and risks identified, NSF has established an IPA Candidate Vetting Working Group. The purpose of the group is to make recommendations to the NSF Chief Operating Officer regarding the NSF approach to vetting candidates for IPA positions at NSF.

[29] Report available at https://www.oversight.gov/sites/default/files/oig-reports/17-2-008_COI.pdf

- NSF's Office of Information and Resource Management proactively improved the process for vetting IPA candidates for Assistant Director positions, which was used for two Assistant Director searches in FY 2022.
- The IPA Candidate Vetting Working Group has partnered with NSF stakeholders to address issues such as (1) potential threats to national or economic security by IPA candidates with foreign affiliations or sources of funding; (2) potential risks due to other conflicts of interest and commitments; (3) confirmation of eligibility, salary, and employment history; (4) timeliness of vetting relative to employment offers and start of assignment; and (5) responsibility and overall timeline for various aspects of vetting and assessment.

NSF's Ongoing Actions

NSF management developed the following anticipated milestones and responses to the findings in the FY 2022 OIG Management Challenge Report in consideration of NSF's strategic and operational objectives, the risks inherent to achieving these objectives, and the key actions NSF has already taken in response to those risks.

The IPA Steering Committee will continue to use ERM concepts, applying them to the committee's risk environment to monitor metrics related to participation, demographic characteristics, annual costs, and cost share value.

The IR/D Council will continue to develop and monitor internal controls related to the IR/D Program, to include clear communication on participation and NSF policies on the use of IR/D.

The NSF IPA Candidate Vetting Working Group will partner with NSF stakeholders to address the below issues:

- Potential threats to national or economic security by IPA candidates with foreign affiliations or sources of funding,
- Potential risks due to other conflicts of interest and commitment,
- Timeliness of vetting relative to employment offers and start of assignment, to include identifying the responsibilities and authorities of different organizations within NSF and how and when they interact during the process, and
- NSF will release a Corrective Action Plan related to OIG's audit on the agency's IPA vetting process in FY 2023.

MANAGEMENT CHALLENGE 5: Overseeing Major Multi-User Research Facilities

NSF Leads: Linnea Avallone, Chief Officer for Research Facilities and Janis Coughlin-Piester, Chief Financial Officer and Office Head, Budget, Finance, and Award Management

Summary of OIG Identified Challenge

As part of its mission, NSF funds award recipients to manage the development, design, construction, operation, and divestment of major multi-user research facilities (major facilities), which are state-of-the art infrastructures that support research and education and include telescopes, ships, detectors, and distributed observatories. The major facilities portfolio is complex and has certain inherent risks including meeting emergent scientific objectives, protecting the safety of life and property, potential construction delays, and unanticipated additional costs. The OIG previously reported on the risk of inadvertent misuse of funds and improper use of budget contingency, but the COVID-19 pandemic presented additional, unique challenges across the portfolio. Following the flexibilities granted by the Office of Management and Budget (OMB) in response to the pandemic, NSF took action to address the associated cost impacts by developing internal and external guidance for major facility programs and award recipients. NSF has continued to monitor this unforeseen event, implement mitigation strategies, and assess any remaining financial impacts as the pandemic becomes better understood and managed.

Since 2015, NSF has implemented enhanced controls and strengthened agency governance to fully address OIG recommendations, the recommendations of the 2015 National Academy of Public Administration report, the requirements of the *American Innovation and Competitiveness Act of 2017* (AICA), and FY 2018 and FY 2019 Government Accountability Office (GAO) reports. As a result, oversight of NSF's major facilities portfolio has continued to evolve and improve each year, making it a model program within NSF.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

NSF understands the importance of its role in overseeing award recipients' on-going management of major facilities. The agency also recognizes the importance of assessing prospective recipients' capabilities for managing major facilities prior to award. Over the past several years, NSF has strengthened its oversight policies and procedures. This includes a bi-annual Major Facilities Portfolio Risk Assessment to determine the necessary reviews and audits to be conducted by the Office of Budget, Finance, and Award Management (BFA). In close cooperation with NSF program offices, BFA's Large Facilities Office (LFO) and Division of Acquisition and Cooperative Support conduct these reviews to safeguard NSF's significant, long-term investments in supporting the scientific endeavor.

NSF leadership continues to show its commitment to major facilities oversight through appointment of the Chief Officer for Research Facilities (CORF) and periodic use of the Office of the Director's Watch List. The governance structure currently in place, which includes the Accountable Directorate Representatives, Facilities Governance Board, Facilities Readiness Panel, and the Director's Review Board, continues to help ensure consistent implementation of NSF's enhanced controls related to major facilities oversight. Furthermore, NSF is ensuring adequate human capacity among the Major Facility oversight staff through

implementation of the Program Management Improvement Accountability Act (PMIAA) on the major facility/acquisition portfolio, and by establishing guidance on the necessary core competencies for recipient staff managing major facilities.

Since 2017, NSF has been through five GAO reviews related to its oversight of projects funded from the Major Research Equipment and Facilities Construction (MREFC) account. The June 2018 report (GAO-18-370)[30] recommended that NSF revise its policies for estimating and reviewing the costs and schedules of major facility projects to better incorporate the best practices in GAO's guides. The March 2019 report (GAO-19-227)[31] recommended that NSF conduct a workforce gap analysis for project management competencies, ensure recipients provide lessons learned and best practices to NSF, and establish criteria for recipient project management competencies to be incorporated into NSF's review process. The April 2020 report (GAO-20-268)[32], the June 2021 report (GAO-21-417)[33], and the July 2022 report (GAO-22-105550)[34] had no new recommendations. NSF has corrective action plans (CAPs) in place as described below, and five of the six GAO recommendations from 2018 and 2019 are considered fully implemented.

The COVID-19 pandemic presented unique challenges for major facilities, including protecting the safety of personnel and property, construction delays, and other unanticipated additional costs related to this unforeseen event. The greatest risks were loss of scientific capability, the inadvertent misuse of funds when re-budgeting (Operations Stage awards) and the proper use of budget contingency (Construction Stage awards). Following the flexibilities granted through OMB Guidance under the pandemic, NSF took action to address these risks by developing internal and external guidance for major facility programs and recipients. These efforts included the following: (1) developing and updating a set of frequently asked questions (FAQs) specific to major facility recipients as a complement to NSF's implementation of OMB Guidance; (2) issuing guidance jointly from the CORF and LFO to NSF program officers in response to the COVID-19 pandemic to ensure recipients segregate and track related cost increases; and (3) providing guidance for addressing re-baselining of construction projects, incorporation of impacts into earned value management, and the application of management reserve to reduce the need for de-scoping. NSF followed its current policies and controls with only minor clarifications. No additional controls were deemed necessary.

NSF has evaluated this management challenge under ERM considering the activities already completed and those planned for FY 2022. NSF has determined that the residual risk impact for fraud, waste and abuse (Risk 1) is "low" and the likelihood is "very low," and that the residual risk impact for scientific performance (Risk 2) is "moderate" and the likelihood is "very low." Risk 2 impact and likelihood assume sufficient additional funding is made available when needed to sustain on-going activities. Additional funding needs for both Operations Stage and Construction Stage awards were addressed by reprogramming of funds, modification of budget requests to Congress, and application of American Rescue Plan funds as described below. NSF's controls related to major facility oversight adequately considered and balanced risk, resources, benefit to the science community, and stewardship of federal funds.

[30] GAO-18-370 is available at https://www.gao.gov/products/gao-18-370.
[31] GAO-19-227 is available at https://www.gao.gov/products/gao-19-227.
[32] GAO-20-268 is available at https://www.gao.gov/products/gao-20-268.
[33] GAO-21-417 is available at https://www.gao.gov/products/gao-21-417.
[34] GAO-22-105550 is available at https://www.gao.gov/products/gao-22-105550

Regarding removal criteria described in OIG Bulletin 18-02, Attachment 2,[35] NSF believes it has demonstrated senior-level leadership commitment through the appointment of the CORF, has CAPs in place that implement solutions that are tied to root causes, and has established appropriate performance measures to monitor construction progress. Capacity is demonstrated through rigorous reporting and accountability, and workforce capacity will continue to be enhanced as NSF completes implementation of PMIAA for the major facilities portfolio. In addition, NSF has implemented planned corrective actions, demonstrated progress, and monitored on-going activities as described below.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

Since 2015, NSF has implemented enhanced controls and strengthened agency governance to fully address the recommendations of the 2015 National Academy of Public Administration report; the requirements of the AICA; the FY 2018 and FY 2019 GAO reports; and numerous OIG report recommendations. Examples of recent (FYs 2020 and 2021) agency actions include the following:

- Revised Major Facility Terms and Conditions to require recipients to participate in NSF's Major Facilities Knowledge Management Program, which identifies good practices aimed at improving agency oversight and recipient management of major facilities projects, as part of the CAP for GAO-19-227.
- Required recipients of Construction Stage awards to develop Segregation of Funding Plans.
- Continued use of the Office of the Director's Watch List under cognizance of the CORF with inclusion based on credible threats of cost or schedule overruns, performance issues, or constituting a new, high-risk, large-scale endeavor for the agency.
- Re-programmed funds appropriated in the MREFC account for use as management reserve to cover documented costs incurred due to COVID-19.
- Implemented corrective actions in response to all OIG recommendations under OIG Report *Audit of NSF's Oversight of Subrecipient Monitoring* (18-2-005),[36] which included updating various NSF policies and procedures related to subrecipient risk assessments.
- Continued to monitor allocation of funds between awards as part of required cost incurred audits using Segregation of Funding Plans as reference.
- Completed the major facilities portfolio workforce gap analysis and began development of a Course Curriculum Tool tied specifically to the major facility oversight competency model as part of PMIAA implementation and the GAO-19-227 CAP.
- Finalized revisions to the 2021 *Major Facilities Guide* (MFG) and the re-titled 2022 *Research Infrastructure Guide* (RIG),[37] including:

[35] OIG Bulletin 18-02, "Management Challenges," dated August 15, 2018, describes OIG's process for identifying and reporting the most significant management challenges facing NSF and the National Science Board (NSB). This document also describes OIG's criteria for removing prior reported management challenges.

[36] OIG Report 18-2-005 is available at https://www.oversight.gov/report/nsf/audit-nsf%E2%80%99s-oversight-subrecipient-monitoring

[37] The *Major Facilities Guide* was renamed to the *Research Infrastructure Guide* to be more inclusive of the expanding portfolio of Mid-Scale Research Infrastructure.

    - More detailed guidance on Segregation of Funding Plans which was provided to the OIG for consideration in closing recommendations in OIG Report 19-2-006,[38] *Audit of NSF's Controls to Prevent Misallocation of Major Facility Expenses.*
    - Development of new sections on Key Personnel and Recipient Core Competencies.
    - Development of Section 4.3, *Schedule Development, Estimating, and Analysis* (GAO-19-227)
- Revised and published the *Business Systems Review (BSR) Guide* to better align with the Uniform Guidance and address implementation of segregation of funding plans and the allocation of expenses during the Construction and Operations Stages (if identified as a risk).
- Revised and published *Obligation and Allocation of Management Reserve* Standard Operating Guidance (SOG) (NSF-LFO-FY19-02-00) to clarify the relationship to the National Science Board's delegation of award authority and to eliminate the $10 million applicability limit for use on construction projects impacted by the COVID-19 pandemic.
- In response to the OIG audit report *Monitoring of Government-Owned Equipment Purchased on NSF Award*s (20-2-007), implemented a new SOG on *NSF Oversight and Monitoring of Property in the Custody of Recipients* (NSF-BFA-IRM-FY20-01, Rev 0), transferred title of property to recipients as appropriate, conducted a vehicle allocation methodology, and updated optimal fleet profiles for NSF-titled vehicles.
- Authorized additional management reserve for projects in the Construction Stage, either using the Director's delegated authority or requesting authorization from the National Science Board, as appropriate, to account for continuing impacts of the COVID-19 pandemic and other unforeseen events (e.g., Hurricane *Ida*) and enhanced federal requirements for data security.
- Allocated FY 2021 funds from the American Rescue Plan to cover realized and anticipated COVID-caused cost increases for projects in the Construction Stage, as well as for operations of the Academic Research Fleet.
- Until April 2022, produced a regular report on COVID-19 impacts on major facilities in both the Operations and Construction Stages,[39] which kept leadership aware of the current state of COVID-19 impacts and where NSF action or enhanced oversight might be necessary.

Demonstrated Progress Through Agency Actions Taken in FY 2022

- Finalize the *Major Facilities Oversight Reviews* SOG and provide to the OIG and GAO for consideration in closing a remaining recommendation in OIG Report 19-2-006, *Audit of NSF's Controls to Prevent Misallocation of Major Facility Expenses* and a recommendation on recipient project management expertise from GAO-19-227 [FY 2022, Q3].
- Addressed pending OIG recommendation on NSF's divestment of major facilities by utilizing NSF's 2022 Strategic Review process to develop revised definitions and other recommendations related to policies, procedures, and practices. Revised internal standard operating guidance related to competition, renewal, and divestment [FY 2022, Q4].

[38] OIG Report 19-2-006 is available at https://oig.nsf.gov/reports/audit/audit-nsfs-controls-prevent-misallocation-major-facility-expenses.

[39] The regular COVID-19 impacts report was produced weekly by the CORF, working closely with the ADRs, from early March 2020 through mid-June 2020, then biweekly through the beginning of March 2021, and now is produced once per month.

NSF's Ongoing Actions

NSF management established the following milestones in consideration of NSF's strategic and operational objectives and the previous actions NSF has already taken as described above:

- Complete development and implementation of the PMIAA Course Curriculum Tool for the major facilities oversight workforce as part of PMIAA implementation and the GAO-19-227 CAP. Monitor progress through periodic self-assessment surveys or other means.
- Continue to evaluate title to property (federally-owned versus recipient-titled) and develop property transition plans, as necessary.

MANAGEMENT CHALLENGE 6: Mitigating Threats Posed by Foreign Government Talent Recruitment Programs

NSF Lead: Rebecca Keiser, Chief of Research Security Strategy and Policy

Summary of OIG Identified Challenge

Safeguarding the U.S. research enterprise from threats of inappropriate foreign influence is of critical importance to NSF and other agencies that fund research, especially as the research community continues to face challenges from foreign talent recruitment programs. According to the Office of Science and Technology Policy, a foreign government sponsored talent program is an effort directly or indirectly organized, managed, or funded by a foreign government to recruit science and technology professionals in targeted fields. While some countries sponsor such programs for legitimate purposes, some programs encourage or direct unethical and criminal behaviors. Contracts for participation in some programs include language that creates conflicts of commitment and/or conflicts of interest for researchers, such as requirements to attribute U.S.-funded work to a foreign institution; recruit or train other talent recruitment plan members, circumventing merit-based processes; and to replicate or transfer U.S.-funded work in another country.

NSF has taken action to mitigate threats posed by such programs. NSF should continue to assess and refine its controls in this area and should work to ensure that it has sufficient staff and resources to address this challenge.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

To maintain a vibrant science and engineering community for the benefit of the nation and maintain the integrity of international scientific collaborations, NSF seeks to safeguard the U.S. research enterprise from threats of inappropriate foreign influence. Participation in this community relies on individuals to uphold core principles such as openness, transparency, reciprocity, collaboration, and integrity. However, open scientific exchange and research face a challenge from some foreign governments through the use of talent recruitment programs. Some of these programs deliberately disregard these core principles and incentivize participants to misappropriate U.S.-funded scientific research prior to its open publication. These programs target scientists, engineers, and educators of all nationalities working or educated in the United States.

Over the past four years, NSF has taken action to mitigate threats posed by talent recruitment programs by working to strengthen disclosure requirements and processes; developing guidelines for strengthening research security; creating a research security strategy position; expanding research security training; and educating the research community.

NSF focuses on the following risks to its funded research from foreign government interference:

- Conflicts of interest that need to be recognized and mitigated by the U.S. employers of the research community,
- Undisclosed research duplication and researcher commitments to research entities outside their U.S. employer,
- Compromises to the merit review system, and

- Unauthorized use of pre-publication data and information.

NSF serves as co-chair of the National Science and Technology Council (NSTC) Subcommittee on Research Security, working closely with the rest of the U.S. government to develop policy that enhances the security and integrity of America's science and technology research enterprise. The Subcommittee on Research Security brought together science agencies and law enforcement to develop the recommendations that served as the foundation for National Security Presidential Memorandum 33 (NSPM-33).[40] The *Recommended Practices for Strengthening the Security and Integrity of America's Science and Technology Research Enterprise*, and the associated fact sheet were released by the White House in January 2021 to direct a national response to safeguard the security and integrity of federally-funded research and development (R&D) in the United States.[41]

In January 2022, the NSTC Subcommittee on Research Security subsequently published the NSPM-33 Implementation Guidance to provide further direction to federal departments and agencies on issues regarding disclosure of conflicts of interest, digital persistent identifiers, consequences for violation, information sharing, and research security programs.[42] The Subcommittee on Research Security is in the final stages of developing common disclosure formats that will soon be released for public comment.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

NSF has completed many actions in prior fiscal years to help mitigate threats posed by foreign government talent recruitment programs and ensure the integrity of federally-funded research. Below are a few of the major actions NSF has taken to address this challenge in prior years.

To provide organizational leadership and oversight, NSF created and filled the first-in-government position of the Chief of Research Security Strategy and Policy (CRSSP) in 2020. The CRSSP provides the NSF Director with policy advice on all aspects of research security strategy while concurrently leading efforts alongside relevant NSF offices to develop and implement strategies that improve research security and the agency's coordination with the White House and other federal agencies.

In March 2020, NSF released mandatory training for all NSF personnel on science and security. The training includes modules on the importance of international collaborations, undue foreign government interference, NSF's policies on disclosure, and NSF's policies on staff participation in foreign government talent recruitment programs. In August 2021, NSF released a second phase of training aimed at staff that directly communicate with proposer and awardee organizations as well as principal investigators on new

[40] The National Security Presidential Memorandum 33 (NSPM-33) may be accessed at https://trumpwhitehouse.archives.gov/presidential-actions/presidential-memorandum-united-states-government-supported-research-development-national-security-policy/

[41] Recommended Practices for Strengthening the Security and Integrity of America's Science and Technology Research Enterprise may be accessed at https://trumpwhitehouse.archives.gov/wp-content/uploads/2021/01/NSTC-Research-Security-Best-Practices-Jan2021.pdf. The associated fact sheet is available at https://trumpwhitehouse.archives.gov/wp-content/uploads/2021/01/NSC-OSTP-NSPM33-Fact-Sheet-Jan2021.pdf.

[42] Guidance for Implementing National Security Presidential Memorandum 33 (NSPM-33) may be accessed at https://www.whitehouse.gov/wp-content/uploads/2022/01/010422-NSPM-33-Implementation-Guidance.pdf.

requirements in the proposal process related to the submission of "Current and Pending Support" and the "Biographical Sketch" by senior personnel.

As part of its revision to the Proposal & Award Policies & Procedures Guide (PAPPG), NSF announced that use of an NSF-approved format will be required to be used by senior personnel in preparation of both the biographical sketch and current and pending support sections of the proposal.[43] In addition, a new table entitled, *NSF Pre-award and Post-award Disclosures Relating to the Biographical Sketch and Current and Pending Support,* has been developed, disseminated, and updated in April 2022 to assist users in completion of these sections of the proposal.[44]

In FY 2021, NSF greatly increased its collaboration with the OIG and the Federal Bureau of Investigation to exchange information and take action to address offenses, where appropriate. NSF worked collaboratively with the OIG, where appropriate, to address threats posed by foreign government talent recruitment programs. In 2021, consistent with our OIG Cooperation Directive, NSF continued to support the OIG's investigations, including those involving allegations related to foreign talent programs. Following referrals by the OIG, NSF has recouped, or prevented the loss of, millions of taxpayer dollars through actions on awards given to institutions of higher education and small businesses through NSF award suspension, government-wide suspension, and NSF award termination.

Demonstrated Progress Through Agency Actions Taken in FY 2022

Pursuant to NSPM-33, the NSPM-33 Implementation Guidance, and the recommendations of JASON, NSF took multiple actions in FY 2022, which are summarized here:

Developing Policy Across the Enterprise

- NSTC Subcommittee: NSF continues to serve as a co-chair on the NSTC Subcommittee on Research Security, closely working with the White House and other federal science funding agencies, intelligence, and law enforcement communities to coordinate policy and practices, and conduct outreach to institutions of higher education and other research organizations. The NSTC Subcommittee on Research Security is currently working to provide further guidance to the federal enterprise and research community on standardized disclosure formats, digital persistent identifiers, and standardized research security program standards. In addition, the Subcommittee is hosting listening sessions to connect with members of the Asian American, Native Hawaiian, and Pacific Islander communities on issues related to research security and integrity.

  Malign Foreign Talent Programs Working Group: The NSF working group, chaired by the CRSSP, was developed to make recommendations to the NSF Director regarding strategy and implementation of a prohibition of involvement in foreign government talent recruitment programs for those supported by an NSF project, for NSF reviewers, and for those working at NSF-funded large facilities. Following enactment of the CHIPS and Science Act of 2022, NSF is coordinating with the White House

[43] NSF's Proposal & Award Policies & Procedures Guide (PAPPG) may be accessed at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf22001&org=NSF. Additional information on the biographical sketch is available at https://www.nsf.gov/bfa/dias/policy/biosketch.jsp and on the current and pending support is available at https://www.nsf.gov/bfa/dias/policy/cps.jsp.

[44] The updated NSF Pre-award and Post-award Disclosures Relating to the Biographical Sketch and Current and Pending Support table can be accessed at https://www.nsf.gov/bfa/dias/policy/disclosures_table/april2022.pdf.

Office of Science and Technology Policy (OSTP) as OSTP is responsible for coordination of a malign foreign talent plan prohibition.

- Intergovernmental Personnel Act (IPA)-Vetting Working Group: The IPA-vetting Working Group was developed to make recommendations to the Chief Operating Officer regarding (1) potential threats to national or economic security by IPA candidates with foreign affiliations or sources of funding; (2) potential risks due to other conflicts of interest and commitments; (3) confirmation of eligibility, salary, and employment history; (4) timeliness of vetting relative to employment offers and start of assignment; and (5) responsibility and overall timeline for various aspects of vetting and assessment. Recommendations are expected to be delivered to the COO in FY 2023.
- Revision of Terms and Conditions: NSF is undergoing a process to revise the terms and conditions with a requirement on principal investigator certifications for inclusion in the 2023 PAPPG.
- JASON study on "Research on Research Security": NSF is working with the JASON Advisory Group to begin a study that will advise on the constitution of a program on "Research on Research Security."
- Security Clearances Working Group: The NSF working group was formed to make recommendations to the CRSSP regarding establishing a more consistent approach to managing clearances agency-wide. The working group, which met over two phases, worked to develop high-level principles and strategies for determining which positions require security clearances for NSF personnel (Phase 1), and a final set of implementation recommendations (Phase 2). The CRSSP later made recommendations to the Director and COO for integration into NSF's policies and practices.

Pursuing a Systems of Record Notice (SORN) to Use Data Analytics Tool

- SORN-77: NSF published a notice on a new system of records, NSF-77 Data Analytics Application Suite, that will aggregate, link, and analyze information reported by individuals and organizations participating in NSF-supported activities along with published information related to the research enterprise.[45]

Continuing Outreach and Education

- Research Security Training for the External Community and Solicitation: NSF published a solicitation, a joint effort with four other federal agencies (the National Institutes of Health, the Department of Energy, the Department of Defense, and the Federal Bureau of Investigation), to develop online training modules designed to promote the understanding of research security threats as they relate to activities of researchers and other key personnel whose work is supported by federally-funded research awards at awardee organizations.[46] The training will include aspects of talent programs and is also intended to fulfill the training portion of the research security program condition in NSPM-33, which directs federal funding agencies to strengthen protections of U.S. government-supported research and development against foreign government interference and exploitation.
- Outreach to the Academic Community: To increase awareness of the risks and compliance with NSF's policies and procedures, NSF's CRSSP participated in numerous meetings and conferences with the research community, including but not limited to meetings with the Association of American Medical Colleges, the Association of International Education Administrators, the Association of Public and Land Grant Universities, the American Physical Society, the American Physiological Society,

[45] NSF-77 Data Analytics Application Suite can be accessed at https://www.federalregister.gov/documents/2021/11/09/2021-24487/privacy-act-of-1974-system-of-records.

[46] The joint solicitation on Research Security Training for the United States (U.S.) Research Community (NSF 22-576) can be accessed at https://www.nsf.gov/pubs/2022/nsf22576/nsf22576.htm#pgm.

AUTM, the Council on Governmental Relations, the National Academies of Sciences, Engineering, and Medicine, as well as to institutions of higher education such as Bucknell University, Duke University, the University of Arizona, the University of Pennsylvania, the University of Tennessee-Knoxville, and the University of Texas.

NSF's Ongoing Actions

NSF will continue to work diligently to address the risks of foreign government interference in NSF-funded research so that our research community can continue to contribute to the U.S. economy and U.S. security. NSF management developed the following anticipated milestones in consideration of NSF's strategic and operational objectives, and previous actions are described above. Ongoing and future actions include:

- NSTC Subcommittee: NSF will continue to serve as co-chair on the NSTC Subcommittee on Research Security and work closely with the White House, other federal science funding agencies, and intelligence and law enforcement communities to coordinate policy, develop practices, and engage with the research community.
- Malign Foreign Talent Program Working Group: The NSF Malign Foreign Talent Program Working Group will revise policy and implementation options based on the CHIPS and Science Act of 2022.
- 2023 PAPPG: Additional language in the 2023 PAPPG is in development to conform with the NSPM-33 Implementation Guidance, including language on standardized disclosure formats and consequences for violation.
- JASON study "Research on Research Security": The Office of the CRSSP will work to carry out an initial implementation of JASON's study on the constitution of a program on "Research on Research Security."
- Research Security Risk Assessment Center[47]: The Office of the CRSSP will begin concept development on a Research Security Risk Assessment Center and other duties assigned to the Office of the CRSSP as outlined in the CHIPS and Science Act of 2022.
- Research Security Training for the Research Community: The Office of the CRSSP will work together with awardees under cooperative agreements to develop training for the research community in research security. The training requirement is also included in the CHIPS and Science Act of 2022.
- NSF Engines Program: The NSF Engines program under the new Directorate for Technology, Innovation and Partnerships (TIP) is considering new approaches to research security. Specifically, TIP may engage lead awardee organizations in periodic reviews of their research security approaches, both to verify accountability for the large and complex NSF Engines awards, and for the tangential benefit of other awards to those lead awardee organizations.

[47] "The Research Security Risk Assessment Center" is expected to incorporate the requirements that the CHIPS and Science Act of 2022 assigns to a Research Security and Integrity Information Sharing Analysis Organization. https://www.congress.gov/bill/117th-congress/house-bill/4346/text

MANAGEMENT CHALLENGE 7: Mitigating Threats Posed by the Risk of Cyberattacks

NSF Lead: Dorothy Aronson, Chief Information Officer

Summary of OIG Identified Challenge

The prevention, detection, assessment, and remediation of cybersecurity incidents is a top priority of the Administration and essential to national and economic security. Recent world incidents, such as those impacting SolarWinds and Microsoft Exchange, demonstrate the significant risk to federal information when systems are breached. In these and other incidents, foreign governments exploited vulnerabilities in commercial software programs used by federal agencies and gained privileged access to federal systems, allowing them to extract data and personally identifiable information. Although these incidents did not directly affect NSF, they highlight the need for increasingly effective measures to ensure the availability, integrity, and confidentiality of data used to achieve NSF's mission.

Executive Order 14028 "Improving the Nation's Cybersecurity"[48] directs agencies to focus on implementing or expanding key baseline security measures, including universal logging, multi-factor authentication, reliable asset inventories, and ubiquitous use of encryption; and to adopt a zero-trust architecture (ZTA). Zero-trust assumes there is no implicit trust granted to assets or user accounts based solely on their physical or network location or based on asset ownership, and thus shifts to an authentication model where every stage of a digital interaction is validated.

Although OIG has found that NSF has an effective information security program under current FISMA standards, the agency could enhance cybersecurity by implementing zero trust measures.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

NSF's Information Technology (IT) Security Program is committed to ensuring that NSF infrastructure and assets are appropriately protected while maintaining an open and collaborative environment for scientific research and discovery. The agency established a strong and comprehensive risk-based IT Security Program consistent with government-wide guidance and industry best practices. NSF maintains a sophisticated and robust capability to quickly detect and respond to incidents, including state-of-the-art network and security protections as well as advanced threat and breach protections that provide industry-leading threat visibility and detection against attacks.

NSF recognizes the importance and necessity of moving to a modern data-centric model of cybersecurity as government networks evolve and adopt more resilient architectures. The concept of ZTA provides the framework for implementing controls and providing scalability as NSF extends mission critical applications into diverse cloud environments. NSF's ZTA plan and approach describes plans to address the five pillars of

[48] Executive Order 14028, "Improving the Nation's Cybersecurity" is available at https://www.whitehouse.gov/briefing-room/presidential-actions/2021/05/12/executive-order-on-improving-the-nations-cybersecurity/

the Department of Homeland Security's Zero Trust Maturity Model: identity, device, network/environment, application workload, and data.

NSF is employing a multi-pronged approach to the implementation of the ZTA model. NSF understands that implementing a mature ZTA is a long-term effort that will require coordinated efforts across many pillars of cybersecurity. NSF developed a high-level roadmap towards zero trust adoption to move our security program forward with a defense-in-depth strategy. NSF's zero trust approach focuses on a security model that informs risk-based decisions and integrates the principles across the entire IT environment.

NSF's Completed Actions to Address the Challenge

NSF has implemented many actions in support of ZTA principles. NSF leverages the Department of Homeland Security's Continuous Diagnostics and Monitoring program for asset inventory and information sharing; fully deploys endpoint detection and response capabilities; maintains a vulnerability disclosure policy; and implements techniques where components are replaced rather than changed in the NSF Amazon Web Services (AWS) cloud environment.

In years prior to FY 2022 NSF completed encryption of data at rest, and initiated encryption of data in transit.

Demonstrated Progress Through Agency Actions Taken in FY 2022

Implementation of encryption of data in transit continues in FY 2022. In addition, NSF made significant progress in the following areas in FY 2022:

- Enterprise identity management and multifactor authentication: NSF implemented Login.gov for Research.gov as an option for external customers to facilitate the implementation of multi-factor authentication for external users. NSF will be continuing to expand multifactor authentication, e.g., PIV access, for internal applications and is in the early stages of assessing the effort, time and resources required.
- Software security testing: NSF conducts comprehensive and rigorous software testing, including automated security testing throughout the system authorization process. Further manual security testing is planned to strengthen automated testing to provide adequate software security assurance.
- Secure internet accessible system: NSF has identified an initial plan for making a system internet accessible and is in the process of modifying a system to be accessible over the public internet and evaluating the accessibility for others.
- Auditing encrypted data in NSF's AWS cloud environment: NSF incorporates independently managed AWS storage service encryption and decryption services in AWS and configures encryption for data at rest. NSF will continue to encrypt data at rest where the data storage solution contains sensitive data.
- Supply chain risk management anti-counterfeit training: NSF developed and delivered counterfeit detection awareness training for employees and contractors who test software and hardware, have IT security roles, or conduct acquisitions or purchases. The counterfeit awareness training applies to employees and contractors who have IT security roles or conduct acquisitions or purchases.

NSF is incorporating ZTA approaches into all agency modernization strategies. NSF made significant strides in moving IT systems and services to the cloud to modernize legacy technology, improve capacity and uptime, enable more standardization of services, and leverage the security benefits of cloud-based infrastructure. As NSF continues to move agency systems and services to the cloud, the agency will use the

principles of ZTA in cloud planning and deployment efforts. NSF's continuing work will further strengthen data protection, access controls, and application boundaries in alignment with ZTA principles.

NSF's Ongoing Actions

NSF's near-term zero trust efforts are focused on establishing new capabilities to reduce risk and protect sensitive agency data from compromise. NSF's IT infrastructure, applications, security, and development teams are using this approach to describe how NSF plans to isolate applications and environments based on the zero trust principles.

In line with Office of Management and Budget (OMB)'s guidance *Moving the U.S. Government Toward Zero Trust Cybersecurity Principles*,[49] NSF has developed an initial plan to achieve zero trust security goals by the end of FY 2024. As this plan develops, NSF will continue to refine the long-term ZTA migration plan in alignment with guidance from OMB. NSF understands implementing a mature Zero Trust Architecture is a long-term effort requiring coordinated efforts across and within the agency.

In addition to the actions NSF has already taken as described above, NSF management identified the following priority milestones in support of a zero-trust architecture to meet the outcomes outlined in Executive Order 14028 to improve cybersecurity:

Cloud migration
NSF has been migrating enterprise applications to the cloud for the past several years. During migration, NSF makes improvements in process and design that align to ZTA principles, such as network environment isolation, automation for component build, and secure application deployment. NSF's cloud deployments use AWS Organization Units to create multiple accounts. Each account services the needs for a specific environment with minimal connectivity between the accounts. NSF cloud migration activities are ongoing.

Identifying critical software used by NSF
Executive Order 14028 recognizes the importance of software security, particularly critical software security, to the federal government. The National Institute of Standards and Technology (NIST) defines EO-critical software as any software that has, or has direct software dependencies, upon one or more components, e.g., designed to control access to data or operational technology. NSF identified critical software in the IT environment focusing on standalone, on-premises software that has security-critical functions or poses similar significant potential for harm if compromised. NSF's security measures ensure proper access control, inventory, backup, and configuration of software, including critical software, to ensure system integrity and availability. NSF will continue to monitor critical software in its environment.

Ensuring storage and retention of logging data complies with requirements
Audit logging is a central component in the evaluation and analysis of events that affect system security. NSF's IT Security team, in coordination with Information System Owners and other stakeholders, ensures the integrity of NSF information systems by identifying critical logging data in different production environments. NSF retains all audit records for agency required timeframes online using its Security

[49] OMB Memo M-22-09, Moving the U.S. Government Toward Zero Trust Cybersecurity Principles, is available at https://www.whitehouse.gov/wp-content/uploads/2022/01/M-22-09.pdf

Information and Event Management solution. Audit records may be archived to a secure location. NSF will continue to monitor, store, log required critical data across the various production environments.

Supply chain risk management authenticity/anti-counterfeit training
NSF will continue to provide supply chain risk management anti-counterfeit training to employees and contractors as required.

Expand access to phishing-resistant multi-factor authentication on public-facing systems
NSF will continue to work with Login.gov to understand how their timeline for implementing phishing-resistant multi-factor authentication will impact NSF's plan for this task.

Review and revise password policies across the agency
NSF is drafting new password policies for enterprise-facing and public-facing systems and evaluating technologies to support the change. For example, NSF is evaluating capabilities to check passwords against known-breached data and dictionary words, and enterprise password manager tools. NSF plans to implement a password review tool and update the password policy by January 2023.

Secure Access Service Edge (SASE) Deployment
NSF intends to deploy Secure Access Service Edge (SASE) solutions as an architectural approach that will converge networking and security services into a cloud service. NSF is evaluating several enterprise SASE solutions and performing proof-of-concept deployments with select vendors. After evaluating the success of the proof-of-concept deployments, a vendor will be chosen to proceed with a pilot deployment with the goal of rolling out SASE enterprise-wide once policies and configurations have been tuned. NSF anticipates proceeding with deployment in FY 2023.

NSF's high-level roadmap towards zero trust adoption and continued migration to the cloud will serve to optimize security. NSF will continue to refine its long-term ZTA migration plan in alignment with the Department of Homeland Security's zero trust maturity model and guidance from the Office of Management and Budget and NIST.

MANAGEMENT CHALLENGE 8: Managing Transformational Change

NSF Lead: Karen Marrongelle, Chief Operating Officer

Summary of OIG Identified Challenge

NSF may be facing transformational change due to pending legislation, establishment of a new directorate with a cross-disciplinary focus, and the shift to a hybrid workforce. These changes will require NSF to sustain existing programs while developing and implementing new ones, and with existing staff working at maximum capacity. Ensuring NSF continues to provide resources and opportunities to strengthen and advance diversity, equity, inclusion, and accessibility is paramount as NSF faces possible large-scale growth and the transition to a hybrid workforce model.

NSF Management's Overview of the Challenge and Action Plan to Address and Monitor the Challenge

Fiscal year 2022 was one of notable change for NSF. In Spring 2022, the agency announced the establishment of the Directorate for Technology, Innovation and Partnerships (TIP), the first new directorate at the agency in 30 years; received its largest appropriations increase in over a decade; and began transitioning staff back to working in the NSF headquarters building after two years of operating under a maximum telework posture. At the same time, the need for NSF to carry out its mission to, "promote the progress of science; to advance the national health, prosperity and welfare; to secure the national defense..." has never been more important. NSF-funded research addresses some of society's most pressing issues including developing solutions to address climate change, investing in the emerging industries that will strengthen our economy, and increasing equity for underserved communities through development of a more representative science and engineering workforce.

NSF has established processes to identify, anticipate, and manage the risk to accomplishment of these organizational changes so the agency may continue to carry out its mission. NSF has a strong history of financial controls, including 24 consecutive years of a clean audit opinion, as well as robust pre- and post-award monitoring to ensure awardees adhere to financial and other reporting guidelines. NSF's Enterprise Risk Management (ERM) process has also matured in recent years, leveraging tools such as data analytics to identify risk areas, risk profiles to articulate a level of risk and the appropriate response, and regular communications to share information and best practices.

In addition to strengthening existing processes, NSF recognizes it must develop new capacity and centralize certain functions to ensure smooth transitions across growth and change. One of these shifts is from knowledge being housed within a program or a specific individual to a paradigm of rapid access to knowledge across directorates and offices. In FY 2022, NSF established an executive-level senior advisor in the Office of Integrative Activities within the Office of the Director with the purpose of establishing a Knowledge Management Framework at NSF to position the agency to be more strategic and agile in delivering the mission. NSF has committed dedicated resources and innovative workforce planning processes to ensure it will recruit and retain the staffing required to capitalize on opportunities presented by our changing environment. In addition, the agency has centralized its space management to facilitate a holistic reassessment of space needs under a hybrid working environment.

Change Management Actions

Managing transformational change is a challenge with a scope that spans the entire agency, as well as both program and business operations. For this reason, there was no singular action plan to address this challenge. Rather, NSF incorporated its existing risk management tools into the broader approach it used to prepare for and manage through changes in FY 2022. In each instance, NSF assembled leaders and subject matter experts from across the organization to define objectives, identify the data needed to assess risks, and outline various options. By engaging all the relevant parties in the process, NSF ensured it achieved its ERM objective to manage strategic and reputational threats and opportunities, and its internal control objective to manage operational, reporting, and compliance risks.

The following narrative discusses how prominent examples of change in FY 2022 – establishment of TIP and transition to a hybrid workforce – employed principles of effective change management based on a model that describes the various components of successful change, including defining success, leadership, project management, and change management.[50] Other examples of managing transformational change throughout NSF are described in the progress reports for OIG's Management Challenges regarding Overseeing Grants in a Changing Environment, Managing the Intergovernmental Personnel Act Program, and Improving Diversity in Science and Engineering Education and Employment, which also speaks to actions NSF has taken to advance diversity, equity, inclusion, and accessibility in its own workforce.

Establishing the Directorate for Technology, Innovation and Partnerships (TIP)

The TIP directorate is a cross-cutting platform that spurs innovation across all science and engineering fields to rapidly address societal challenges and bring new technologies to market and society, while investing in nurturing the diverse talent needed for the future. Effective change management was critical to ensuring that the new directorate's programmatic, technological, and human capital processes were integrated into the NSF structure, while also delivering on new and innovative ways of engaging within and externally to the organization.

Definition of Success: The mission of the TIP directorate is to harness the nation's vast and diverse talent pool to advance critical and emerging technologies, address pressing societal and economic challenges, and accelerate the translation of research results from lab to market and society.

Leadership/Sponsorship: Given the importance of TIP's mission, NSF ensured executive support and management oversight for all phases of the establishment of the TIP directorate. In addition, the NSF Director, senior advisors to TIP, and the Office of Legislative and Public Affairs (OLPA) leadership developed a strategic alliance with the Congressional four corners and the White House to advance a national focus on U.S. competitiveness to bolster TIP's scientific impact.

[50] The Prosci Change Triangle Model outlines four critical aspects for successful change: 1) **Success** – the definition of success for a change, which includes the reason for the change, project objectives, and organizational benefit, 2) **Leadership/Sponsorship** – the direction and guidance for a project, including who is accountable for defining why a change is happening, how it aligns with the direction of the organization, and why it is a priority, 3) **Project Management** – the discipline that addresses the technical side of a change, by designing, developing and delivering the solution that solves a problem or addresses an opportunity, within the constraints of time, cost and scope, and 4) **Change Management** – the discipline that addresses the people side of the change, enabling people to engage, adopt and use the solution. More information available at https://www.prosci.com/methodology/pct-model?hsLang=en-us

Project Management: The TIP implementation and launch were thoughtfully executed through a close collaboration between the Office of Budget, Finance, and Award Management (BFA) and the Office of Information and Resource Management (OIRM), in conjunction with TIP advisors in the Office of the Director and senior NSF officials within OLPA, the Office of the Director, the Office of General Counsel, and AFGE Local 3403. Project plans outlined milestones across eight areas: organization, staffing, contracts, communications, outreach, programmatic, space, and budget. Office points of contact engaged in vital communication at regular checkpoints to review the TIP implementation timeline and establish priorities, chart progress, and provide opportunities for synergy and integration.

Change Management: The unique business objectives and operations of the TIP directorate required innovation and flexibility. As an example, TIP will leverage novel solicitation and award instruments, such as the use of Broad Agency Announcements, to encourage participation from diverse types of entities including industry, non-profits, governments, academia, and communities of practice. The intended outcomes of these awards are also a departure from many traditional NSF awards—formation of regional partnerships to address and solve societal and economic challenges while advancing technology innovations. Acclimating the NSF workforce to new ways of doing business, and cultivating relationships with new types of potential awardees, requires intentional and frequent communications and trust-building.

Transitioning NSF to a Hybrid Workforce

In 2018, NSF contemplated changes to its workforce to adapt to the agency's evolving needs and mission as part of the Renewing NSF initiative. One such change was to "assess the workforce's desire to and feasibility of a geographically dispersed physical presence," as an opportunity to increase the attractiveness of NSF as an employer and increase rotator opportunities by eliminating the need to relocate to the Washington, D.C. metro area. The work to consider the feasibility of a hybrid workforce was accelerated by the COVID-19 pandemic and transition to maximum telework in the spring of 2020, as well as the need to plan to transition at least some of the workforce back to the NSF headquarters building when it was safe to do so.

Definition of Success: NSF's plan for transitioning to a hybrid workforce and re-entry to NSF headquarters in spring 2022 articulated the following desired future outcomes: preserving the organizational culture; enhancing the employee experience and development; strengthening recruitment, retention, and diversity of NSF talent; maintaining and increasing collaboration across the agency; refining and maintaining customer service delivery; and leveraging flexible work arrangements to achieve mission requirements.

Leadership/Sponsorship: From the start of the pandemic, NSF leadership assured staff that the number-one priority was their safety and welfare and backed that promise by executing maximum telework and scheduling flexibilities. As the agency anticipated returning to work in the building, NSF leadership – including the Director and Chief Operating Officer – continued to play a prominent role in providing frequent status updates and addressing staff concerns. NSF is now in an optimal position to proceed to a hybrid work environment due to the credibility of NSF management and the trust earned from NSF staff.

Project Management: NSF is set-up for success in managing the change to a hybrid environment due to proactive planning, engagement with NSF staff, and superior technological infrastructure. The data collected and lessons learned during the pandemic have strengthened the applicability of a hybrid workforce environment at NSF.

Change Management: Communication has been of utmost importance during the pandemic and throughout the transition to hybrid work. The Office of the Director, the Chief Human Capital Officer and

OIRM leadership held numerous town halls and forums to inform staff of the latest situation and the current policies and tools that were in place to ensure staff were comfortable and engaged. NSF has consistently received feedback from its staff during the pandemic through human resources "pulse surveys" to assess staff's concerns and needs. The feedback has been used to expand workplace flexibilities and supervisor tools, which will also be utilized in the hybrid environment. OIRM has provided tools to staff and supervisors to assist with managing change including courses and seminars to improve skills specific to the hybrid environment and supervisor listening sessions to understand challenges associated with moving to a hybrid workforce.

NSF's Completed Actions to Address the Challenge

Demonstrated Progress Through Agency Actions Taken in Prior Fiscal Years

Agency-wide initiatives

- NSF increased its workforce's ability to communicate and manage through change by promoting learning opportunities on change management to staff and leadership beginning in FY 2021.
- Establishment of an ERM governance structure, including a community of practice to share ideas and information on enterprise-level risks, and development of tools such as risk profiles to help to engrain risk management processes more fully into the NSF culture.

Establishing TIP

- NSF established a workgroup of points of contact throughout OIRM, BFA, and the Office of the Director to coordinate on TIP implementation and roll-out.

Transitioning NSF to a Hybrid Workforce

- NSF incorporated infrastructure needed to conduct hybrid work in its 2017 headquarters relocation, including integrated video conferencing in every conference room, wireless presentation capability, and large video monitors. Hundreds of hybrid meetings were conducted from the conference rooms prior to the pandemic. In addition, the agency accelerated the rollout of Zoom for Government and increased the adoption of Microsoft Teams early in the pandemic to facilitate ease of virtual meetings, webinars, chat, and document collaboration.
- In March 2021, NSF assembled a Hybrid Panel Task Force to evaluate and analyze hybrid panel and meeting operations. The Task Force recommended deploying a state-of-the-art technical panel and meetings collaboration environment.
- NSF established a Remote Work Tiger Team in April 2021 based on an assessment showing strong support for implementing a hybrid workforce model. The purpose of the Tiger Team was to engage staff perspectives and promulgate recommendations for policy, guidance, logistics, and change management required to support implementing a hybrid workforce model. The results of the Tiger Team report have been used to assist in the development of new policies related to remote and hybrid work.

Demonstrated Progress Through Agency Actions Taken in FY 2022

Establishment of the TIP Directorate

TIP was formally announced by the NSF Director and successfully rolled out on March 16, 2022. Establishment of the TIP Directorate involved both integrating operations into existing processes as well as establishing novel approaches to achieve intended program outcomes.

- TIP built on the existing culture of innovation and the extensive portfolio of existing NSF programs that foster public and private partnerships to advance technological innovation, such as the Small Business Innovation Research and Innovation Corps programs. For the recently-launched NSF Regional Innovation Engines (NSF Engines) and Pathways to enable Open-Source Ecosystems (POSE)

programs, TIP established cross-NSF working groups involving representatives from all directorates to help implement the programs.
- NSF's operationally-focused offices—BFA and OIRM—facilitated TIP integration into existing business processes by gathering status information through standardized templates, allowing for management of interdependencies, communication of task completion, and adjustments for delays or roadblocks.
- In general, NSF followed standard IT implementation processes such as documenting and refining business requirements, performing quality assurance and user acceptance testing, and monitoring development using ERM concepts. NSF followed its standard IT playbook for executing a reorganization and was able to establish new best practices given the additional rigor of creating a new directorate. For example, TIP was the first new directorate established under the current NSF business applications and financial system (iTRAK).

TIP engaged in extensive outreach and communication with both internal and external stakeholders to ensure the needed input and buy-in to successfully implement the new directorate's programs and operations.
- For example, NSF leadership conducted outreach to an extensive set of stakeholders in advance of the rollout, including industry, venture capital firms, federal agencies, professional organizations, and colleges and universities. This included listening sessions with 259 participants from 143 different organizations representing minority-serving institutions, two-year colleges, and primarily undergraduate institutions with the objectives of gathering insight from participants about how they can benefit from TIP initiatives, how their experiences and perspectives can be incorporated into the designs of new TIP programs, and to address the questions, concerns, and challenges related to engaging with TIP.
- TIP leadership presented TIP's mission, vision and strategic goals to all directorate leadership teams and advisory committees, including discussion of investment touch points for partnership investments and the establishment of cross-directorate working groups for TIP programs.
- Weekly and ad-hoc meetings of points of contact from BFA, OIRM, and the Office of the Director fostered information sharing and provided motivation and comradery among BFA and OIRM points of contacts and their staff. This close collaboration allowed for efficient issue identification and resolution and helped to secure buy-in from senior management and internal stakeholders.

Transition to a Hybrid Workforce

NSF's planning for transition to a hybrid workforce reflected a robust change-management process that engaged all levels of the workforce. Each phase details specific steps, considerations, and communications requirements to prepare the NSF facility, systems, and support functions for re-entry. Detailed timelines and project plans have been developed to execute, track, and review progress throughout the re-entry process. In general, the transition to a hybrid workforce involved strategies and actions in three key areas: people, place, and technology.

<u>People:</u>
- OIRM issued two pulse surveys in FY 2022 to seek input and feedback from staff to make policy decisions. NSF was able to validate that the workforce felt supported and heard, allowing NSF management to make real time decisions accordingly.
- An NSF-wide Hybrid Vision Work Group drafted an employee engagement action plan that recommended expanding employee networks, promoting shared values, and amplifying the employee voice. Action plans will be developed both at the NSF level and within the directorates and offices with the goals to attract, hire, and retain a talented and diverse workforce.

- NSF conducted a survey of panelist experiences in virtual versus in-person panels to inform future panel operations.
- NSF communicated plans for employee re-entry and transition to a hybrid workforce in many forums and provided numerous resources to address employee concerns. NSF launched a FutureWorks email alias and intranet site to include a transition plan, a fact sheet on assessing positions for remote work eligibility, a variety of tips, guides, and effective practices for hybrid work, and frequently asked questions. Many of these topics were presented at employee and supervisor town halls and addressed during office hours.
- NSF initiated a process to categorize each NSF position as either telework or remote work eligible based on the position's job duties and the effectiveness of performing the job in a fully virtual environment. Results of this assessment, as well as a revised telework and remote work policy, were disseminated in the fourth quarter of FY 2022.

Place:

- OIRM's Division of Administrative Services developed a strategic plan focused on leveraging existing expertise and new building capabilities to enable NSF staff to do their best work. As part of this process, OIRM undertook a large-scale effort to consider each of 100 service areas through the lens of hybrid work. Examples of implemented hybrid operations include moving to an "on-call" or "appointment only" model for onsite services and transitioning certain help desks from on-site to fully remote support.
- NSF centralized space management functions in OIRM to better understand the need and availability of existing workstations because the shift to a hybrid workforce will require a holistic reassessment of space needs.
- In preparation for re-entry and future hybrid work, NSF developed a hoteling center demonstration that staff can use to familiarize themselves with hoteling options and provide feedback.

Technology:

- NSF prepared staff for successful hybrid engagements through extensive testing and updating of conference room equipment, distribution of tips sheets for hybrid meetings and conference room technology, and by conducting an analysis of available technologies to better support hybrid meetings. Specific recommendations included procurement of new camera systems that support either voice tracking or presence tracking in the conference rooms.
- NSF established a Hybrid Work Working Group that will review and recommend current and emerging technologies for NSF's hybrid work environment for the future. Examples include ready access to standard equipment such as laptops and mobile devices, and cutting edge technology such as virtual reality headsets and conference rooms that facilitate hybrid collaboration using advanced audio-visual and immersive techniques.

NSF's Ongoing Actions

NSF management developed the following anticipated milestones in consideration of NSF's strategic and operational objectives and the previous actions NSF has already taken as described above:

- NSF will take steps to improve knowledge management by completing an inventory of all agency policies and making them easily accessible by all staff.
- NSF will continue to mature its ERM process as new programs and risks are identified, including updating its risk profiles to reflect the current operating environment.

- NSF will continue to offer courses on change management and hybrid skills, including supervisor listening sessions to understand the challenges as they navigate moving to a hybrid workforce.
- Based on experience gained during TIP establishment, OIRM is in the process of updating, confirming, and validating the process for realignments and reorganizations, including specific duties, roles, and responsibilities of each organization to ensure that all parties are made aware of potential changes, and are able evaluate the proposed changes prior to the effective date.
- NSF will continue to evaluate and implement options for innovative financial instruments, such as the Broad Agency Announcement to accelerate use-inspired research, foster new pathways to rapidly translate discoveries to market and society, and fully engage the nation's diverse talent pool in shaping, conducting, piloting, and scaling research efforts.
- OIRM will continue to monitor and develop technologies to improve the agency's hybrid work capabilities.
- As NSF continues to evaluate space utilization and future needs, OIRM will continue analysis and review of space requirements, including recommendations on design, blocking and stacking plans and the possible creation of new workspaces throughout NSF headquarters.

PAYMENT INTEGRITY INFORMATION ACT REPORTING

The Improper Payments Information Act of 2002 (IPIA; Pub. L. 107-300), as amended by the Improper Payments Elimination and Recovery Act of 2010 (IPERA; Pub. L. 111-204), the Improper Payments Elimination and Recovery Improvement Act of 2012 (IPERIA; Pub. L. 112-248), and the Payment Integrity Information Act of 2019 (PIIA; Pub. L. 116-117) require agencies to annually report information on improper payments to the President and Congress. NSF does not have any high-priority programs as defined by A-123 Appendix C (programs with estimates of improper payments resulting in monetary loss that exceeds $100 million annually). More detailed information on NSF's payment integrity program can be found at https://paymentaccuracy.gov/.

Actions Taken to Address Auditor Recovery Recommendations

Using OMB Circular A-123, Appendix C, Part V.B.2 guidance, NSF determined that it would not be cost effective to conduct recapture audits of its single grants program and other activities (contracts, charge cards, and payments to employees). OMB agreed with NSF's analysis. As such, NSF does not conduct payment recapture audits.

NSF has leveraged the results of the work performed under PIIA, audits, grant monitoring programs, and internal control reviews. All activities consistently demonstrated that there is not a significant risk of unallowable costs or improper payments within NSF's single grant program and other mission support activities. No circumstances have changed within NSF's grant program or its mission support activities requiring NSF to reassess its payment recapture cost-effectiveness analysis.

CIVIL MONETARY PENALTY ADJUSTMENT FOR INFLATION

The Federal Civil Penalties Inflation Adjustment Act Improvements Act of 2015 (the 2015 Act; Sec. 701 of Public Law [P.L.] 114–74) further amended the Federal Civil Penalties Inflation Adjustment Act of 1990 (P.L. 104–410) to improve the effectiveness of civil monetary penalties and to maintain their deterrent effect. The 2015 Act requires agencies to (1) adjust the level of civil monetary penalties with an initial "catch-up" adjustment through an interim final rulemaking and (2) make subsequent annual adjustments for inflation. Inflation adjustments are to be based on the percent change in the Consumer Price Index for all Urban Consumers (CPI-U) for the month of October preceding the date of the adjustment, relative to the October CPI-U in the year of the previous adjustment.

The civil monetary penalties within NSF's jurisdiction are those authorized by the Antarctic Conservation Act of 1978, 16 U.S.C. 2401, et seq., and the Program Fraud Civil Remedies Act of 1986, 31 U.S.C. 3801, et seq.

The following table identifies NSF's FY 2022 inflation adjustments to civil monetary penalties.

Table 3.3 – FY 2022 Civil Monetary Penalty Adjustment for Inflation

Statutory Authority	Penalty (Name and Description)	Year Enacted	Latest Year of Adjustment (via Statute or Regulation)	Current Penalty Level ($ Amount or Range)	Location for Penalty Update Details
Antarctic Conservation Act of 1978, 16 U.S.C., 2401 *et seq.,* as amended	Antarctic Conservation Act, Knowing violations	1978	2022	$31,980	86 FR 72285 Thursday, December 21, 2021
Antarctic Conservation Act of 1978, 16 U.S.C., 2401 *et seq.,* as amended	Antarctic Conservation Act, Not knowing violations	1978	2022	$18,898	86 FR 72285 Thursday, December 21, 2021
Program Fraud Civil Remedies Act of 1986, 31 U.S.C., 3801, *et seq.*	Program Fraud violations	1986	2022	$12,537	86 FR 72285 Thursday, December 21, 2021

GRANTS PROGRAM REPORTING

OMB's Circular A-136, Financial Reporting Requirements requires agencies with Federal grants programs to submit a high-level summary of expired, but not closed, Federal grants and cooperative agreements (awards). Table 3.4, below, shows the total number of awards and balances for which closeout has not yet occurred, but for which the period of performance has elapsed by two years or more prior to September 30, 2022.

Table 3.4 – Age and Balances for Expired Awards not Closed

CATEGORY	2 – 3 Years	>3-5 years	>5 years
Number of Grants/ Cooperative Agreements With Zero Dollar Balances	363	224	96
Number of Grants/ Cooperative Agreements With Undisbursed Balances	0	0	0
Total Amount of Undisbursed Balances	$0	$0	$0

Information shown above is as of 9/30/2022.

As indicated in the table above, NSF's 683 financial assistance awards (grants, cooperative agreements, and fellowships) that are expired but not closed have zero-dollar balances in NSF's financial accounting system. The majority of these awards (98.4%) that are still not fully closed have overdue final project reports and/or project outcome reports and cannot be completely closed.

In the FY 2021 AFR appendix *Grants Program Reporting*, NSF also reported 0 awards with undisbursed funds. NSF continues to review operating policies and accounting practices to close all awards on the same schedule, thereby, ensuring the number is 0.

NSF works to close out all awards as quickly as possible. Typically, awards are financially closed 120-days after the end-date of the award and are administratively closed automatically once the awards are financially closed. To close awards more quickly, NSF now administratively closes awards nightly instead of monthly and runs the automated closeout routines daily instead of just on weekdays.

NSF has made progress in decreasing the number of overdue final project reports and/or project outcome reports by implementing policies and procedures to track and enforce the submission of required project reports. Changes to our processes are guided by recommendations from an NSF working group addressing overdue reports.

NSF reviews overdue report information for reporting eligibility to the Federal Awardee Performance and Integrity Information System (FAPIIS), as prescribed in the revised 2 CFR § 200.[1] In FY 2022, NSF determined no awards/awardees were subject to FAPIIS reporting.

[1] 2 CFR § 200, published in the Federal Register on 8/13/2020: https://www.federalregister.gov/documents/2020/08/13/2020-17468/guidance-for-grants-and-agreements

UNDISBURSED BALANCES IN EXPIRED GRANT ACCOUNTS

In FY 2022, NSF funded research and education in science and engineering through grants and cooperative agreements to 1,800 colleges, universities, and other institutions. NSF grants are funded in one of two ways: (1) the grant may be funded fully at the time of award, called a standard grant, or (2) the grant may be funded incrementally (one year at a time), called a continuing grant. In both cases, all costs on the grant must be incurred by the grantee during the term of the grant period. At NSF, grantees typically have 120 days after the grant expires to complete final drawdowns and expenditures.

The information provided here pertains to the agency's two grant making appropriation accounts: Research and Related Activities and Education and Human Resources. The data reported are based on the following definitions:

- An **expired grant** is a grant award that has reached the grant end date and is eligible for closeout. For NSF, this means grants with an expired period of performance.
- **Undisbursed balances** on expired grants are amounts that remain available for expenditure before it is closed out.

Once a grant has expired, NSF takes actions to close out the grant both administratively and financially. The financial closeout action takes place 120 days after the award expiration date when the undisbursed balances are de-obligated from the award. Administrative closeout is initiated after financial closeout is completed.

The methodology used to develop undisbursed balances on expired grant awards is consistent with the U.S. Government Accountability Office (GAO) conclusions documented in their April 2012 report, GAO-12-360, *Grants Management: Action Needed to Improve the Timeliness of Grant Closeouts by Federal Agencies,* along with discussion and clarifying information from GAO. The data reported here reflects the amount of undisbursed balances in grant accounts that have reached their end date and are eligible for closeout and is provided in accordance with OMB M-16-18, *Financial and Performance Reporting on Undisbursed Balances in Expired Grant Accounts*.

1. **In the preceding three fiscal years, the total number of expired grant accounts with undisbursed balances (on the first day for each fiscal year) and the total amount that has not been obligated to specific grant or project remaining in the accounts**
   The number of expired grants with undisbursed balances for the preceding 3 fiscal years is provided in Table 3.5. The numbers and balances reflect a point in time before expired awards are closed out during normal processes described above. For FY 2022, there were 5,127 expired grants with undisbursed balances of $123,876,877.

Table 3.5 – Status of Undisbursed Balances in Expired Grants

	FY 2022 (as of 9/30/22)	FY 2021 (as of 9/30/21)	FY 2020 (as of 9/30/20)
Number of expired grants	5,127	4,616	4,478
Undisbursed balances prior to closeout	$123,876,877	$99,486,778	$84,615,563

2. **Details on future action NSF will take to resolve undisbursed balances in expired grant accounts**
   NSF continually monitors its grant awards throughout their lifecycle following a comprehensive post-award monitoring process. NSF grants are closed based on their period of performance end date. All unliquidated (or undisbursed) award balances are de-obligated 120 days after the grant period has expired. Having small undisbursed balances at the end of the grant period is a routine occurrence, as not all grantees fully spend the funds obligated during the course of their research.

3. **The method that NSF uses to track undisbursed balances in expired grant accounts**
   NSF completes financial closeout of expired grant awards on a daily basis using a set of automated and manual activities. Eligibility for closeout for all NSF awards begins 120 days after the award expiration date. The NSF closeout process automatically de-obligates any unliquidated award balance, produces an award closeout transaction to flag the award as financially closed, and sends the financial closeout date to NSF's award management system. This initiates final administrative closeout procedures in the award management system.

   The expected award closeout date is made available to awardees and staff through the Award Cash Management Service (ACM$). ACM$ requires the submission of award level payment amounts and expenditures each time funds are requested by awardees and allows NSF to complete post-award monitoring at the individual award level throughout the lifecycle of the award.

4. **Process for identification of undisbursed balances in expired grant accounts that may be returned to the Treasury of the United States**
   When a grant is closed out, the unliquidated balances are de-obligated. The de-obligated grant balances are treated one of three ways:
   - If the source appropriation is still active, the balances are recovered by NSF and remain available for valid new obligations until the source appropriation's expiration date.
   - If the source appropriation has expired but funds have not yet been canceled, the grant balances are recovered by NSF and remain available for upward adjustments on other existing obligations within the source appropriation.
   - If the source appropriation has been canceled, the grant balances are returned to the Treasury.

   Prior to September 30 of each year, all undisbursed grant balances in canceling appropriations are de-obligated and subsequently returned to Treasury.

CLIMATE REPORTING

NSF's FY 2022 *Sustainability Report and Implementation Plan* was prepared in accordance with guidance from the Council for Environmental Quality and highlights actions to advance sustainability and climate resilient operations at NSF.

The report is at this link: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf23005.

AWARDS TO AFFILIATED INSTITUTIONS

The following table lists institutions affiliated with members of the National Science Board (NSB) in FY 2022.[1]

Affiliated Institution	Awards Obligated in FY 2022 (Dollars in thousands)
Arizona State University	$90,390
Auburn University	16,557
California Institute of Technology	78,641
Catholic University of America	1,985
Michigan State University	74,717
Southwest Research Institute	453
Stanford University	61,028
University of California, Los Angeles	77,343
University of Colorado	140,941
University of Florida	52,213
University of Massachusetts	63,001
University of Oregon	26,411
University of Tennessee	40,299
University of Texas at El Paso	26,001
University of the District of Columbia	4,860
University of Utah	52,420
University of Vermont	10,831
Washington University	27,976
TOTAL	***$ 846,067***

[1] This information is provided solely in the interest of openness and transparency. The table lists the dollar value of the awards made to institutions affiliated with NSB members during their time on the NSB in fiscal year ended September 30, 2022. NSB establishes the policies of NSF within the framework of applicable national policies set forth by the President and Congress. Federal conflict of interest rules prohibits NSB members from participating in matters where they have a conflict of interest or there is an impartiality concern without prior authorization from the designated agency Ethics Official. Individual NSF grant awards are made pursuant to a peer-review based process and most are not reviewed by the NSB. With regard to matters that are brought to the Board, NSB members are not involved in the review or approval of grant awards to their affiliated institutions. The table displaying Awards to Affiliated Institutions applicable to the previous fiscal year is available in the Appendices at https://www.nsf.gov/pubs/2022/nsf22002/pdf/nsf22002.pdf. Because of the regular turnover among NSB membership, the information in these tables is not directly comparable across years.

Awards to Assistant Director IPAs' Home Institutions by NSF Directorates

The following tables identify the awards made by directorates to the home institutions of Assistant Directors serving under the Intergovernmental Personnel Act (AD IPAs) during their time at NSF for the fiscal years ended September 30, 2022 and 2021. AD IPAs led four directorates during the fiscal year ended September 30, 2022 and five directorates during the fiscal year ended September 30, 2021. NSF executive staff formulate directorate or office scientific goals, objectives, and priorities. Federal conflict of interest rules prohibit executives, including IPA detailees who serve in AD positions, from participating in matters where they have a conflict of interest or an impartiality concern. NSF grant awards are made pursuant to a merit-review based process and are not routinely reviewed by IPAs serving in executive positions. If matters are brought to such IPAs, they do not participate in the review or approval of awards to their home institutions. The following tables are provided in the interest of openness and transparency.

Table 3.6 – FY 2022 Awards to AD IPAs' Home Institutions

(Dollars in Thousands)

Directorate	Total Dollars and Awards Made by Directorate in FY 2022	Home Institution of IPA Assistant Director	Total Dollars and Awards to Home Institution by Directorate in FY 2022	Total Dollars and Awards to Home Institution by NSF in FY 2022
Computer & Information Science & Engineering	$1,039,029 (2,117 awards)	Princeton University	$10,099 (37 awards)	$57,590 (129 awards)
Engineering	$970,237 (3,260 awards)	Emory University	$424 (3 awards)	$8,387 (41 awards)
Social, Behavioral, & Economic Sciences	$253,555 (1,150 awards)	University of Michigan	$55 (2 awards)	$4,101 (23 awards)
Education & Human Resources	$1,432,621 (3,126 awards)	Ohio State University	$2,726 (5 awards)	$13,115 (26 awards)
Total	$3,695,442 (9,653 awards)		$13,304 (47 awards)	$83,193 (219 awards)

Table 3.7 – FY 2021 Awards to AD IPAs' Home Institutions

(Dollars in Thousands)

Directorate	Total Dollars and Awards Made by Directorate in FY 2021[1]	Home Institution of IPA Assistant Director	Total Dollars and Awards to Home Institution by Directorate in FY 2021	Total Dollars and Awards to Home Institution by NSF in FY 2021
Computer & Information Science & Engineering	$1,064,516 (3,188 awards)	Princeton University	$12,689 (33 awards)	$70,187 (149 awards)
Engineering	$1,068,240 (3,670 awards)	University of Michigan	$4,761 (30 awards)	$93,971 (285 awards)
		Emory University	$715 (4 awards)	$13,681 (38 awards)
Geosciences	$1,573,387 (2,861 awards)	Pennsylvania State University	$2,083 (17 awards)	$28,858 (95 awards)
Social, Behavioral, & Economic Sciences	$259,359 (1,240 awards)	University of Michigan	$14,122 (26 awards)	$93,971 (285 awards)
Education & Human Resources	$1,115,229 (1,906 awards)	Portland State University	$1,546 (5 awards)	$4,268 (20 awards)
Total	$5,080,731 (12,865 awards)		$35,916 (115 awards)	$210,965[2] (587 awards)

[1] Some NSF awards are split funded, meaning an award is funded by two or more directorates. For a split-funded award in this column: the award is counted for each directorate; the award funding is only the split-funded amount.

[2] Two IPAs from the University of Michigan served as ADs during FY 2021. Award dollars and count have been reduced by $93,971 thousand and 285 awards, respectively, in this total box to avoid double counting.

NSF SENIOR MANAGEMENT AND NATIONAL SCIENCE BOARD

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(as of September 30, 2022)

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(during FY 2022)

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[1] Members of the National Science Board whose terms have recently expired, temporarily serving as consultants to the Board.
[2] Resigned November 9, 2021

PATENTS AND INVENTIONS RESULTING FROM NSF SUPPORT

The following information about inventions is being reported in compliance with Section 3(f) of the National Science Foundation Act of 1950, as amended [42 U.S.C. 1862(f)]. There were 1,388 NSF invention disclosures reported to NSF either directly or through the National Institutes of Health's iEdison database during FY 2022. Rights to these inventions were allocated in accordance with Chapter 18 of Title 35 of the United States Code, commonly called the "Bayh-Dole Act."

ACRONYMS

ACM$	NSF Award Cash Management Service
AFR	Agency Financial Report
AOAM	Agency Operations and Award Management
APR	Annual Performance Report
ARP Act	American Rescue Plan Act of 2021
ASC	Antarctic Support Contractor
BFA	Office of Budget, Finance and Award Management
CAP	Cross-Agency Priority or Corrective Action Plan
CFO	Chief Financial Officer
COVID	Coronavirus Disease
DEIA	Diversity, Equity, Inclusion, and Accessibility
EAC	Evaluation and Assessment Capability
EHR	Directorate for Education and Human Resources
EHT	Event Horizon Telescope
ERM	Enterprise Risk Management
FBWT	Fund Balance with Treasury
FECA	Federal Employees' Compensation Act
FFMIA	Federal Financial Management Improvement Act of 1996
FFRDC	Federally Funded Research and Development Center
FISMA	Federal Information Security Modernization Act
FMFIA	Federal Managers' Financial Integrity Act of 1982
FTE	Full-time Equivalents
FY	Fiscal Year
GAAP	Generally Accepted Accounting Principles
GAO	Government Accountability Office
GPRA	Government Performance and Results Modernization Act of 2010
GPS	Global Position System
GRANTED	Growing Research Access for national Transformative Equity and Diversity
GRFP	Graduate Research Fellowship Program
GSA	General Services Administration
H-1B	H-1B Nonimmigrant Petitioner Account
IAA	Interagency Agreement
IG	Inspector General
INCLUDES	Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science
IPA	Intergovernmental Personnel Act
IR/D	Independent Research/Development
IT	Information Technology
iTRAK	NSF's financial management system
MREFC	Major Research Equipment and Facilities Construction
MSI	Minority Serving Institution
NCSES	National Center for Science and Engineering Statistics
NSB	National Science Board
NSF	National Science Foundation
OIG	Office of Inspector General

OMB	Office of Management and Budget
OPM	Office of Personnel Management
OPP	Office of Polar Programs
PAPPG	Proposal and Award Policies and Procedures Guide
PP&E	General Property, Plant, and Equipment
R&D	Research and Development
R&RA	Research and Related Activities
SAM	System for Award Management
SBIR	Small Business Innovation Research
SBR	Statement of Budgetary Resources
SFFAS	Statement of Federal Financial Accounting Standards
STEM	Science, Technology, Engineering, and Mathematics
STTR	Small Business Technology Transfer
TIP	Directorate for Technology, Innovation and Partnerships
UEI	Unique Entity Identifier
USAP	U.S. Antarctic Program
USSGL	United States Standard General Ledger
ZTA	Zero-trust Architecture