The National Science Foundation Act of 1950 (Public Law 81-507) sets forth our mission: ***"To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."***

The National Science Foundation's FY 2025 Budget Request of $10.183 billion lays out a plan for investments in fundamental research and education across all fields of science, technology, engineering, and mathematics (STEM). NSF support is critical to the U.S. research and development enterprise, to training the STEM workforce, and to cultivating access to scientific learning and resources. These investments will continue to spur the economic growth that keeps our Nation moving forward. This will help create the next generation of supply chain processes, a key factor in U.S. manufacturing competitiveness.

For almost 75 years, NSF has advanced the frontiers of the full spectrum of science and engineering research and innovation. Tasked with keeping the U.S. at the leading edge of scientific and engineering discovery to the benefit of all, NSF funds research that generates new knowledge that provides a greater understanding of the world around us. NSF's long-term support for solutions-oriented research has fueled industries of the future, produced advancements for the American people, and created world-leading technologies.

In FY 2025, the Foundation will build on prior investments that grow the U.S. STEM enterprise. The agency will continue to cultivate regional innovation across the Nation, strengthening investments in emerging technologies, advancing climate research and development, bolstering research infrastructure, and promoting access in STEM education and workforce training. NSF will move the needle ahead on priorities articulated in the CHIPS and Science Act of 2022 and expand efforts in research security that are vital to U.S. interests worldwide.

The NSF Director's vision rests on **three pillars**, which guide transformational science and technology investments in recent years, including those enabled by the CHIPS and Science Act of 2022 and by the FY 2023 Omnibus and the Disaster Relief Supplemental appropriations. These pillars are:

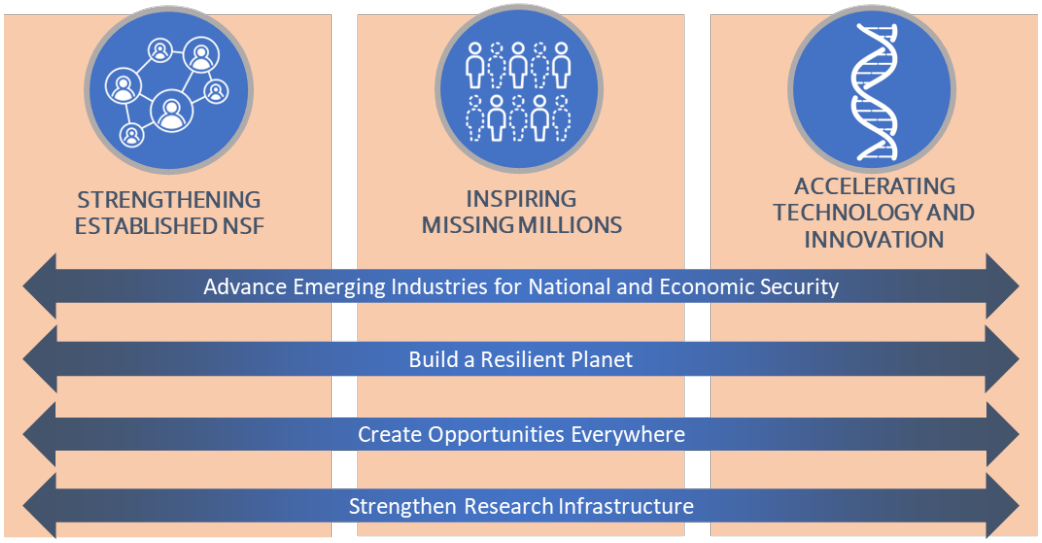
1. **Strengthening Established NSF**
   NSF investments have been expanding the frontiers of knowledge and technology for over 7 decades. Accelerating discovery and enhancing state-of-the-art research capabilities are and will continue to be the Foundation's central focus.

2. **Inspiring Missing Millions**
   The National Science Board (NSB) in its *Vision 2030*[1] report states, "Faster progress in increasing diversity is needed to reduce a significant talent gap" and they name that talent gap the "Missing Millions." Every demographic and socioeconomic group in every geographic region of the country has talented people who can contribute to the innovation enterprise. In this effort to bring the "Missing Millions" into the STEM workforce, NSF will continue to scale up existing pathways into STEM fields and create new tracks. This commitment to finding talent will result in a well-paid workforce that supports a vibrant U.S. economy.

[1] www.nsf.gov/nsb/publications/2020/nsb202015.pdf

3. **Accelerating Technology and Innovation**
   Global competition in science, engineering and technology is fierce, pushing our Nation to accelerate our efforts. For the U.S. to hold its competitive advantage, both tomorrow and in the decades ahead, support for advancing breakthrough technologies, translating research results to the market and society, and nurturing and attracting diverse talent is key. To enable these investments, NSF will continue to seek out and expand partnerships with other agencies, private industry, philanthropy, and like-minded countries to foster environments that leverage resources and deliver results.

In NSF's FY 2025 Budget Request, the three pillars underpin four major themes— **Advance Emerging Industries for National and Economic Security, Build a Resilient Planet, Create Opportunities Everywhere, Strengthen Research Infrastructure**. These themes align with the Administration's priorities of expanding basic research to kickstart innovation and give life to new approaches that address hard topics. The themes described below are integrated into NSF's broad portfolio of fundamental research that is at the core of the Foundation's mission.



NSF's four themes that shape our FY 2025 Request are:

<u>Advance Emerging Industries for National and Economic Security Theme</u>
NSF's portfolio in Emerging Industries aligns with its broader goals to energize the Nation's economic competitiveness, sustain our global leadership and resilience, expand the geography of innovation, and improve the quality of life for everyone. Specifically, NSF will (i) advance science and engineering research and innovation leading to key technologies as well as solutions to national, societal, and geostrategic challenges; (ii) accelerate the translation of fundamental discoveries from the lab to the market and society, growing jobs and the U.S. economy; and (iii) create equitable education pathways to ensure every American can pursue high-wage, good-quality jobs.

In FY 2025, NSF will advance the Emerging Industries by strengthening and scaling a dynamic, diverse, and well-coordinated portfolio of investments. NSF investments will afford scaling of existing activities to accelerate outcomes and deepen impacts, while also launching new programs that will empower

researchers and innovators to collaborate. Support for key technology focus areas that will drive Emerging Industries will come from across NSF. For example:

- **The Directorate for Technology, Innovation, and Partnerships (TIP)** ($900.0 million), in close collaboration with all of NSF's directorates and offices, aims to usher in a new era for American innovation, accelerating research to impact and enhance job and economic growth and national security. Serving as a crosscutting platform that leverages, energizes, and rapidly advances use-inspired research and innovation as well as workforce development across all STEM fields supported by NSF, TIP helps to ensure the U.S. remains in the vanguard of technology competitiveness for the foreseeable future. TIP advances key technologies; accelerates the translation of research results from the laboratory to the market and society; addresses national, societal, and geostrategic needs; and cultivates new education pathways leading to a diverse and skilled future technical workforce comprising researchers, practitioners, technicians, entrepreneurs, and educators. Programs include:

    - **NSF Regional Innovation Engines (NSF Engines)** ($205.0 million), authorized in the CHIPS and Science Act, will catalyze new business and economic growth in those regions of America that have not fully participated in the technology boom of the past several decades. They will advance equitable and inclusive use-inspired research, entrepreneurship, and workforce development to nurture and accelerate regional industries. Collectively, they will contribute to long-term U.S. competitiveness.

    - **NSF Convergence Accelerator** ($100.0 million) will regionalize its approach to accelerate the translation of use-inspired research by investing in regional cohorts of transdisciplinary, multi-sector teams pursuing technology solutions to location-specific challenges in food and agriculture, disaster response and mitigation, and transportation, to name a few.

    - **Accelerating Research Translation (ART)** ($45.0 million), in alignment with the CHIPS and Science Act authorization, will support institutions of higher education that wish to build the necessary infrastructure to boost their overall institutional capacity to accelerate the pace and scale of translational research. Importantly, ART will result in a network of ambassadors who will champion translational research throughout the Nation.

    - **Experiential Learning in Emerging Industries (ExLENT)** ($20.0 million) will support inclusive experiential learning opportunities designed to provide cohorts of diverse learners with the crucial skills needed to succeed in the key technology focus areas and prepare them to enter the workforce ready to solve the Nation's most pressing societal, economic, national, and geostrategic challenges. Of note, ExLENT will enable those active in the workforce today to pivot into key technology focus areas to pursue high-wage, good-quality jobs.

    - **NSF Entrepreneurial Fellows** ($10.0 million), authorized in the CHIPS and Science Act, will provide a diverse cohort of Ph.D.-trained scientists and engineers with resources, including lab space, to mature promising ideas and technologies from the lab to the market and society. These NSF Entrepreneurial Fellows will forge connections between academic research and government, industry, and finance, becoming leaders in technology translation.

FY 2025 funding will also catalyze research and innovation in these key Emerging Industries:

- **Artificial Intelligence**, including machine learning, autonomy, and related advances, ($729.16 million) investments will bring together numerous fields of scientific inquiry—including computer and information science; cognitive science and psychology; economics and game theory; education research; engineering and control theory; ethics; linguistics; mathematics; and philosophy—to advance the frontiers of trustworthy AI, including advancing perception, learning, reasoning, recommendation, and action in the context of specific fields and economic sectors. NSF investments are needed to develop new foundational AI theory and implementation techniques, as well as novel AI methods that are inspired by use cases in specific application domains and contexts. NSF will play a key part in supporting implementation of the President's *Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence* (AI E.O.). For example, NSF investments in efforts such as the National AI Research Resource pilot will create opportunities for more researchers to access the computational, data, software, model and training resources needed to push the boundaries of AI and apply AI across areas of science and engineering.

- **Biotechnology**, including genomics and synthetic biology, ($421.18 million) investments will support fundamental and translational research, infrastructure, and education to understand and harness biological processes for societal benefit. It will propel advances in genomics, bioinformatics and data analytics, structural and computational biology, biophysics, synthetic and engineering biology, tissue and metabolic engineering, medical technology, the development of new types of biomaterials, bio-inspired data storage and microelectronics, and biomanufacturing, as well as accelerate the ability to harness biological systems to create goods and services that contribute to agriculture, health, security, manufacturing, and resilience to climate change, including natural and anthropogenic disaster prevention and mitigation. As part of the National Engineering Biology Research and Development Initiative codified in the CHIPS and Science Act, NSF investments in research at the intersection of the biological, physical, chemical, data, computational and information sciences and engineering, and social, behavioral and economic sciences will accelerate scientific understanding and technological innovation in engineering biology as well as assure public acceptance of the products of engineering biology.

- **Advanced Manufacturing**, including robotics and sensing technologies, ($386.67 million) investments will accelerate breakthroughs in manufacturing materials, technologies, and systems through fundamental and translational, multidisciplinary research that transforms manufacturing capabilities, methods, and practices. NSF investments will further advanced manufacturing through advanced energy and industrial efficiency technologies, resilient manufacturing strategies, novel methods in engineering biology, next-generation materials, and the power of data science, automation, robotics, and machine learning to intelligently design and develop future approaches that are secure, sustainable, and resilient to natural and anthropogenic disasters.

- **Quantum Information Science (QIS)**, including quantum computing and simulation, ($294.37 million) will advance fundamental understanding of uniquely quantum phenomena that can be harnessed for information processing, transmission, and measurement in ways that classical approaches do less efficiently, or not at all. Current and future applications of QIS differ from prior applications of quantum mechanics by using distinct properties that do not have classical

counterparts. The development of new applications for QIS will lay the groundwork for one of the major technological revolutions of the 21st century. NSF investments are a key component of the National Quantum Initiative (NQI), aligning with the Administration's focus on critical and emerging industries.

- **Microelectronics and Semiconductors**, including advanced computer hardware, ($174.97 million) investments will address the microelectronics and semiconductor challenges facing our Nation due to technological and global trends, such as the end of Moore's Law and offshoring of semiconductor fabrication and manufacturing. NSF will advance novel semiconductor design and manufacturing, enabling future advanced computing systems, including quantum computing and networking technologies. Investments will also advance next-generation materials and highly parallel chip designs that will improve the performance of AI algorithms as well as integrate advanced energy efficiencies for low-power and high-performance devices that will drive a mobile and wireless future, and smart sensors that will interface between biosystems and electronics. Additionally, the CHIPS and Science Act provides NSF with $200 million over five years for semiconductor workforce development activities.

- **Advanced Wireless**, including communications technology and immersive technology, ($167.90 million) investments will bridge knowledge gaps and advance innovations in areas critical to future generations of communications technologies and networks, such as novel wireless devices, circuits, protocols, and systems; mobile edge computing; distributed machine learning and inference on mobile devices; human-machine-network interactions; ultra-low-latency connections; and dynamic spectrum allocation and sharing, all while ensuring security for all users. For example, this investment will serve to advance both new active spectrum applications and spectrum used for non-commercial purposes, such as advanced receiver design and interference mitigation techniques for radio astronomy and atmospheric science. NSF investments will provide the backbone that connects users, devices, applications, and services that will continue to enrich America's national and economic security

Build a Resilient Planet Theme

Resilience is the watchword as the U.S. and world see and feel the impacts of a changing climate and the growing need for clean, reliable, sustainable energy. Without the resilience to withstand and recover quickly from these impacts, populations everywhere are at the mercy of heat waves, droughts, floods, wildfires, rising oceans, and other extreme events, as well as power disruptions, economic instability, food insecurity, and deleterious effects on human health. NSF's Build a Resilient Planet initiative takes on these multifaceted challenges. Accelerating the development of solutions to the interconnected challenges of resilience requires bold thinking, convergent approaches, and an overarching commitment to environmental equity, justice, and workforce development and education. NSF will invest strategically in emerging research areas on resilience to ensure U.S. leadership for an economically strong, nationally secure, sustainable, and equitable future.

NSF's FY 2025 investments in Build a Resilient Planet will support research to improve our understanding of climate systems and related environmental and human interactions, water quality and food-energy-water systems, and natural hazards and community resilience, including social and behavioral dimensions. Supported research will advance sustainable chemistry, the provision of critical minerals, engineering biology, biomanufacturing, precision agriculture, and resilient rural and urban infrastructure that will enable economic growth that protects people and the planet. Focus

areas include:

- **U.S. Global Change Research Program (USGCRP)** ($897.18 million) supports research that contributes to the USGCRP goals to (1) advance scientific knowledge of interconnected natural and human systems and risks to society from global change; (2) build global capacity to respond to global change through international cooperation and collaboration; (3) enhance the Nation's ability to understand and respond to global change by expanding participation in the Federal research enterprise; and (4) provide accessible, usable information to inform decisions on mitigation, adaptation, and resilience. In FY 2025, NSF will expand its activities related to risk and resilience, including efforts that will improve climate hazard and disaster resilience in communities, develop technologies needed to advance resilience research, support research on the human health implications of climate change, and grow the human capital to take on the climate challenges of today and tomorrow. NSF will also initiate activities for new approaches related to design in extreme environments.

- **Clean Energy Technology (CET)** ($500.52 million) investments are designed to identify and support transformative research to advance U.S. leadership in the clean energy transition and meet the U.S. Net Zero objectives for 2030 and beyond. NSF's investments in integrated clean energy research and education span longstanding programs as well as focused new solicitations and will support high-risk, high-reward research ideas across the science and engineering spectrum that create broad new understanding and innovations to support energy efficiency, enhance sustainability, support net-zero solutions for decarbonization, adapt to and mitigate climate change, spawn new industries and transform existing industries, and support translation and partnerships for innovation, as well as education and workforce development. NSF also will support multidisciplinary research in areas such as affordable green housing and sustainable systems for clean water, clean transit, and other infrastructure. In FY 2025, investments will focus on fundamental and convergent research, energy research infrastructure, innovation and translation, and education and workforce development.

- NSF will continue investments in **greenhouse gas (GHG) research** ($69.50 million), where NSF-funded projects will develop measuring strategies as well as reporting and verification systems with an emphasis on methane.

- Examples of other programs supported within the Build a Resilient Plant Theme in FY 2025 include further development of the **National Discovery Cloud (NDC) for Climate** ($30.0 million), a resource that will federate advanced compute, data, software and networking resources, democratizing access to a cyberinfrastructure ecosystem that is increasingly necessary to further climate-related S&E, and the **Focus On Recruiting Emerging Climate and Adaptation Scientists and Transformers (FORECAST**) ($15.0 million) program, which centers on individuals from communities that have traditionally been underrepresented in STEM, making resilience research relevant to students and equipping participants with the broader skills necessary to excel in their future endeavors inside and outside academia.

<u>Create Opportunities Everywhere Theme</u>

NSF is laser-focused on the Nation's need for a science and engineering workforce that draws on the talents of all Americans, wherever they may be. Create Opportunities Everywhere (COE) is a comprehensive approach for attracting, supporting, and advancing groups underrepresented in

STEM. This whole-of-NSF approach infuses the actions of all NSF directorates and offices by striving to ensure equity in program delivery, while building on the concept of the "Missing Millions." It focuses on expanding access and inclusion in STEM along individual, institutional, and geographic lines.

These principles guide NSF's COE efforts: (1) address research equity, (2) build capacity, (3) foster collaborations and partnerships, and (4) support the next generation of researchers. In FY 2025, NSF intends to continue applying these four principles to COE by strengthening and scaling investments, expanding beyond the Broadening Participation portfolio, and increasingly incorporating them into NSF's core research portfolio. For *individuals*, NSF will continue to make investments in democratizing STEM education and workforce. For *institutions*, NSF will be more intentional about how it engages Minority Serving Institutions and Emerging Research Institutions in its formal and informal programs. For *jurisdictions,* NSF will expand support in EPSCoR jurisdictions to ensure geographic diversity.

NSF's commitment to finding talent provides opportunities that build strong STEM pathways that lead to a well-paid workforce and support the U.S. economy. Key investments include these areas:

- **Graduate Research Fellowship Program** ($341.11 million) will support 2,300 new fellows in FY 2025.

- **Established Program to Stimulate Competitive Research (EPSCoR) Office** ($258.37 million) provides strategic programs and opportunities that stimulate sustainable improvements to EPSCoR jurisdictions' R&D capacity and capability. EPSCoR aims to stimulate research that enhances jurisdictional competitiveness in NSF disciplinary and multidisciplinary research programs, especially those that drive economic growth and geographic diversity. Also, pursuant to the CHIPS and Science Act, all NSF research divisions will commit additional support for meritorious proposals from EPSCoR jurisdictions.

- **Hispanic-Serving Institutions (HSI)** ($55.92 million) program seeks to enhance the quality of undergraduate STEM education at HSIs and to increase retention and graduation rates of undergraduate students pursuing degrees in STEM fields at HSIs. The HSI program seeks to build capacity at HSIs that typically do not receive high levels of NSF grant funding.

- The **Louis Stokes Alliances for Minority Participation (LSAMP)** ($55.0 million) is an alliance-based program that works to increase the number of STEM baccalaureate and graduate degrees awarded to populations historically underrepresented in STEM disciplines.

- **Historically Black Colleges and Universities Undergraduate Program (HBCU-UP)** ($44.94 million) is committed to enhancing the quality of undergraduate STEM education and research at HBCUs to broaden participation in the Nation's STEM workforce. HBCU-UP provides awards to develop, implement, and study evidence-based innovative models and approaches for improving the success of HBCU undergraduates so that they may pursue STEM graduate programs and/or careers.

- **Growing Research Access for Nationally Transformative Equity and Diversity (GRANTED)** ($40.0 million) will improve the Nation's research support and service capacity at emerging and underserved research institutions. GRANTED will use a variety of mechanisms and programs to further NSF's reach in advancing the geography of innovation and engaging the

Missing Millions. GRANTED activities will support the enhancement of research administration and post-award management as well as the sharing and implementation of effective practices that lead to competitive proposal development for external funding in STEM research and training.

- **Eddie Bernice Johnson INCLUDES Initiative (NSF INCLUDES)** ($37.35 million) is a comprehensive national initiative to enhance U.S. leadership in STEM discoveries and innovations focused on NSF's commitment to diversity, inclusion, and broadening participation in these fields. The vision of this program is to catalyze the STEM enterprise to work collaboratively for inclusive change, resulting in a STEM workforce that reflects the population of the Nation.

- **Centers of Research Excellence in Science and Technology (CREST)** ($30.31 million) enhance the research capabilities of minority-serving institutions (MSI) through the establishment of centers that effectively integrate education and research. CREST promotes the development of new knowledge, enhancements of the research productivity of individual faculty, and an expanded presence of students historically underrepresented in STEM disciplines.

- **National STEM Teacher Corps** ($30.0 million) aims to bring greater attention and recognition to outstanding STEM teachers in today's classrooms, reward them for their accomplishments, elevate their public profile, and create rewarding career paths in which all STEM teachers can aspire, both to prepare the future STEM workforce and create a scientifically literate public.

- **Historically Black Colleges and Universities Excellence in Research (HBCU-EiR)** ($26.13 million) program supports projects that enable STEM and STEM education faculty to further develop research capacity at HBCUs and to conduct research.

- The **Tribal Colleges and Universities Program (TCUP)** ($20.90 million) provides awards to Tribal Colleges and Universities, Alaska Native-serving institutions, and Native Hawaiian-serving institutions to promote high quality STEM education, research, and outreach.

- **Alliances for Graduate Education and the Professoriate (AGEP)** ($9.93 million) program aims to increase the number of African American, Hispanic American, Native American Indian, Alaska Native, Native Hawaiian and Native Pacific Islander (or AGEP population) faculty in STEM at all types of institutions of higher education. The program funds projects that increase the understanding of institutional policies and practices to help doctoral candidates, postdoctoral scholars, and faculty improve their academic pathways to tenure and promotion in the STEM professoriate.

- **Analytics for Equity Initiative** ($1.25 million) builds on the Evidence-Based Policymaking Act[2]. Led by NSF with four interagency partners, this program will fund researchers to produce rigorous empirical research and actionable recommendations in equity-related topics aligned to agency Learning Agendas.[3] Federal agencies and other organizations can use the resulting recommendations to increase the impact of equity-focused evidence-based strategies.

[2] www.congress.gov/115/plaws/publ435/PLAW-115publ435.pdf

[3] www.evaluation.gov/evidence-plans/learning-agenda/

Research Infrastructure Theme

Research infrastructure (RI), from individual instruments to major research facilities, is foundational to the scientific endeavor. Definitions of RI have evolved significantly over the years, particularly as remote access and cyberinfrastructure have become essential components of almost every tool in use by the research community. The COVID-19 pandemic further emphasized the critical nature of these components and illustrated how they can enable ongoing efforts to expand access to RI to historically underserved groups and communities. Additionally, NSF investments in science and engineering have stimulated discovery and innovation in the design and development of novel infrastructure, giving rise to new and different forms of RI.

RI is an essential construct of science and engineering research and education and is critical to the success of research across a wide array of disciplines and over a broad range of time scales. Needed for all forms of fundamental research – from exploratory to solutions-oriented – RI investments enable advances in areas as varied as modeling of the epidemiology of infectious diseases; analysis of the changes in biomass in forests; studies of the rate at which underrepresented groups are engaged in science and engineering disciplines; generation of data via shake table and wind tunnel experiments that inform natural hazard mitigation efforts; investigation of the fundamental structure of particles that make up everything in the universe; studies of biological, chemical, and physical processes at various timescales; use of AI-powered tools and techniques for data collection and management to expand the capacity of pattern recognition; and characterization of the contents of our solar system, including potentially hazardous asteroids. Catalyzed by the CHIPS and Science Act of FY 2022 and by FY 2023 appropriations, investments in FY 2025 will support the modernization of existing research infrastructure and the development of new infrastructure.

Support for **Major Facilities operations and maintenance (O&M**) ($1,120.33 million) continues to reflect a balance among multiple priorities. NSF divisions carefully allocate resources between research grants and O&M costs for research infrastructure. In addition to regular O&M needs to keep a facility functional, support for upgrades, significant periodic maintenance, and infrastructure renewal must also be addressed within Facilities O&M, which accounts for over 10 percent of NSF's total request in FY 2025. NSF continues to explore ways to invest in research infrastructure, at all scales, to keep pace with changing technologies, increased demand by users, and expanding research opportunities.

The **Mid-scale Research Infrastructure (Mid-scale RI)** ($192.45 million total, comprising $134.42 in agency-wide Track 1 and Track 2 program investments plus $58.03 million in division level programs), program supports research infrastructure with a total project cost above the upper limit for the MRI program ($4.0 million) and below the Major Research Equipment and Facilities Construction (MREFC) threshold ($100.0 million). This dedicated funding line implements a high-priority, agency-wide mechanism that includes upgrades to major facilities as well as stand-alone projects.

The goals of the Mid-Scale RI program are to:

- Provide access to cutting-edge mid-scale research infrastructure, including instrumentation.
- Enable agile development and implementation of frontier scientific and engineering research infrastructure with a high potential to significantly advance the Nation's research capabilities.
- Train early-career scientists and engineers in the development and use of advanced research infrastructure.

In FY 2025, NSF investments will support Mid-scale RI Track-1 ($4.0 million to $20.0 million awards), funded through the Research & Related Activities account, and Track-2 ($20.0 million to $100.0 million awards), funded through the MREFC account. Both use an approximately biennial funding opportunity; the third solicitation for Mid-scale RI-1 (NSF 22-637[4]) was issued in FY 2022, with awards made in FY 2023 and more anticipated in FY 2024. In addition, proposals have recently been received in response to the Mid-scale RI-2 solicitation (NSF 23-570[5]), with awards anticipated in FY 2025.

The **Major Research Instrumentation (MRI)** ($82.82 million) program is responsible for catalyzing new knowledge and discoveries by helping STEM professionals acquire or develop the instrumentation needed for innovative science and engineering research. MRI grants support instrumentation in all NSF-supported research disciplines. In FY 2025, NSF will continue the implementation of CHIPS and Science Act provisions that began in FY 2023. These include waiving cost-sharing for new MRI projects and supporting projects for equipment and instrumentation to conserve or reduce the consumption of helium.

Major Research Equipment and Facilities Construction. Construction projects that require an investment of more than $100 million are generally supported in NSF's MREFC Account. The FY 2025 Request includes funding for two projects: the Antarctic Infrastructure Recapitalization program, an enduring effort that replaces the Antarctic Infrastructure Modernization for Science or AIMS project, and the Leadership-Class Computing Facility (LCCF). The MREFC account also supports the Mid-scale RI Track 2 program, covering projects in the $20 million to $100 million range.

MREFC Account Funding, by Project

(Dollars in Millions)

	FY 2024 Request	FY 2025 Request
Leadership-Class Computing Facility (LCCF)	$93.00	$154.00
Antarctic Infrastructure Recapitalization (AIR)	60.00	60.00
HL-Large Hadron Collider Upgrade (HL-LHC)	38.00	-
Vera C. Rubin Observatory (Rubin)	7.61	-
Mid-scale Research Infrastructure, Track 2	105.06	85.00
Dedicated Construction Oversight	1.00	1.00
Total	**$304.67**	**$300.00**

- The **Leadership-Class Computing Facility** ($154.0 million) is envisioned as a distributed facility that will provide unique computational and data analytics capabilities, as well as critical software and services, for the Nation's science and engineering research community to enable discoveries that would not be possible otherwise. The project will deploy a comprehensive range of education and outreach activities that will expand and nurture our Nation's future STEM workforce in data and computational science. Construction of the LCCF, funded from the MREFC Account, is planned to begin in FY 2024 now that the development and design phases, funded from the R&RA Account,

[4] www.nsf.gov/pubs/2022/nsf22637/nsf22637.htm

[5] https://new.nsf.gov/funding/opportunities/mid-scale-research-infrastructure-2-mid-scale-ri-2/nsf23-570/solicitation

are complete.

- NSF manages all U.S. Antarctic activities as a single, integrated program, making Antarctic research possible for scientists supported by NSF and other U.S. agencies. Impacts of the COVID-19 pandemic on U.S. Antarctic Program (USAP) operations required construction activities at McMurdo Station to be suspended and caused a significant delay in the completion of AIMS. In the meantime, other investments in facilities and infrastructure on the continent have emerged as priorities that cannot be deferred until after completion of AIMS. As a result, the **Antarctic Infrastructure Recapitalization** (AIR) ($60.0 million) program was conceived as a portfolio of investments in infrastructure across the USAP stations that will replace AIMS. On-ice AIMS construction will continue in FY 2023 with a focus on meeting near-term needs, and unfunded parts of AIMS will be considered for incorporation into the longer-term AIR program.

- In FY 2025, no funding is provided for **HL-LHC Upgrade** ($0.0 million) as the project is being completed. NSF investments are being used to upgrade components of the ATLAS and CMS detectors. These upgrades are approximately 40 percent complete and are anticipated to be finished in FY 2027.

- In FY 2025, no funding is provided for **Vera C. Rubin Observatory** ($0.0 million) as the eleven-year construction project is completed. Rubin will be an 8-meter class wide field optical telescope capable of carrying out surveys of the entire southern sky.

- **Mid-scale Research Infrastructure, Track 2 (Mid-scale RI)**. See discussion of Mid-scale RI above.

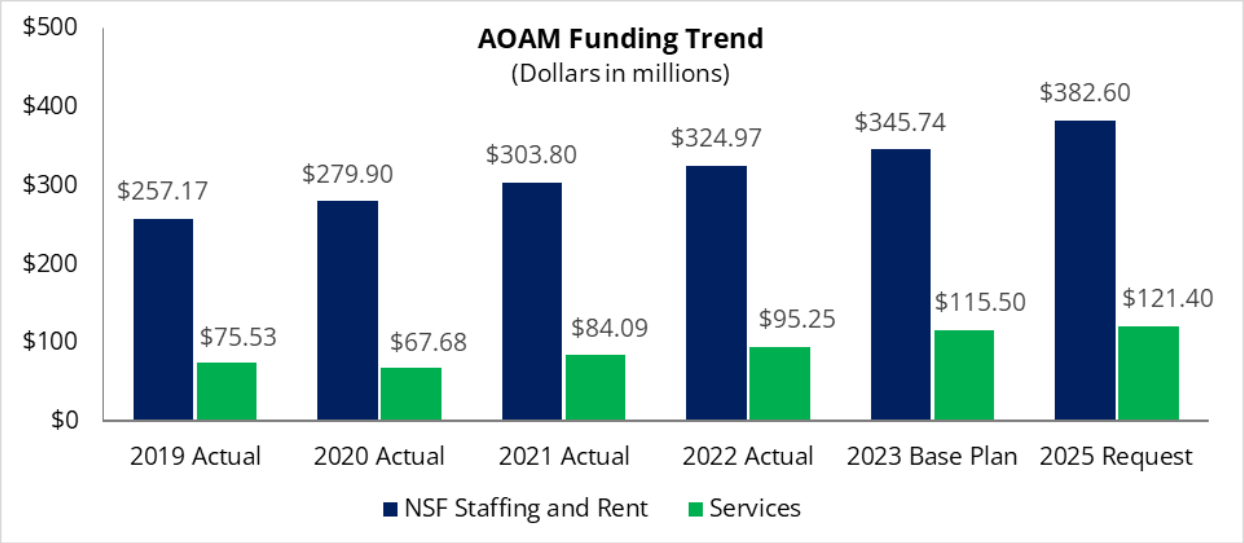
Design of Potential New Major Facility Construction Projects. The FY 2025 Request supports the continued design of a single telescope within the U.S. Extremely Large Telescope (U.S. ELT) program. Consistent with a recent statement by the National Science Board to fund one telescope in the ELT program, NSF will initiate an external expert panel to conduct a review of the two U.S. ELT projects that will inform NSF's decision of which project will remain in the Major Facility Design Stage. A future decision remains about whether to advance that project to Construction, pending completion of the Final Design Phase.

ORGANIZATIONAL EXCELLENCE - AGENCY OPERATIONS AND AWARD MANAGEMENT (AOAM)

The $10.183 billion in funding that NSF will support in FY 2025 is managed by the staff at NSF who enable research and steward the taxpayer investment. Investments in the Agency Operations and Award Management (AOAM) account provide the fundamental framework through which the Foundation's science and engineering research and education programs are administered. AOAM is the avenue by which NSF directly supports and responds to Congressional priorities and the Administration's management and performance priorities, including a growing research science and security framework vital to the well-being of the NSF-funded scientific enterprise. AOAM funds the essential services NSF needs to operate, and investments in the AOAM account continue to be an NSF priority.

In FY 2025, NSF requests a total of $504.0 million for AOAM, an increase of $40.87 million or 8.8 percent above FY 2023 Current Plan level for the AOAM account. Even with this large increase, NSF continues to operate as a lean agency, with AOAM costs representing less than five percent of NSF's total FY 2025 budget.

In the AOAM account, about 77 percent of the total AOAM funding covers NSF personnel and NSF's headquarters location in Alexandria, VA, with the remaining quarter going to mission support services. Over the last several fiscal year budget requests, NSF reduced or held flat mission support services costs to accommodate the year-over-year increases in the fixed costs for staffing and rent while minimizing growth to the AOAM account in the Request.



In FY 2025 NSF will continue its recent practice of requesting the AOAM amount NSF estimates it needs and is commensurate with the overall plans and priorities for NSF. The requested level will enable NSF to maintain a current services level of funding across its mission support activities while at the same time expand agency staffing needs, to effectively and efficiently meet the needs of the agency.

RESEARCH SECURITY STRATEGY AND POLICY

NSF is expanding capabilities and competencies to protect the U.S. science and engineering enterprise through its Research Security Strategy and Policy activity. In January 2022, the National Science and Technology Council's Research Security Subcommittee, co-chaired by NSF, issued implementation guidance for National Security Presidential Memorandum 33 (NSPM-33) on National Security Strategy for United States Government-Supported Research and Development. The August 2022 CHIPS and Science Act contained several research security provisions that NSF is implementing. NSF participation in discussions with the U.S. research community and with international colleagues and development of common frameworks for understanding research security are major components of the NSF Research Security activity, which is expected to continue to grow in FY 2025. Specific activities include:

- As required by Section 10338 of the CHIPS and Science Act, NSF will establish the Research Security and Integrity Information Sharing and Analysis Organization, to be known as the SECURE center, which will serve as a clearinghouse for information to empower the research community to identify and mitigate foreign interference that poses risks to the U.S.-funded research enterprise. The SECURE Center will share information and reports on research security risks and provide training to the research community. NSF aims to grant SECURE Center award through cooperative agreement(s) by the end of FY 2024, officially standing up this Center in FY 2025.

- NSF will fund a Research on Research Security (RoRS) workshop in FY 2024, followed up a RoRS funding program in FY 2025. The primary goals of the program will include assessment of the characteristics that distinguish research security from research integrity, improving the quantitative understanding of the scale and scope of research security risks, developing methodologies to assess the potential impact of research security threats, and assessing the additional research security risks in an innovation system that includes more use-inspired research rather than staying well within the bounds of fundamental research.

- NSF will continue to scale-up its analytic capabilities to proactively identify conflicts of commitment, vulnerabilities of pre-publication research, and risks to the merit review system in NSF proposals and the SBIR due diligence process in FY 2025.

- Through a partnership with the federal government interagency community, NSF published research security training modules for the research community in FY 2024. NSF will continue to fund the delivery of these modules and assess if more are required in FY 2025.

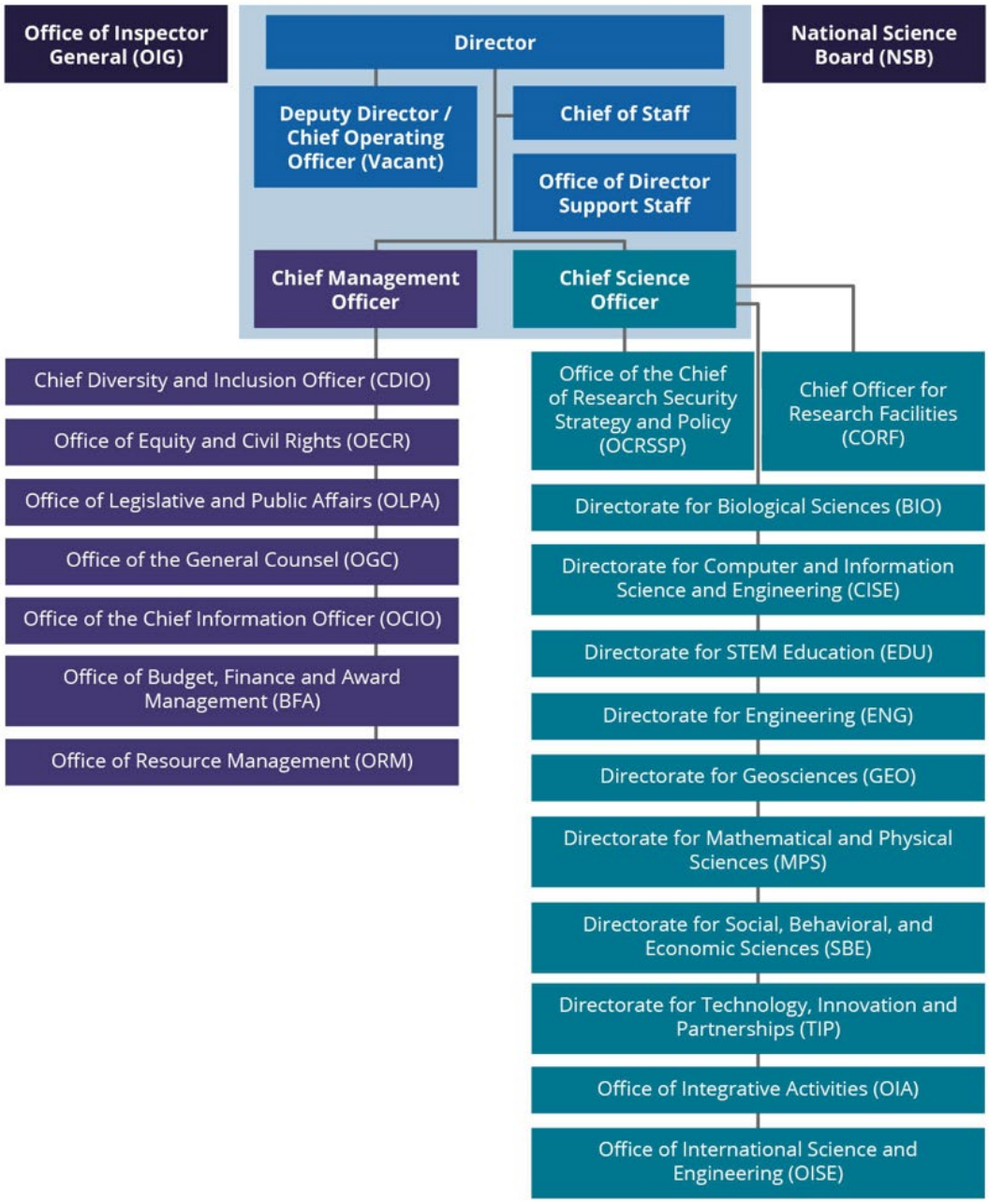
- As required by Section 10339B of the CHIPS and Science Act, NSF will develop and implement a new framework and IT system to begin to collect Foreign Financial Disclosure Requirements (FFDR) from NSF recipient institutions of higher education in FY 2024. NSF will refine the collection and analysis of these reports to enable OCRSSP to identify potential threats in FY 2025.

- NSF will develop and implement a new policy to review NSF proposals for national security concerns in FY 2024. As part of the new policy, NSF will develop a National Security Evaluation Rubric, comprised of risk-based indicators to inform the basis of this decision-making process. NSF intends to pursue and implement mitigation measures to address and minimize risk. NSF will begin a pilot program in summer FY 2024 and will continue the pilot program through FY 2025.

ORGANIZATION AND ROLE IN THE FEDERAL RESEARCH ENTERPRISE

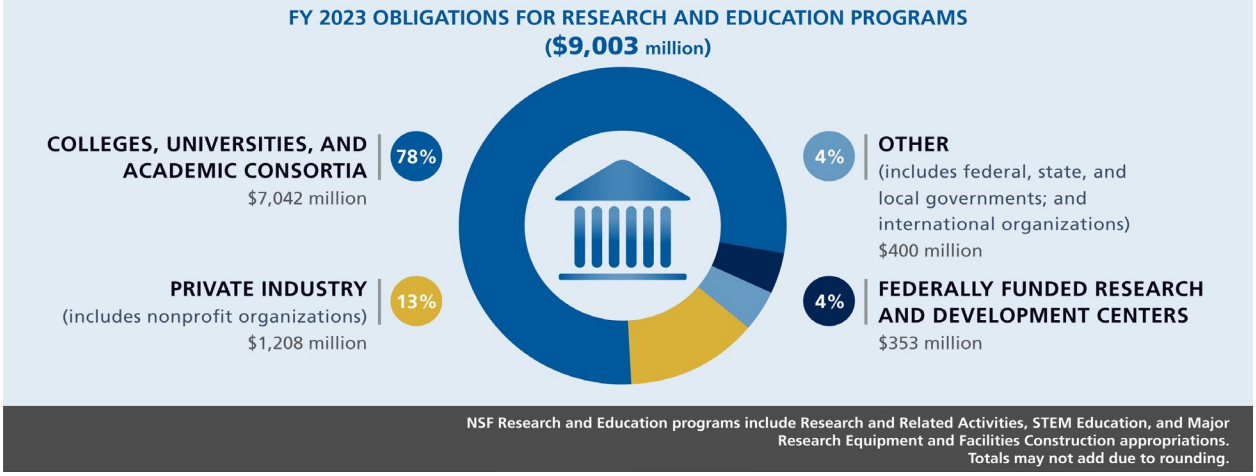
NSF's comprehensive and flexible support of meritorious projects enables the Foundation to identify and foster both fundamental and transformative discoveries and broader impacts within and among fields of inquiry. NSF has the latitude to support emerging fields, high-risk ideas, interdisciplinary collaborations, and research that pushes—and creates—the very frontiers of knowledge.

NSF's organization represents all major science and engineering fields. NSF also carries out specific responsibilities for STEM Education, integrative activities, and international science and engineering. The 25-member National Science Board consults with NSF on high level policies and approaches.

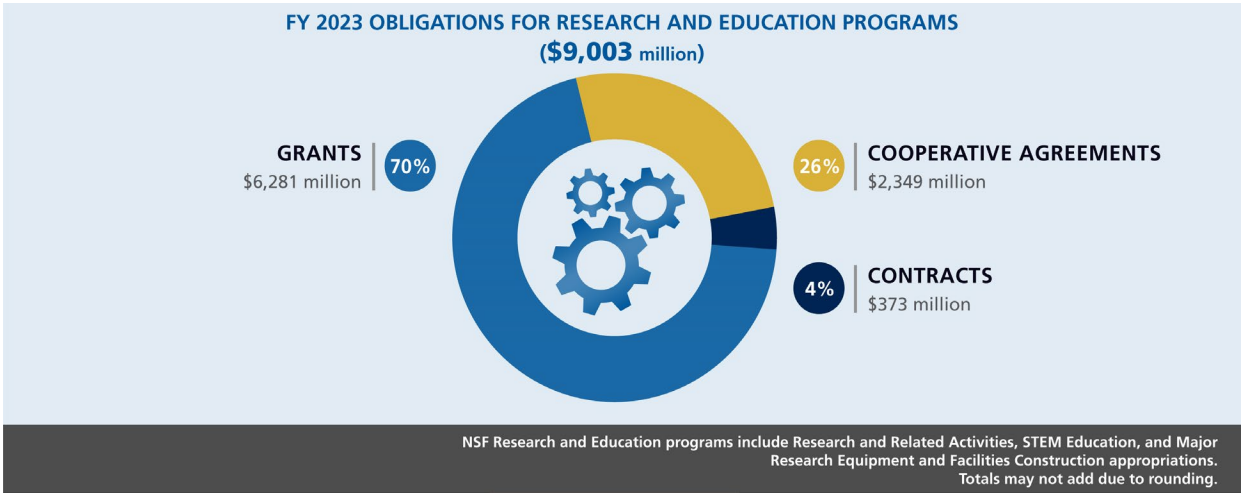


NSF BY THE NUMBERS

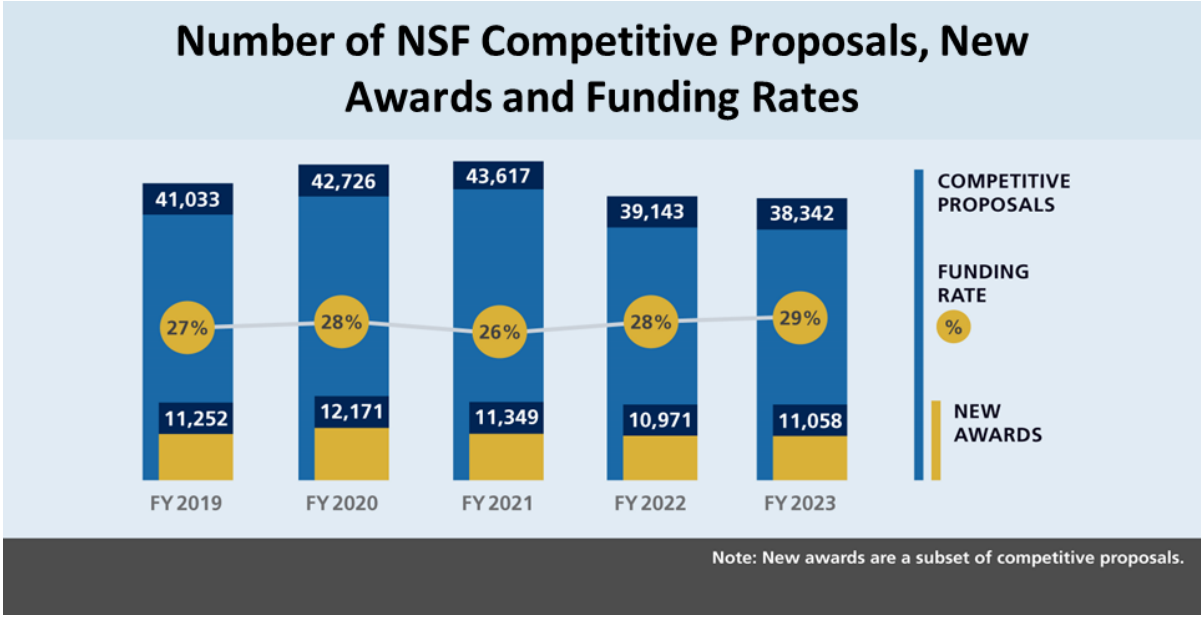
NSF's annual budget represents about 23 percent of the total federal budget for basic research conducted at higher education institutions. In many science and engineering fields, NSF is the primary source of federal academic support. NSF awards are chiefly made to academic institutions. In FY 2023, 78 percent of support for research and education programs ($7,042.0 million) was awarded to colleges, universities, and academic consortia. Private industry, including small businesses and non-profit organizations, accounted for 13 percent ($1,208.0 million), and support to Federally Funded Research and Development Centers accounted for four percent, or $353.0 million. Other recipients (federal, state, and local governments and international organizations) received four percent ($400.0 million) of support. This distribution in FY 2025 is expected to be similar.



Almost 96 percent of NSF's FY 2023 projects were funded using grants or cooperative agreements. NSF grants are either standard or continuing awards. That is, the award is made during one fiscal year for the full amount of the award or made over several years in increments. Cooperative agreements are used when the project requires substantial agency involvement during the project performance. Contracts are used to acquire products, services, and studies required primarily for NSF or other government use. This distribution by funding mechanism is expected to be similar in FY 2025.



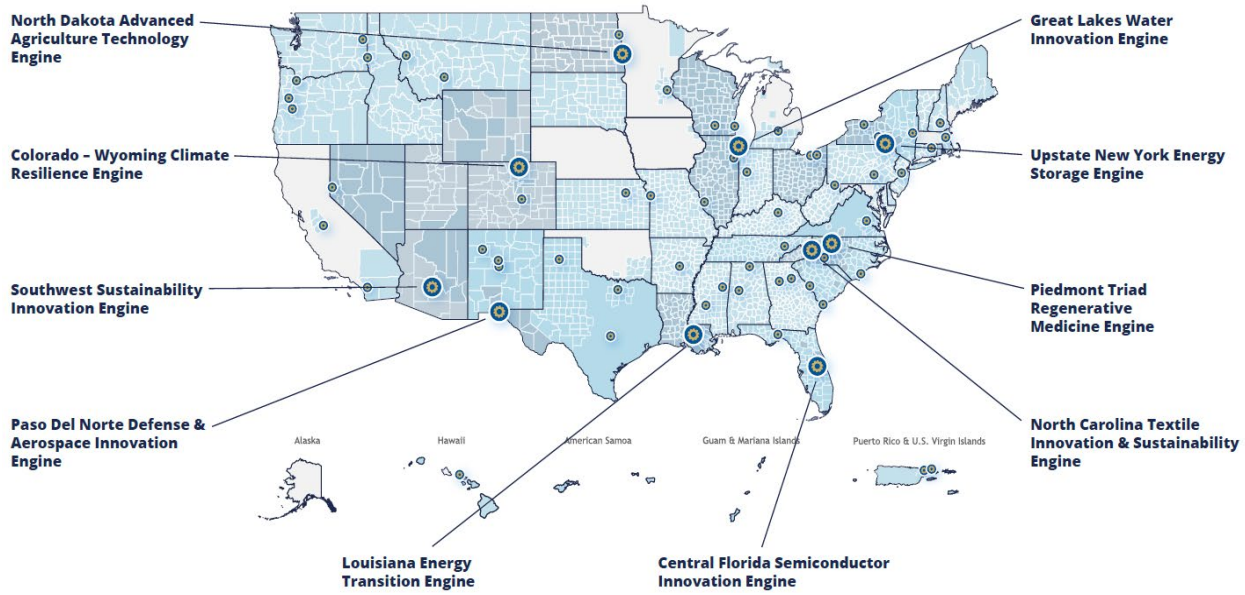
NSF continuously monitors key portfolio, proposal workload, and financial measures to understand short- and long-term trends and to help inform management decisions. The chart below presents a high-level, agency-wide estimate of funding rates, or proposal "success," as a comparison of the number of competitive proposals, new awards, and funding rates between FY 2019 and FY 2023. In FY 2025, NSF expects to evaluate over 40,500 proposals through a competitive merit review process and make almost 11,000 new competitive awards, of which almost 9,000 are expected to be new research grants and the remainder of contracts and cooperative agreements.



HIGHLIGHTS

NSF establishes 10 inaugural Regional Innovation Engines across the country

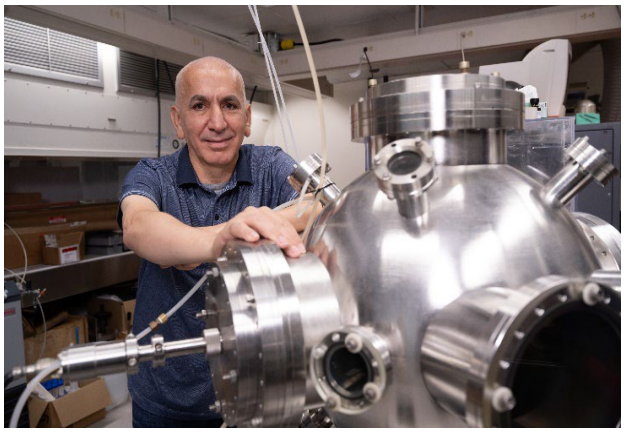
In January 2024, NSF established the first-ever NSF Regional Innovation Engines (NSF Engines), awarding 10 teams spanning 18 states. With a potential NSF investment of nearly $1.6 billion over the next decade, NSF Engines represent one of the single largest broad investments in place-based research and development in the nation's history – uniquely placing science and technology leadership as the central driver for regional economic competitiveness. Each NSF Engine will initially receive up to $15 million for two years. NSF's initial $150 million investment in these 10 regions is being matched nearly two to one in commitments from state and local governments, other federal agencies, philanthropy, and private industry. Together, this first cohort of NSF Engines comprises almost 500 partners that span nearly the entire United States and include participants from academia, industry, small business, nonprofits, investors, federal agencies, and state, local, and tribal governments. Beyond the 10 NSF Engines awards, a subset of the semifinalists and finalists were invited to pursue NSF Engines Development Awards, with each receiving up to $1 million to further develop their partnerships and model for a future NSF Engines proposal. They will join 44 existing NSF Engines Development awardees announced in May 2023.



Credit: NSF

CREST Phase I Center for Advanced Magnets and Semiconductors

A new research and educational hub is being established at Morgan State University in Baltimore with funding from NSF's Center of Research Excellence in Science and Technology (CREST) program. The $5 million award, partly funded through the CHIPS and Science Act of 2022, will support CREST over the next five years and play a major role in producing a highly talented and diverse technology workforce. The center will partner with neighboring institutions to perform bold, innovative studies in advanced magnets and semiconductors and oversee STEM education and outreach initiatives for underrepresented minorities. This includes developing two new graduate programs, joint educational initiatives such as symposia and internships, and summer programs for high school students and science teachers.



Adbellah Lisfi, Ph.D., professor of Physics at Morgan State University, serves as the principal investigator on NSF's Center of Research Excellence in Science and Technology (CREST) grant. *Credit: Morgan State University*

NSF Funding Drives Semiconductor Industry in Arkansas

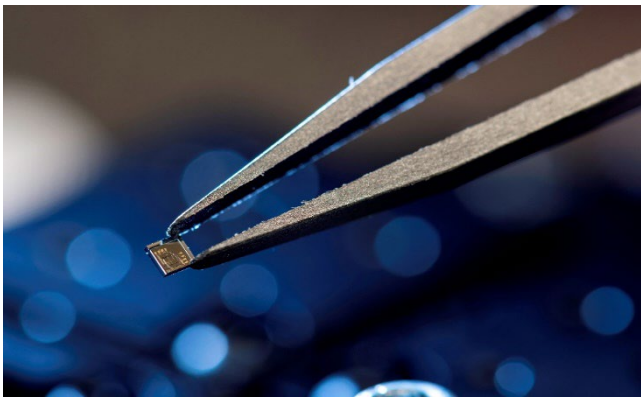
NSF has funded semiconductor research in Arkansas for over 20 years and spawned an entire manufacturing industry in the state. Most notably, a Materials S&E Center award (0520550) worth $8.0 million and an EPSCoR award (1457888) worth $20.0 million have enabled basic research to move to technology transfer.

Arkansas NSF EPSCoR logo. *Credit: U.S. National Science Foundation*

As a result of funded research from NSF for over 20 years there are now more than 20 companies in Arkansas that manufacture semiconductors and related components. One such example, Ozark Integrated Circuits, was founded by Matt Francis in 2011, who received his Ph.D. from the University of Arkansas. This company was initially funded through an NSF SBIR grant (1248693); resulting federal investments have helped it to become an industry leader in semiconductor and circuit fabrication for extreme environments.

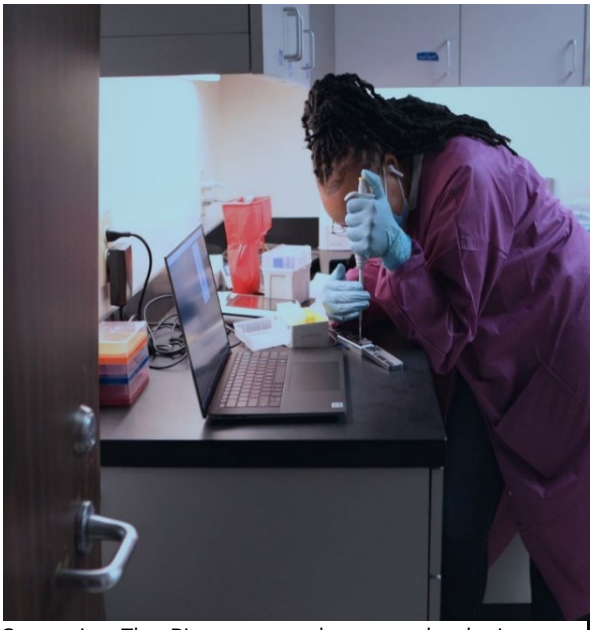
Breakthrough in computer chip energy efficiency could cut data center electricity use

Researchers at Oregon State University and Baylor University have made a breakthrough in reducing the energy consumption of the photonic chips used in data centers and supercomputers. The findings are important because a data center can consume up to 50 times more energy per square foot of floor space than a typical office building. The expanded use of silicon photonics facilitates high-speed data movement, which is the biggest barrier to higher performance in both data centers and high-performance computing.



Photonic Chip pictured in the lab. *Credit: J. Adam Fenster*

Computing the Biome



Computing The Biome researchers are developing cost-effective ways to create AI-ready biothreat signatures of disease-transmitting and invasive species. *Credit: Harris County Public Health/Johns Hopkins University*

Led by Vanderbilt University, the Computing the Biome team is developing an AI technology platform to monitor and detect vector-borne pathogens to mitigate disease outbreaks. Funded by the NSF Convergence Accelerator, the solution is a part of Track D: AI-Driven Innovation via Data and Model Sharing, focused on developing tools and platforms to address data and model sharing and national-scale societal challenges. Computing the Biome's convergent team consists of engineers, computer scientists, biologists, epidemiologists, public health experts, and policy experts from Microsoft's Premonition technology, Tomorrow.io, Harris County Public Health, Johns Hopkins University, University of Pittsburgh Medical School, Vanderbilt University, and the University of Washington. Since September 2021, the solution's AI-enabled mosquito traps have been piloted in Harris County to gather data on pathogens transmitted by mosquitoes and other species. In September, a partnership was formed between Microsoft, biopharma company GSK, and the Centre for Health and Diseases Studies Nepal to test the solution's sensors in Nepal based on the success of the ongoing pilot in Harris County. The Nepal pilot is currently in progress, and the findings will assist the team in developing a framework to scale the technology and drive economic sustainability.

US-Australia Collaboration in Responsible and Equitable AI

NSF and Australia's national science agency, CSIRO, awarded $1.8 million on the U.S. side and $2.3 million on the Australian side to accelerate groundbreaking research in responsible and ethical artificial intelligence solutions. Responsible and ethical AI concerns have grown sharply with the increasing availability of AI-powered technologies. Awards under the NSF-CSIRO partnership is expected to contribute to establishing ethical frameworks — and ultimately guidelines — to ensure AI algorithms and their deployments are safe, fair, and beneficial to all citizens.

NSF Director Sethuraman Panchanathan met with Australian Chief Scientist Cathy Foley to discuss the recent successes of and ways to further advance NSF-CSIRO partnerships. *Credit: Brian Stone/NSF*

Studying Fire and Ice in Alaska Yields Sizzling Impacts

Through the Alaska EPSCoR RII Track-1 award, Alaskan researchers use remote sensing, field work, laboratory experiments, and modeling methods to study boreal forest fires and coastal marine ecosystems. This project is currently in its 5th year and has yielded some interesting findings, including predictive modeling for regional wildfires and how glacial melt impacts streams and estuaries, which has enormous implications for keystone fish species and the fishing industry in Alaska.

Fire & Ice Boreal Fires student lays down a transect in the Shovel Creek burn outside Fairbanks, July 30, 2020. *Credit: Tom Moran/Alaska NSF EPSCoR*

NSF-led National AI Research Institutes Program

NSF and its partners announced a $140 million investment to establish seven new National Artificial Intelligence Research Institutes. The announcement is part of a broader effort across the federal government to advance a cohesive approach to AI-related opportunities and risks.

The AI Institutes have now invested close to half a billion dollars since 2020. Among those funded in FY 2023 are some that will promote ethical and trustworthy AI systems and technologies, a theme that is of critical importance with the popular conversation in setting the foundation for a more responsible AI future.

NSF hosted an AI Hill Day on Tuesday, September 19, 2023, at the Russell Senate Office Building in Washington, D.C. This event was an opportunity for the 25 AI Institutes to showcase their research, accomplishments, and programs to members of Congress. *Credit: NSF/Giovanni Rodriguez*

Insurers Need Climate Change Data: The Industry-University Cooperate Research Center is Here to Help

As the rate of climate-driven extreme weather events increases, insurance companies are struggling to adapt. Across the nation, insurers have been raising prices or canceling policies, leaving homeowners trying to keep up. A new partnership between the National Science Foundation and the National Oceanic and Atmospheric Administration plans to address this issue by helping insurers consider climate change predictions. The goal of the new Industry-University Cooperative Research Center (IUCRC) is to assist companies in combining their traditional catastrophe models with modern climate change data and projections. This will help insurers adjust their business to cope with the risk of climate-driven disasters in the future, which will better inform the products and services they are able to offer consumers.

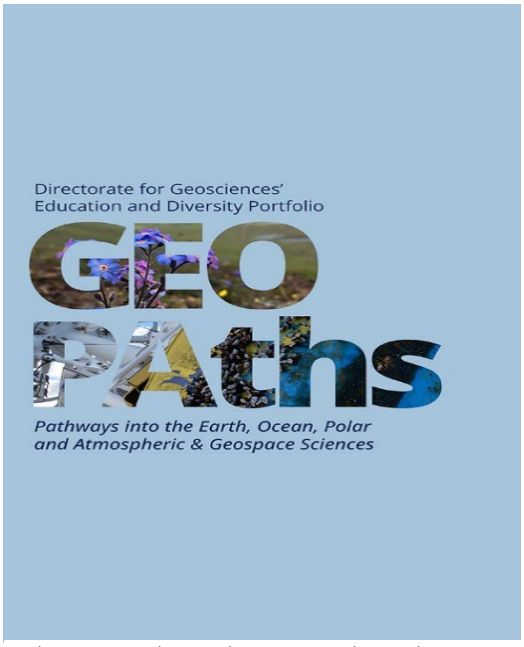
Supercell thunderstorm near Moscow, Kansas, on May 21, 2020. NSF-supported scientists are honing long-range forecasts of U.S. tornadoes and hail. *Credit: Victor Gensini, Northern Illinois University*

A protein mines and sorts rare earths, paving way for green tech

Rare earth elements, like neodymium and dysprosium, are a critical component to almost all modern technologies, from smartphones to hard drives, but they are notoriously hard to separate from the Earth's crust and from one another. Penn State scientists have discovered a new mechanism by which bacteria can select between different rare earth elements, using the ability of a bacterial protein to bind to another unit of itself, or "dimerize," when it is bound to certain rare earths, but prefer to remain a single unit, or "monomer," when bound to others.

Exploring Careers in Geoscience: Growing the Number and Diversity of Non-geoscience Students in Cornell's Geoscience Graduate Programs

The NSF-funded Cornell Geopaths Geoscience Learning Ecosystem (CorGGLE) program has opened doors for students and recent graduates from minority serving institutions to explore geoscience careers. CorGGLE has partnered with institutions in the mid-Atlantic region that have diverse student populations with educational backgrounds outside the geosciences. Over the course of 9 weeks, these students, who often focus on mathematics, technology, science, or engineering, conduct impactful research with Cornell University Department of Earth and Atmospheric mentors. The CorGGLE program also includes Cornell alumni who consult with students about careers in the geosciences. This program aims to increase the number and diversity of non-geoscience undergraduate students who then go on to pursue graduate degrees in geosciences.



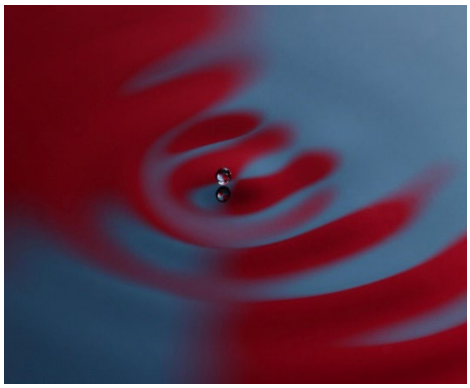
Pathways into the Earth, Ocean, Polar and Atmospheric & Geospace Sciences. *Credit: NSF*

Using Virtual Reality and Augmented Reality to Improve Manufacturing Environments and Workforce Education

Graduate Assistant Ritesh Chakradhar using VR & AR to enhance manufacturing. *Credit: Kynsfepscor.edu / Morehead State University*

Through software algorithms and machine learning, as well as powerful augmented and virtual reality scenarios, the engineering labs at Morehead State University are working to test, train, and enrich the manufacturing workforce. "In Kentucky, there is a lack of knowledge in manufacturing skills, especially in the areas of automation and robotics design…so we created different scenarios using virtual reality and augmented reality to create this kind of environment in order to train our students but also to train people that are working in the industry," says Dr. Jorge Ortega-Moody. Dr. Ortega-Moody's lab consists of ten post-doctoral, graduate, and undergraduate students from diverse backgrounds, each with their own project. Students learn mechanical design, electrical design, and programming in their courses. From virtual welding to excavation, these students are laying the groundwork for future collaborations with local industry.

Quantum visualization technique gives insight into photosynthesis

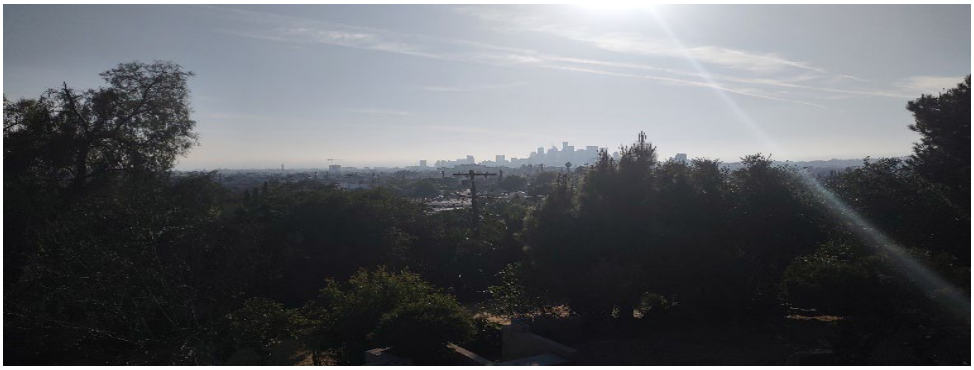


Quantum physics measures movements of the tiniest particles in the universe, which happen incredibly quickly and on very small scales and defy physicists' intuition. *Credit: Daniel M. Harris and John W.M. Bush*

Systems obeying quantum mechanics are notoriously difficult to visualize, but researchers at the University of Illinois Urbana-Champaign have developed an illustration technique that displays quantum features in an easy-to-read diagram called a coherence map. The researchers used these maps to study the quantum mechanisms that underlay photosynthesis, the process by which plants and some bacteria use sunlight to convert carbon dioxide and water into food. The researchers studied the molecular complex that "harvests" sunlight, absorbing it and transferring its energy to a chemical reaction site where carbon dioxide and water are processed. Coherence maps not only displayed how energy was transferred to the reaction site, but they gave a clear quantum explanation for the transfer.

Drought, Heat Waves Worsen West Coast Air Pollution Inequality

A new study supported by NSF's Dynamics of Integrated Socio-Environmental Systems (DISES) Program found drought and heat waves could make air pollution worse for communities that already have a high pollution burden in California and deepen pollution inequalities along racial and ethnic lines. The study also found financial penalties for power plants can significantly reduce people's pollution exposure, except during severe heat waves, when penalties fail to reduce emissions.



Downtown Los Angeles through pollution haze. *Credit: Elizabeth Holloway*

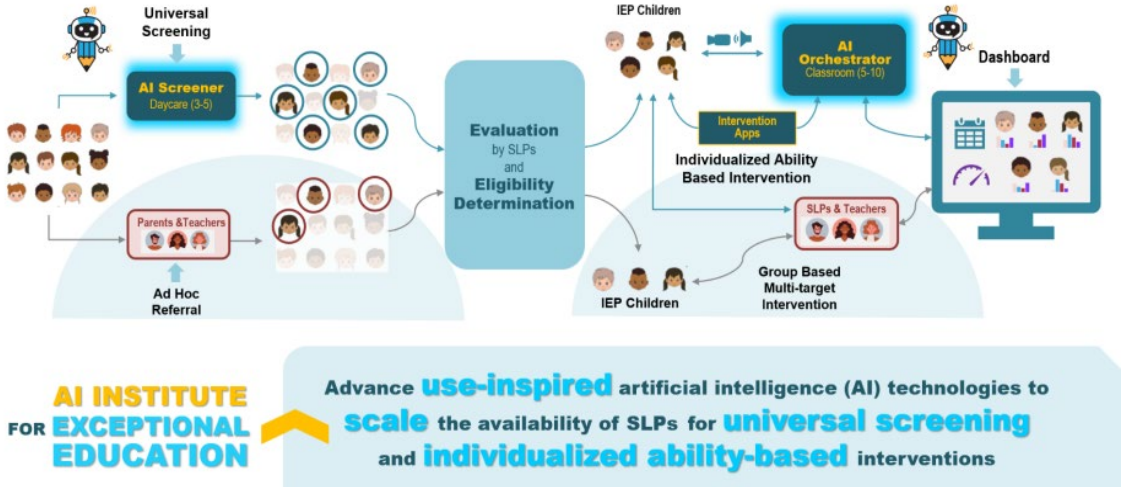
Partnership to Advance Conservation Science and Practice

Six new projects, funded by a partnership between NSF and the Paul G. Allen Family Foundation, will combine scientific research and conservation activities to learn from and protect Earth's biodiversity. The projects, funded by $8 million in combined support from the two organizations, focus on protecting diverse ecosystems and imperiled species across the country. The projects are part of a new collaboration called Partnership to Advance Conservation Science and Practice (PACSP). The program calls for teams of researchers and conservation practitioners to develop science-informed conservation action plans and contribute to the development of tools and efforts that advance biodiversity conservation. The competition received broad interest, with many submissions coming from researchers who had not previously submitted to NSF.

NC Aquariums Researcher Carol Price Plants Seaside Little Bluestem, the plant on which Crystal skipper butterflies lay their eggs. *Credit: Carol Price*

Transforming Education for Children with Speech and Language Processing Challenges

NSF announced a new artificial intelligence institute for exceptional education to focus on the speech language pathology needs of children. The institute is supported by a $20 million grant from NSF in partnership with the Department of Education's Institute of Education Sciences to the State University of New York at Buffalo.



NSF and IES AI Institute for Transforming Education for Children with Speech and Language Processing Challenges (or National AI Institute for Exceptional Education, in short) aims to close this gap by developing advanced AI technologies to scale SLPs' availability and services such that no child in need of speech and language services is left behind. Towards this end, the Institute proposes to develop two novel AI solutions: (1) the AI Screener to enable universal early screening for all children, and (2) the AI Orchestrator to work with SLPs and teachers to provide individualized interventions for children with their formal Individualized Education Program (IEP). *Credit: InfoGraphic Buffalo.edu / SUNY at Buffalo*