U.S. HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HEARING CHARTER

National Science Foundation: Advancing Research for the Future of U.S. Innovation Part II

Thursday, May 6, 2021
11:00 am – 1:00 pm
Zoom

PURPOSE

On Thursday, May 6, 2021, the Subcommittee on Research and Technology will hold a hearing to discuss opportunities and challenges for leveraging and expanding the National Science Foundation mission to continue to advance excellent research; improve STEM education and research training; increase research accessibility, accountability, and security; and accelerate research to address major societal challenges. The Subcommittee will consider the merits of the *National Science Foundation for the Future Act* for addressing such opportunities and challenges.

WITNESSES

- **Dr. Roger M. Wakimoto**, Vice Chancellor for Research and Creative Activities, University of California, Los Angeles
- **Ms. Gabriela Cruz Thompson**, Director, University Research and Collaboration, Intel Labs, Intel Corporation
- **Dr. Mahmud Farooque**, Associate Director, Consortium for Science, Policy and Outcomes, DC and Clinical Associate Professor, School for the Future of Innovation in Society, Arizona State University
- **Dr. Gerald Blazey**, Vice President for Research and Innovation Partnerships, Northern Illinois University
- **Dr. P. Barry Butler**, President, Embry-Riddle Aeronautical University

BACKGROUND

The National Science Foundation (NSF or the Foundation) was established by Congress in 1950 as an independent federal agency with a mission "to promote the progress of science; to advance the national health, prosperity and welfare; to secure the national defense; and for other purposes."[1]

Governance – As an independent agency, the Foundation does not fall within a cabinet department. The agency's activities are governed jointly by the Foundation Director and the National Science Board (NSB or the Board). The Director is appointed to a six-year term by the

[1] National Science Foundation Act of 1950, http://uscode.house.gov/statviewer.htm?volume=64&page=149

President and confirmed by the Senate.[2] The current NSF Director, Dr. Sethuraman Panchanathan, was nominated by President Trump in 2019 and subsequently unanimously confirmed by the U.S. Senate on June 18, 2020.[3]

The Board consists of 24 members appointed to six-year terms by the President.[4] The NSB performs two primary functions: (1) provide policy direction to NSF, including approval of the annual budget submission to the Office of Management and Budget (OMB) and new major programs and awards, and (2) serve as an external advisory body to Congress and the President on policy issues pertaining to science and engineering and STEM education. The Board also publishes a biennial report on indicators of the state of science and engineering in the United States.[5] The Board Chair and Vice Chair are elected to two-year terms by the Board membership. The current Chair, Dr. Ellen Ochoa, was elected in May 2020.[6,7]

Research and Education – NSF supports fundamental non-biomedical research and education across all fields of science and engineering. Research and education activities are managed through six research directorates under the Research and Related Activities (R&RA) appropriations account – Biological Sciences (BIO), Computer and Information Science and Engineering (CISE), Engineering (ENG), Geosciences (GEO), Mathematical and Physical Sciences (MPS), Social, and Behavioral and Economic Sciences (SBE) – and the Education and Human Resources (EHR) directorate under its own account. Each directorate is headed by an Assistant Director (AD) and further subdivided into divisions. In addition to these seven directorates, two offices administer agency-wide programs – the Office of International Science and Engineering (OISE) and the Office of Integrative Activities (OIA), both of which are housed in the Office of the Director.

NSF is the primary source of support for academic research in several scientific disciplines, accounting for more than 60% of federal funding in computer science, biology, environmental sciences, mathematics, and social sciences.[8] Further, more than a third of all federal funding for STEM education comes from NSF in a typical budget year.[9] The Foundation is a primary source of support for graduate student fellowships in the non-biomedical sciences and engineering.

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[2] The Deputy Director position is similarly appointed by the President, but this position has been vacant since 2014.
[3] NSF, "New director takes helm at National Science Foundation", https://www.nsf.gov/news/news_summ.jsp?cntn_id=300793&WT.mc_id=USNSF_52&WT.mc_ev=click
[4] NSB appointments are staggered so that every two years one-third of the Board is appointed.
[5] The most recent Indicators report was released in January 2018 and can be found here: https://www.nsf.gov/statistics/2018/nsb20181/
[6] NSF, "National Science Board elects new leaders," https://www.nsf.gov/nsb/news/news_summ.jsp?cntn_id=300538
[7] The current Vice-Chair of the NSB is Dr. Victor McCrary.
[8] NSF, "FY 2021 Budget Request to Congress", https://www.nsf.gov/about/budget/fy2021/pdf/fy2021budget.pdf
[9] OSTP, "Progress Report on the Implementation of the Federal STEM Education Strategic Plan", https://trumpwhitehouse.archives.gov/wp-content/uploads/2017/12/Progress-Report-Federal-Implementation-STEM-Education-Strategic-Plan-Dec-2020.pdf

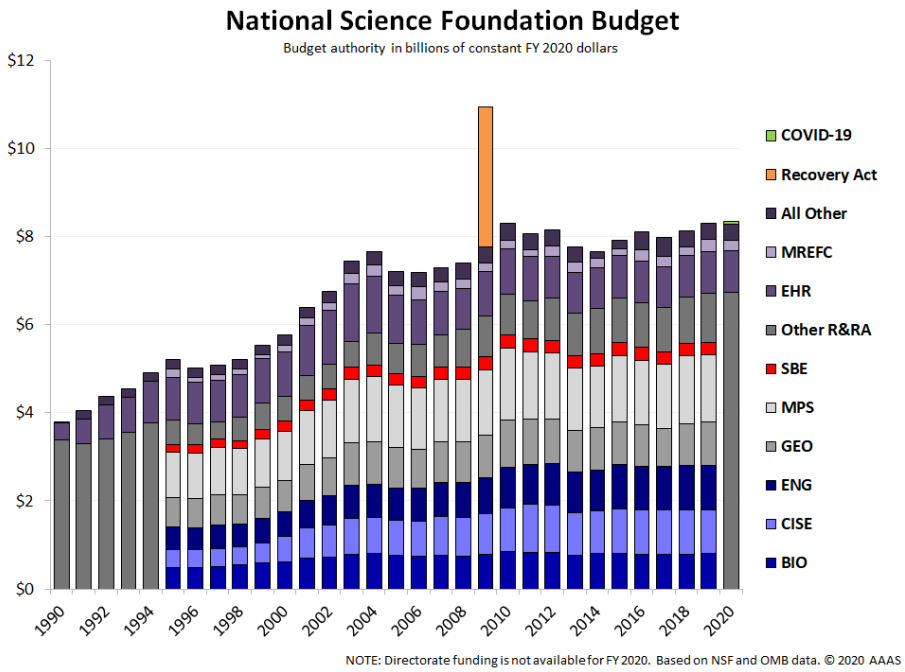

Figure 1: For a decade NSF's budget has remained relatively flat at around $8 billion. https://www.aaas.org/programs/r-d-budget-and-policy/historical-trends-federal-rd

Institutions and People – To support research and education activities, NSF typically enters into grant agreements[10] with universities or other non-profit organizations. In FY 2019, NSF received 33,500 research grant proposals and made about 8,500 new awards to colleges, universities, and other institutions across all 50 states. Across the agency, 25 percent of proposals were selected for grant awards in FY 2019. In some divisions, the funding rate is as low as 15%.[11] The average award size that year was $194,400 over 3 years. Activities funded by NSF in FY 2019 involved an estimated 40,800 senior researchers, 5,300 postdoctoral associates, 41,500 graduate students, 38,200 undergraduate students, and 167,000 K-12 teachers and students.[12]

Approximately 80% of NSF research and education funds are awarded to colleges, universities, and academic consortia. While there are 645 accredited U.S. institutions that award graduate degrees in science and engineering, the top 100 institutions perform 80 percent of all Federally funded research. None of the top 100 institutions is a Historically Black College and University (HBCU). Only seven are high Hispanic enrollment institutions. While some are in rural areas, they are heavily concentrated in urban and coastal regions. The top 30 institutions in terms of R&D expenditures accounted for 42 percent of the total spent on R&D (all funding sources)

[10] According to OMB Uniform Guidance, a grant agreement is "a legal instrument of financial assistance between a Federal awarding agency or pass-through entity and a non-Federal entity that" … "Is used to enter into a relationship the principal purpose of which is to transfer anything of value from the Federal awarding agency or pass-through entity to the non-Federal entity to carry out a public purpose." https://www.ecfr.gov/cgi-bin/text-idx?SID=46104990e1c2a6428d3e417781304a9f&mc=true&node=pt2.1.200&rgn=div5#se2.1.200_151

[11] https://dellweb.bfa.nsf.gov/awdfr3/default.asp

[12] NSF, "FY 2021 Budget Request to Congress," https://www.nsf.gov/about/budget/fy2021/pdf/fy2021budget.pdf

within the higher education sector in FY 2019. Those 30 institutions accounted for 13 percent of the science and engineering bachelor's degrees awarded in 2018.

The remainder goes to private industry, including small businesses and non-profits (13%), Federally Funded Research and Development Centers (3%), and other recipients (4%).[13] To enhance research competitiveness in states and jurisdictions receiving a comparatively lower share of NSF R&D funding, the agency supports research capacity building activities through the Established Program to Stimulate Competitive Research (EPSCoR).[14]

***Facilities* –** In addition to research grants, NSF funds the construction, operations, and maintenance of research facilities and equipment. NSF typically enters into cooperative agreements[15] with universities or other non-profit organizations for the construction and management of major facilities. The construction phases of such projects usually span multiple years, with extensive planning and oversight. Large equipment and facility projects include multi-user facilities, such as astronomical observatories and ocean research vessels; networked instrumentation and equipment; and large-scale computational infrastructure.

The total support for research infrastructure at NSF, including construction, operations, and maintenance, is nearly a quarter of the agency's total budget. NSF funds construction and operations of major research facilities and equipment separately. One agency-wide account – the Major Research Equipment and Facilities Construction (MREFC) appropriations account – supports construction, while operations for a given facility are funded by the research directorate that manages it. In response to a recommendation by the NSB[16], in FY 2020 the agency established the Facility Operation Transition pilot program within the R&RA account to help managing directorates gradually absorb facility operations costs and balance support for facility operations with support for individual research grants.

On December 1, 2020, the suspended platform housing a suite of instruments collapsed onto Arecibo Observatory's 305-meter radio telescope after a catastrophic failure of three supporting cables. An investigation of the collapse and exploration of future opportunities for Arecibo is ongoing. Initial estimates indicate the cleanup costs will be in the range of $30 –$50 million spread over fiscal years 2021 and 2022. NSF is planning to sponsor a community workshop to bring together stakeholders to explore options for future research capabilities on the site. The costs of potential projects coming out of this stakeholder engagement are unknown.[17]

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[13] NSF, "FY 2020 Agency Financial Report," https://www.nsf.gov/pubs/2021/nsf21002/pdf/nsf21002.pdf

[14] A jurisdiction is eligible to participate in NSF EPSCoR if their most recent 5-year level of total NSF funding is equal to or less than 0.75% of the total NSF budget. There are 28 jurisdictions currently eligible for NSF EPSCoR funding. https://www.nsf.gov/od/oia/programs/epscor/nsf_oiia_epscor_eligible.jsp

[15] According to OMB Uniform Guidance, a cooperative agreement is "distinguished from a grant in that it provides for substantial involvement between the Federal awarding agency or pass-through entity and the non-Federal entity in carrying out the activity contemplated by the Federal award." https://www.ecfr.gov/cgi-bin/text-idx?SID=46104990e1c2a6428d3e417781304a9f&mc=true&node=pt2.1.200&rgn=div5#se2.1.200_124

[16] National Science Board, "Study of Operations and Maintenance Costs for NSF Facilities (NSB-2018-17)," www.nsf.gov/pubs/2018/nsb201817/nsb201817.pdf

[17] NSF, "Report on the Arecibo Observatory," https://www.nsf.gov/news/reports/AreciboReportFINAL-Protected_508.pdf

Merit Review – The NSF proposal review and award process is based on competition between proposals within a specific scientific discipline or under an interdisciplinary initiative. Award selection involves input from individuals outside and within NSF, starting with a review panel made up of scientists and engineers with expertise in the relevant research area.

Every proposal is reviewed by multiple experts in the field and confidential feedback is made available to each proposer, allowing them to refine their proposal and increase their chance of success in the future. The panel evaluates proposals using two, NSB-approved criteria: (1) Intellectual Merit and (2) Broader Impacts. The NSF Merit Review Process is rigorous, highly competitive, and widely regarded as the "gold standard" for reviewing proposals in a competitive environment.

Cross-Agency Initiatives – While the agency maintains six research directorates organized around distinct scientific disciplines, in addition to the EHR Directorate, NSF has long supported cross-agency initiatives to advance interdisciplinary or transdisciplinary – the favored term today is "convergent" – research in specific areas, e.g. the Energy-Food-Water nexus. In 2016, the then Director, Dr. Córdova, unveiled 10 Big Ideas to drive NSF's long-term research agenda.[18] Most of the Big Ideas, e.g. Future of Work at the Human-Technology Frontier and Navigating the New Arctic are inherently transdisciplinary/convergent.

Starting with the FY 2019 budget request, NSF initiated a new model for accelerating use-inspired and convergence research in areas of national importance. The Convergence Accelerator (CA) stands separately from the research directorates and is divided into individual tracks. Each Convergence Accelerator track is time-limited and supports transdisciplinary research in two phases to address national-scale societal challenges. The first cohort of teams are in Phase II of their projects related to Open Knowledge Networks, AI and Future Jobs, and National Talent Ecosystem, while the second cohort is in Phase I, working to develop solutions related to Quantum Technology and AI-Driven Data and Model Sharing. The third cohort has not yet been selected, but they will focus their efforts on the Networked Blue Economy and Trust & Authenticity in Communication Systems.[19]

Emerging Technologies – NSF has supported research to advance emerging technologies for decades. NSF is the leading Federal funder of nondefense research on artificial intelligence (AI).[20] In August 2020, NSF announced the first round of NSF AI Institutes. Each of the five institutes is funded at $20 million over five years and will accelerate AI research on topics ranging from particle physics, extreme weather and climate, agriculture, and K-12 education. NSF invested $534 million in AI research in FY 2020 and was appropriated $868 million for FY 2021.[21, 22] NSF's investments in AI, including the institutes, were codified in the *National*

[18] https://www.nsf.gov/news/special_reports/big_ideas/
[19] NSF, "Accelerating Research into Practice," https://www.nsf.gov/od/oia/convergence-accelerator/news.jsp
[20] NITRD, "AI R&D Investments," https://www.nitrd.gov/apps/itdashboard/AI-RD-Investments/#fn4
[21] Commerce, Justice, Science and Related Agencies Appropriations Act, 2021, https://docs.house.gov/billsthisweek/20201221/BILLS-116RCP68-JES-DIVISION-B.pdf
[22] NSF, "FY 2021 Budget Request to Congress," https://www.nsf.gov/about/budget/fy2021/pdf/fy2021budget.pdf

Artificial Intelligence Initiative Act of 2020 (DIV E of P.L. 116-283), developed in large part by the Committee on Science, Space, and Technology..

NSF also funded the fundamental quantum physics research that has enabled today's innovations in quantum sensing, communication, and computing. In July 2020, NSF announced three Quantum Leap Challenge Institutes to support multidisciplinary and multi-sector collaborations that will design, build, and employ quantum sensing technology, build networks for quantum processors, and design large-scale quantum computers that outperform classical computers.[23] NSF invested $143 million in quantum information science in FY 2020 and was appropriated $226 million for FY 2021.[24, 25] These activities were codified in the National Quantum Initiative Act (P.L. 115-368), also developed in large part by the Committee on Science, Space, and Technology..

Similarly, NSF has significant fundamental research investments in cybersecurity, biotechnology and synthetic biology, robotics and automation, advanced manufacturing, advanced communications, advanced materials, high-performance computing, semiconductors and other advanced computing hardware, advanced energy technologies, and every other technology contributing to U.S. economic competitiveness and national security.

COVID-19 Response and Recovery – NSF's fast-track grant process, called Rapid Response Research (RAPID), allows the agency to support quick-response research related to natural or man-made disasters or other unanticipated events. Starting in April 2020, NSF started soliciting proposals for COVID-related research through this and other mechanisms and in FY 2020 made 1,172 COVID-related awards to nearly 2,250 principal investigators in 48 states and the District of Columbia. These projects advanced research to improve our understanding of the coronavirus and develop approaches to mitigate the spread of the virus and its negative impacts on society. NSF's support for COVID-related research totaled $198 million in FY 2020, $75 million of which was provided by the *CARES Act*.[26, 27, 28]

With respect to recovery, awardee institutions, researchers and their trainees, and the construction and operation of research facilities were all affected by the COVID-19 pandemic. As the Committee heard during a previous hearing on the impact of COVID on the U.S. research enterprise, the academic research community urgently needs tens of billions of dollars in emergency funding to recover from COVID-related losses and prevent long-lasting negative consequences for U.S. competitiveness. Last month, Dr. Francis Collins, the Director of the National Institutes of Health (NIH) estimated NIH delayed or lost $16 billion worth of medical

[23] NSF, "NSF establishes 3 new institutes to address critical challenges in quantum information science," https://www.nsf.gov/news/special_reports/announcements/072120.jsp
[24] Commerce, Justice, Science and Related Agencies Appropriations Act, 2021, https://docs.house.gov/billsthisweek/20201221/BILLS-116RCP68-JES-DIVISION-B.pdf
[25] NSF, "FY 2021 Budget Request to Congress," https://www.nsf.gov/about/budget/fy2021/pdf/fy2021budget.pdf
[26] CARES Act, https://www.congress.gov/bill/116th-congress/house-bill/748
[27] NSF, "FY 2020 Agency Financial Report," https://www.nsf.gov/pubs/2021/nsf21002/pdf/nsf21002.pdf
[28] NSF, "COVID-19 Response Funding Update," https://www.nsf.gov/about/congress/funding%20updates/COVID_update_Jan19.pdf

research due to the pandemic.[29] To date, NSF has not publicly disclosed an estimate for the total cost of lost or delayed NSF-funded research.

In addition, NSF has three major research facilities currently under construction – the Vera Rubin Observatory (VRO), Antarctic Infrastructure Modernization for Science (AIMS), and the High-Luminosity Large Hadron Collider (HL-LHC) upgrades. All three projects have experienced significant delays due to COVID mitigation measures. The cost and schedule of these projects will likely need to be re-baselined.

Research Security – U.S. research agencies have worked for decades to foster openness, transparency, and reciprocal international collaboration on basic research. However, in recent years, a small group of governments (primarily China) have made efforts to benefit from the global research ecosystem without upholding those values. A key tactic is the use of foreign talent recruitment programs that require participants to engage in deceptive practices or other behaviors that create conflicts of interest and undermine research integrity. In 2019, NSF-commissioned a JASON study on this issue – "The picture of foreign influence in fundamental research is far from complete, but JASON does see a developing situation that appears to be worsening and that represents a threat to our fundamental research enterprise and, in the longer run, our economic security and national security."[30]

Research agencies, law enforcement and intelligence agencies, and universities are actively engaging to identify and mitigate threats to research security. At NSF, a new Chief of Research Security Strategy and Policy position was created in March 2020 to lead the agency's response to this challenge. NSF employees and IPA Program staff are prohibited from participating in foreign talent recruitment programs. Disclosure requirements for researchers seeking a grant were clarified to include participation on foreign talent recruitment programs and an electronic form was created to facilitate and streamline such disclosures.

In January 2021, OSTP provided guidance to research organizations on best practices for protecting the security and integrity of Federally funded research.[31] President Trump also issued a National Security Presidential Memorandum (NSPM-33) outlining steps agencies should take.[32] The Biden Administration has indicated it plans to move forward with implementation of NSPM-33.

Strategic Planning – In January 2020, the National Science Board (NSB) released its biennial Science and Engineering Indicators report which found that "the United States is playing a less

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[29] Bloomberg Law, "Pandemic Cost NIH $16 Billion in Delayed, Lost Medical Research," https://news.bloomberglaw.com/health-law-and-business/pandemic-cost-nih-16-billion-in-delayed-lost-medical-research

[30] JASON, "Fundamental Research Security," https://www.nsf.gov/news/special_reports/jasonsecurity/JSR-19-2IFundamentalResearchSecurity_12062019FINAL.pdf

[31] OSTP, "Recommended Practices for Strengthening the Security and Integrity of America's Science and Technology Research Enterprise," https://trumpwhitehouse.archives.gov/wp-content/uploads/2021/01/NSTC-Research-Security-Best-Practices-Jan2021.pdf

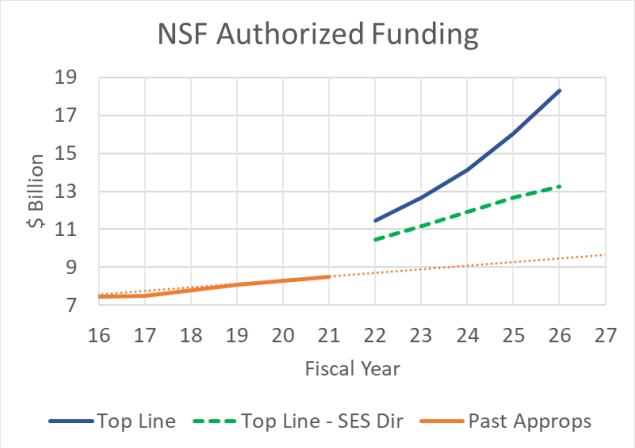
[32] White House, "Presidential Memorandum on United States Government-Supported Research and Development National Security Policy," https://trumpwhitehouse.archives.gov/presidential-actions/presidential-memorandum-united-states-government-supported-research-development-national-security-policy/

dominant role in many areas of S&E activity." In May of that year, the National Science Board (NSB) released a new report that builds on this finding and identifies threats to U.S. leadership in science and engineering and charts a course for the agency to correct this trend over coming decade. The report recommends NSF and other stakeholders prioritize efforts that deliver social and economic benefits from NSF-funded research, develop a more diverse and multifaceted STEM workforce, expand research capacity and infrastructure across the country, and expand international research partnerships. It also outlines a number of more specific steps for the Board itself to undertake, such as reassessing the organizational structure of NSF, including the idea of adding a new directorate focused on translating research into applications.[33]

NSF is currently preparing its 2022-2026 Strategic Plan. In December 2020, the agency issued a request for public comments which were due in January 2021. The aim of the Strategic Plan is "to advance the frontiers of research into the future and secure global leadership in science and engineering, while ensuring accessibility and inclusivity." The request for comments instructs respondents to address the following questions:

(1) What are the interests, values, and emergent science and policy issues that the Strategic Plan should recognize?
(2) How can NSF help maintain U.S. leadership in an evolving global research and education landscape?
(3) How can the plan best underscore the importance to the Nation of fundamental research and its broader impacts?[34]

NSF FOR THE FUTURE ACT



On March 26, 2021, Chairwoman Johnson, Ranking Member Lucas, and Subcommittee on Research and Technology Chairwoman Haley Stevens and Ranking Member Michael Waltz introduced H.R. 2225, the *National Science Foundation for the Future Act*.[35, 36, 37] This is a comprehensive reauthorization for the agency and is the product of over a year of engagement with stakeholders, policy experts, and thought leaders. The previous authorization legislation for NSF was enacted over a decade ago, the 2010 *COMPETES Act*.[38] While the

[33] NSB, "Vision 2030," https://www.nsf.gov/nsb/publications/2020/nsb202015.pdf
[34] NSF, "Request for Information," https://www.federalregister.gov/documents/2020/12/10/2020-27120/request-for-information-strategic-and-performance-plans
[35] NSF for the Future Act, https://www.congress.gov/bill/117th-congress/house-bill/2225
[36] HSST, "Science Committee Leaders Introduce NSF for the Future Act," https://science.house.gov/news/press-releases/science-committee-leaders-introduce-nsf-for-the-future-act
[37] https://science.house.gov/bills/the-national-science-foundation-for-the-future-act
[38] America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Reauthorization Act of 2010, https://www.congress.gov/bill/111th-congress/house-bill/5116

subsequent *American Innovation and Competitiveness Act* (AICA), enacted in 2017, provided policy direction to the agency, it did not include funding authorizations.[39] NSF's funding authorizations have been expired since 2013. Below is a high-level summary of the bill.

Funds more excellent research – The research community has the capacity to pursue far more research ideas than the National Science Foundation (NSF) can fund. In Fiscal Year 2019, almost $3 billion in proposals received a fundable, "Very Good" or higher, rating in the merit review process but were nonetheless declined. This bill authorizes a significant increase in funding for the agency. Specifically, the bill:

- Increases overall funding for the agency (minus the new directorate) by nearly $2 billion in Fiscal Year 2022, to $10.5 billion, and grows at an average annual rate of 6%, to $13.3 billion in Fiscal Year 2026.
- Directs investments in critical research-enabling infrastructure, including a 50% increase to the Mid-Scale Research Infrastructure program, support for helium conservation equipment, and a roadmap for meeting the research community's growing need for advanced computing capabilities.

Improves STEM education and research training - The country is facing an urgent shortage of STEM workers and research talent that threatens to constrain our innovative capacity and, consequently, our economic prosperity. Broadening the participation and advancement of women and other historically underrepresented groups is critical to an effective strategy for growing the STEM workforce. This bill advances research and development to address persistent challenges at all education levels, including scaling successful models in STEM education and broadening participation in STEM. Specifically, the bill:

- Establishes a new centers program to support translational research and development to help scale up effective PreK-12 STEM education innovations.
- Encourages efforts to align undergraduate STEM education with workforce needs.
- Advances policies and funding to raise the bar for the training, mentoring, and professional development of graduate students and postdoctoral researchers.
- Establishes a pilot program to support partnerships that will expand research opportunities to students who attend minority serving institutions or other emerging research institutions.
- Encourages expanded data collection on the nature of the STEM workforce.
- Authorizes a 50% increase in funding over 5 years for key STEM education programs.

Increases research accessibility, accountability, and security - Federally funded research must be accessible and accountable to the American public. In addition, threats to research security have the potential to undermine the integrity of federally funded research projects. The bill addresses these challenges at multiple levels of accountability. Specifically, the bill:

- Requires assessment and research activities to improve the implementation of the Broader Impacts merit review criterion.

[39] American Innovation and Competitiveness Act, https://www.congress.gov/bill/114th-congress/senate-bill/3084

- Creates a new requirement for researchers to prepare a statement on possible security or other risks to society from their research in order to encourage researchers to always consider their research in a societal context.
- Expands access to data and other research products resulting from Foundation-funded projects through new data stewardship requirements and investments in open science tools and infrastructure.
- Codifies the Office of Research Security and Policy and the Chief of Research Security position to provide guidance and resources to researchers and funds the development of training, resources, and tools to help institutions and researchers understand and mitigate security risks.

Accelerates research to address major societal challenges **-** In carrying out its fundamental science and engineering mission over the past seven decades, the Foundation has delivered enormous benefits to society. It is time to build on that legacy and move the Foundation forward. To that end, the bill creates a creates a new directorate, the Directorate for Science and Engineering Solutions (SES), that will enable the Foundation to take big risks and experiment with new approaches to accelerating progress in translating science and technology into solutions to society's major challenges. A critical consideration for the new SES directorate is its impact on the rest of the agency. The bill creates a structure, a funding profile, and feedback mechanisms to mitigate any risks to the longstanding basic research mission of the Foundation and encourage collaboration across the agency. Specifically, the bill:

- Encourages an ecosystem of partnerships and collaborations in use-inspired and translational research, including intentional engagement of nontraditional players, e.g. policymakers and local communities.
- Provides flexible funding and hiring authorities.
- Places the SES Directorate within the Research and Related Activities Account, with an Assistant Director (AD) at the helm and an advisory committee with tailored expertise to advise the AD.
- Authorizes $1 billion for the SES directorate in Fiscal Year 2022 with an average annual increase of 50% to $5 billion in Fiscal Year 2026. This budget is in balance with the budget for the rest of the agency, reaching 27% of the total agency budget in its fifth year.

ENDLESS FRONTIER ACT

The *Endless Frontier Act* was reintroduced by Senators Schumer and Young on April 21 with a House companion bill sponsored by Representatives Khanna and Gallagher.[40] While that bill contains significant provisions directed at the Department of Commerce, one major provision in the bill would establish a new "Directorate for Technology and Innovation" at NSF. In that bill, the new directorate would be funded at $100 billion over five years through a fund managed by the Office of Science and Technology Policy (OSTP) and is structured much differently than existing NSF directorates and the Science

[40] Endless Frontier Act, https://www.congress.gov/bill/116th-congress/senate-bill/3832

and Engineering Solutions Directorate proposed in the *NSF for the Future Act*. It would have an operations model that borrows many elements of the Defense Advanced Research Projects Agency (DARPA), and a prescriptive list of activities (with prescribed funding allocations for each) to be carried out, including scholarships and fellowships, university technology centers, a lab-to-market program, and test beds, all with the singular goal of enhancing U.S. competitiveness in 10 key technology areas, including the full list described above under the "Emerging Technologies" heading.