

Committee on Science, Space, and Technology

Subcommittee Report

H.R. 2225 – National Science Foundation for the Future Act

Full Committee Markup

Tuesday June 15th, 2021

I. Purpose of the Bill

The purpose of the bill is to authorize funding for the National Science Foundation (NSF) for fiscal years (FY) 2022, 2023, 2024, 2025 and 2026, to provide policy and programmatic direction related to science and engineering research supported by the Foundation, STEM education and broadening participation activities, research infrastructure, and to establish a new Directorate for Science and Engineering Solutions.

II. Background and Need for the Legislation

NSF is an independent federal agency created by the *National Science Foundation Act of 1950* (P.L. 81-507). NSF's mission to support science and engineering across all disciplines is unique among federal science agencies. NSF currently funds research and education activities at more than 1,800 universities, colleges, and other public and private institutions in 50 states, the District of Columbia and U.S. territories. NSF estimates that in FY 2022 approximately 366,800 people will be directly involved in NSF programs and activities, including senior researchers, postdoctoral associates, graduate and undergraduate students, and K-12 teachers and students.

Although NSF's research and development (R&D) budget accounts for only about 4 percent of all federally funded R&D, the role of NSF in promoting fundamental research is vital to the nation's scientific enterprise, as NSF provides approximately 25 percent of the federal support for basic research conducted at academic institutions. NSF provides the majority of federal academic support for basic research in many science and engineering fields, including computer science, mathematics, biology, social and psychological sciences, and environmental sciences.

The last comprehensive reauthorization of the National Science Foundation was included in the *COMPETES Act of 2010* (P.L. 111-358), which authorized appropriations for NSF for FY 2011, 2012, and 2013. Since that time, individual programs and agency management issues have been addressed through other bills, including the *American Innovation and Competitiveness Act* (P.L. 114-329), and multiagency laws focused on specific research or technology areas, including the *National Quantum Initiative Act* (P.L. 115-368) and the *National Artificial Intelligence Initiative Act* (P.L. 116-283).

Although NSF-funded research has had a tremendous impact on society, funding for NSF has not been sufficient to maximize the agency's potential contribution to the nation's research enterprise. Funding for NSF has been flat in constant dollars in the decade since the 2010

COMPETES Act. NSF is currently able to fund less than one quarter of the grant proposals submitted, and \$3 billion of top-rated grant applications are declined. These unfunded proposals represent a rich portfolio of research opportunities. Further, in the last decade, the global landscape of competition in science and technology has changed, with a significant erosion of U.S. leadership. As a result, there is a need to reinvest in the U.S. research enterprise, including by providing increased support for the National Science Foundation’s core mission to advance fundamental research while promoting new approaches to advance innovation and solutions to our nation’s challenges, including competitiveness, and ensure a STEM ready workforce in the coming decades.

III. Committee Hearings

Pursuant to Section 103(i) of H.Res. 6, the Committee designates the following hearings as having been used to develop or consider the legislation:

On April 15, 2021, the Science, Space, and Technology Committee held a hearing entitled, “Reimagining Our Innovation Future.” The purpose of the hearing was to examine the current outlook for U.S. leadership in science and technology and discuss how new investments and new, inclusive models of partnership in science and technology can be leveraged to ensure continued leadership and address economic, security, environmental, public health, and other societal challenges from the local to the global level. The hearing witnesses included Mr. Norm Augustine; Dr. Frances H. Arnold, Linus Pauling Professor of Chemical Engineering, Bioengineering and Biochemistry at the California Institute of Technology; The Honorable Ernest J. Moniz, President and Chief Executive Officer of the Energy Futures Initiative and Former Secretary of the U.S. Department of Energy; and Dr. Farnam Jahanian, President of Carnegie Mellon University.

On April 28, 2021 and May 6, 2021, the Research and Technology Subcommittee held a two-part hearing entitled, “National Science Foundation: Advancing Research for the Future of U.S. Innovation.” The purpose of the hearings was 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 considered the merits of the NSF for the Future Act for addressing such opportunities and challenges. The hearing witnesses included Dr. Sethuraman Panchanathan, Director of the National Science Foundation; Dr. Ellen Ochoa, Chair of the National Science Board, Dr. Roger M. Wakimoto, Vice Chancellor for Research and Creative Activities at the University of California, Los Angeles; Ms. Gabriela Cruz Thompson, Director of University Research and Collaboration at Intel Corporation’s Intel Labs; Dr. Mahmud Farooque, Associate Director of the Consortium for Science, Policy and Outcomes and Clinical Associate Professor at the Arizona State University School for the Future of Innovation in Society; Dr. Gerald Blazey, Vice President for Research and Innovation Partnerships at Northern Illinois University; Dr. P. Barry Butler, President of Embry-Riddle Aeronautical University

IV. Committee Consideration and Votes

On March 26, 2021, Chairwoman Eddie Bernice Johnson, Ranking Member Frank Lucas, Chairwoman Haley Stevens, and Ranking Member Michael Waltz introduced H.R. 2225, the *National Science Foundation for the Future Act*. The bill was referred to the House Committee on Science, Space, and Technology.

On May 13, 2021, the Research and Technology Subcommittee met to consider H.R. 2225. Ms. Moore offered an amendment to direct NSF to support research to improve STEM education at community colleges. *The amendment was agreed to on a voice vote.* Ms. Moore offered a second amendment to direct NSF to support water system research and technology development. *The amendment was agreed to on a voice vote.* Mr. Meijer offered an amendment to ensure students getting a master's or doctorate in fields related to cybersecurity are eligible to apply for the Graduate Research Fellowship Program. *The amendment was agreed to on a voice vote.* Mr. Gonzalez offered an amendment to direct NSF to support research on the cybersecurity workforce. *The amendment was agreed to on a voice vote.* Mr. LaTurner offered an amendment highlighting the importance of the EPSCoR program. *The amendment was agreed to on a voice vote.* Mr. Waltz and Mr. Foster offered an amendment to authorize the Office of Security and Policy and direct NSF to require and support the development of online security training modules for the research community. *The amendment was agreed to on a voice vote.* Ms. Wild offered an amendment to expand the scope of activities to include research equipment and instrumentation for resilient engineered infrastructure. *The amendment was agreed to on a voice vote.* Ms. Wild offered a second amendment to direct NSF to support social and behavioral science research on consumer technology and mental health. *The amendment was agreed to on a voice vote.* Mr. Lamb offered an amendment to update the list of technology areas eligible for funding through the NSF's advanced manufacturing research program to include additive manufacturing. *The amendment was agreed to on a voice vote.* Mr. Foster offered an amendment to establish a requirement for grant proposals to include information on computing needs and include information about computing needs and a path toward fully addressing them in its advanced computing roadmap. *The amendment was agreed to on a voice vote.* Mr. Beyer offered an amendment to establish a National Secure Data Service demonstration project. *The amendment was agreed to on a voice vote.* Ms. Stevens offered an amendment to build technology transfer capacity at smaller research institutions. *The amendment was agreed to on a voice vote.*

V. Summary of Major Provisions of the Bill

Authorizes appropriations for NSF of \$11,469,200,00 for FY 2022, \$12,668,000,000 for FY 2023, \$14,148,200,000 for FY 2024, \$16,036,900,000 for FY 2025, and \$18,325,020,000 for FY 2026.

Establishes a new centers program to support translational research and development to help scaleup effective PreK-12 STEM education innovations. Supports activities and partnerships to align undergraduate STEM education with workforce needs. Advances policies and research to modernize 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. Supports expanded data collection on the nature of the STEM workforce. Authorizes a 50% increase in funding over 5 years for key STEM education programs.

Requires assessment and research activities to improve the implementation of the Broader Impacts merit review criterion. Creates a new requirement for researchers to prepare a statement on possible security or other risks to society from their research. 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.

Supports research-enabling infrastructure, including an 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.

Establishes a new Directorate for Science and Engineering Solutions (SES) to support an ecosystem of non-traditional partnerships and collaborations in use-inspired and translational research.

VI. Section-by-Section Analysis (By Title and Section)

SEC. 1. Short Title

SEC. 2. Findings

SEC. 3. Definitions

SEC. 4. Authorization of Appropriation

SEC. 5. STEM Education and Workforce Training

- (a) PreK-12 STEM Education - Supports a decadal survey to be carried out by the National Academies to identify research priorities in PreK-12 STEM education and an additional study on barriers to the widespread implementation of STEM education innovations. Establishes a program to fund multidisciplinary research and translation centers to scale STEM education innovations.
- (b) Undergraduate STEM Education - Supports research and development to improve the alignment of undergraduate STEM education and training with workforce needs. Updates the Advanced Technological Education program to establish a network of centers for science and technical education.
- (c) Graduate STEM Education - Expands requirement for funding proposals to include a mentoring plan to graduate students. Supports activities to facilitate career exploration for

graduate students and postdoctoral researchers. Creates a requirement for funding proposals to include individual development plans for graduate students and postdoctoral researchers and provides supplemental funding to facilitate professional development activities. Supports research on the graduate education system. Updates the Graduate Research Fellowship Program to address workforce demand, increase the cost of education allowance, and recruit a more diverse pool of applicants. Requires an evaluation of mechanisms for supporting graduate student education and training.

- (d) STEM Workforce Data - Requires a portfolio analysis of Foundation investments in the skilled technical workforce. Requires an assessment of the feasibility and benefits of adding rotating questions/topic modules to existing National Center for Science and Engineering Statistics (NCSES) surveys. Requires an assessment of the feasibility and benefits of incorporating new questions to existing (NCSES) surveys on a range of topics related to the nature of the STEM workforce and the workforce environment. Requires a Government Accountability Office evaluation of the capacity of NCSES to meet current and future needs for data on the STEM workforce.
- (e) Cyber Workforce Development Research and Development - Supports research on the cyber workforce.

SEC. 6. Broadening Participation

- (a) Presidential Awards for Excellence in Mathematics and Science Teaching - Updates the program to allow for the selection of at least one teacher each from the Commonwealth of the Northern Mariana Islands, American Samoa, the Virgin Islands of the United States, and Guam.
- (b) Robert Noyce Teacher Scholarship Program Update - Requires outreach to historically Black colleges and universities, minority institutions, higher education programs that serve veterans and rural communities, and emerging research institutions.
- (c) NSF INCLUDES Initiative - Codifies the NSF INCLUDES program.
- (d) Broadening Participation on Major Facilities Awards - Establishes a requirement for organizations seeking management awards to demonstrate experience and capabilities in employing best practices in broadening participation and directs the Foundation to consider implementation of such practices in oversight of the award.
- (e) Partnerships with Emerging Research Institutions - Establishes a pilot program to require multi-institution proposals seeking funding in excess of \$1 million be submitted in partnership with emerging research institutions and requires annual reporting on such grants to include feedback directly from participating emerging research institutions.
- (f) Tribal Colleges and Universities Program Update - Expands the scope of the Tribal Colleges and Universities program to include support for activities to build graduate programs.
- (g) Diversity in Tech Research - Supports organizational research, including research on diversity, equity, and inclusion in the technology sector.
- (h) Continuing Support for EPSCoR - Expresses the sense of Congress that the Foundation should continue to support research and education capacity building through the EPSCoR program.

SEC. 7. Fundamental Research

- (a) Broader Impacts - Directs an assessment of the application of the Broader Impacts review criterion across the Foundation and provides support for activities to improve its implementation.
- (b) Sense of Congress - Expresses the sense of Congress that the Foundation should continue to identify opportunities to reduce administrative burden on researchers.
- (c) Research Integrity and Security - Directs the Foundation to take steps to address security risks to Foundation-supported research, including through the Office of Research Security and Policy, the appointment of a Chief of Research Security, the development of an online resources to inform institutions and researchers of security risks, support for the establishment of a risk assessment center, and support for research on misconduct in the research environment. Authorizes NSF to request proposal supporting documentation, including talent recruitment program contracts and directs NSF to require and support the development of research security training. Supports an update to the National Academies Guide to Responsible Conduct in Research.
- (d) Research Ethics - Expresses the sense of Congress with respect to potential ethical, social, safety, and security implications of research in emerging technologies. Establishes a requirement for the inclusion of an ethics statement in award proposals. Supports research on the ethical and social implications of Foundation-supported research and the development of approaches for risk mitigation.
- (e) Research Reproducibility and Replicability - Establishes a requirement for the inclusion of a machine-readable data management plan in award proposals. Requires the development of a set of criteria for trusted open repositories and provides support for the development of open data repositories to address any gaps. Requires the establishment of a single web-based point of access for data, software, and code resulting from Foundation funded projects. Directs the Foundation to ensure that data resulting from Foundation-funded projects is made available in trusted open repositories. Supports research and development of tools and infrastructure to support research reproducibility.
- (f) Climate Change Research - Supports research to improve understanding and predictability of the climate system and climate-change risk, resilience, and mitigation and to educate and train climate researchers.
- (g) Violence Research - Supports research related to violence.
- (h) Social, Behavioral, and Economic Sciences - Directs the Foundation to take steps to ensure the participation of social, behavioral, and economic science researchers in cross-cutting agency programs.
- (i) Food-Energy-Water Research - Supports research related to the food-energy-water system.
- (j) Sustainable Chemistry Research and Education - Establishes a program to support research related to sustainable chemistry.
- (k) Risk and Resilience Research - Supports research related to risk assessment and predictability and development of tools and technologies for increased resilience.

- (l) Leverage International Expertise in Research - Directs NSF to explore opportunities to support international research collaboration.
- (m) Biological Research Collections - Supports databases and tools to secure and improve biological research collections. Establishes a requirement for the inclusion of a specimen management plan in award proposals. Supports the establishment of a center to facilitate coordination and data sharing.
- (n) Clean Water Research and Technology Acceleration - Supports water system research and technology development.
- (o) Technology and Behavioral Science Research - Supports social and behavioral science research on consumer technology and mental health.
- (p) Manufacturing Research Amendment - Updates the list of technology areas eligible for funding through the NSF's advanced manufacturing research program to include additive manufacturing.

SEC. 8. Research Infrastructure

- (a) Facility Operations and Maintenance - Requires the continuation of the Facility Operation Transition pilot program in the Facilities Construction (MREFC) account to provide cost sharing with the managing directorate during the first five years of operation.
- (b) Reviews - Directs periodic assessment of the cost and benefits of extending the operation of research facilities beyond their planned operational lifespan.
- (c) Helium Conservation - Expands eligibility for the Major Research Instrumentation program to include the purchase, installation, operation, and maintenance of equipment and instrumentation to conserve helium.
- (d) Advanced Computing - Directs the Foundation to collect information and regularly publish a report on the computational needs for Foundation-funded projects. Directs the Foundation to develop and regularly update an advanced computing roadmap.
- (e) National Secure Data Service – Establishes a National Secure Data Service demonstration project.

SEC. 9. Directorate for Science and Engineering Solutions

- (a) Establishment - Establishes a new directorate to accelerate use-inspired and translational research and development to advance solutions to pressing societal challenges.
- (b) Purposes – Describes the purposes of the directorate.
- (c) Activities - Describes activities to be supported by the directorate, including support for use-inspired research and translation, the development of innovative approaches to connect research with societal outcomes, the development of partnerships and collaborations that include traditional and nontraditional players, support for translational research infrastructure and capacity building, and support for education and training of students.
- (d) Assistant Director - Establishes an Assistant Director position to head the directorate.

- (e) Advisory Committee - Establishes an advisory committee to assess the activities carried out by the directorate and propose new strategies for fulfilling the purpose of the directorate.
- (f) Existing Programs - Authorizes the Foundation to place existing programs under the management of the directorate.
- (g) Focus Areas - Directs the Foundation to identify focus areas to guide directorate activities and to consider focus areas that contribute to a list of societal challenge –climate change and environmental sustainability, global competitiveness, cybersecurity, national security, STEM education and workforce, and social and economic inequality.
- (h) Transfer of Funds - Authorizes the transfer of funds to other Foundation offices, directorates, or divisions and prohibits the reverse transfer of funds.
- (i) Authorities - Provides flexible funding and hiring authorities.
- (j) Ethical, Legal, and Societal Considerations - Directs the Foundation to take steps to ensure that ethical, legal, and societal considerations are integrated into the activities of the directorate.
- (k) Reports and Roadmaps - Directs the Foundation to provide an annual report describing the activities of the directorate and a roadmap describing the strategic vision that will guide future investment decisions.
- (l) Evaluation - Directs an evaluation of the success of the directorate in achieving its purpose to advance solutions to pressing societal challenges through use-inspired and translational research.
- (m) Limitation - Prohibits the appropriation of funds for the directorate unless sufficient funding is appropriated to support the directorate without drawing funding from other Foundation activities.

SEC. 10. Administrative Amendments

- (a) Supporting Veterans in STEM Careers - Provides a technical fix.
- (b) Sunshine Act Compliance - Relaxes the requirement for an annual review and report related to Sunshine Act Compliance of the National Science Board and authorizes a risk-based approach to scheduling compliance reviews.
- (c) Science and Engineering Indicators Report Submission - Changes the deadline for a biennial report on science and engineering indicators from January 15 to March 15.

SEC. 11. Planning and Capacity Building Grants

Supports technology transfer capacity building for smaller research institutions, including support for technology transfer expert staff, private sector partnerships, and education and training of students and researchers.