

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

*A Review of the National Science Foundation FY 2020 Budget Request*

**Wednesday, May 8, 2019  
10:00 am – 12:00 pm  
2318 Rayburn House Office Building**

**PURPOSE**

On Wednesday, May 8, 2019, the Subcommittee on Research and Technology of the Committee on Science, Space, and Technology will hold a hearing to review the Administration’s fiscal year 2020 budget request for the National Science Foundation and related policy and management issues.

**WITNESSES**

- **Dr. France Córdova**, Director, National Science Foundation
- **Dr. Diane Souvaine**, Chair, National Science Board

**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.”<sup>1</sup>

**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 President and confirmed by the Senate.<sup>2</sup> The current NSF Director, Dr. France Córdova, was appointed by President Obama in 2014. Her term is set to expire in March 2020.<sup>3</sup>

The Board consists of 24 members appointed to six-year terms by the President.<sup>4</sup> 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

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

<sup>2</sup> The Deputy Director position is similarly appointed by the President, but this position has been vacant since 2014.

<sup>3</sup> NSF, “France A. Córdova sworn in as NSF director,” [https://www.nsf.gov/news/news\\_summ.jsp?cntn\\_id=130931](https://www.nsf.gov/news/news_summ.jsp?cntn_id=130931)

<sup>4</sup> NSB appointments are staggered so that every two years one-third of the Board is appointed.

States.<sup>5</sup> The Board Chair and Vice Chair are elected to two-year terms by the Board membership. The current Chair, Dr. Diane Souvaine, was elected in 2018. Her term will expire in May 2020.<sup>6,7</sup>

**Research and Education** – NSF supports fundamental non-biomedical research and education across all fields of science and engineering. For many research disciplines, including computer science, biology, environmental science, and social science, NSF is the primary source of Federal funding.

Research and education activities are managed through six research directorates under the Research and Related Activities Account – Biological Sciences (BIO), Computer and Information Science and Engineering (CISE), Engineering (ENG), Geosciences (GEO), Mathematical and Physical Sciences (MPS), Social, 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 and further subdivided into divisions. Interdisciplinary research and agency-wide initiatives are funded through the Office of Integrative Activities, which is housed in the Office of the Director.

To support research and education activities, NSF typically enters into a grant agreement<sup>8</sup> with universities or other non-profit organizations. In FY 2018, NSF received more than 40,300 research grant proposals and made about 9,000 new awards to colleges, universities, and other institutions across all 50 states. Across the agency, 22 percent of proposals were selected for grant awards in FY 2018. The average award size that year was \$182,100 over 3 years. Activities funded by NSF in FY 2018 involved an estimated 50,000 researchers and postdoctoral associates, 80,000 graduate and undergraduate students, and 242,000 K-12 teachers and students.<sup>9</sup>

**Facilities** – In addition to research grants, NSF funds advanced equipment and facilities that are critical to the agency’s mission but too costly for an individual or small group of investigators to afford. NSF enters into cooperative agreements<sup>10</sup> with universities or other non-profit organizations for the construction and management of major facilities. Large equipment and facility projects include multi-user facilities, such as astronomical observatories and ocean

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<sup>5</sup> The most recent Indicators report was released in January 2018 and can be found here:

<https://www.nsf.gov/statistics/2018/nsb20181/>

<sup>6</sup> NSF, “NSF’s National Science Board announces new leadership for 2018-2020,”

[https://www.nsf.gov/nsb/news/news\\_summ.jsp?cntn\\_id=245368](https://www.nsf.gov/nsb/news/news_summ.jsp?cntn_id=245368)

<sup>7</sup> The current Vice-Chair of the NSB is Dr. Ellen Ochoa.

<sup>8</sup> 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](https://www.ecfr.gov/cgi-bin/text-idx?SID=46104990e1c2a6428d3e417781304a9f&mc=true&node=pt2.1.200&rgn=div5#se2.1.200_151)

<sup>9</sup> NSF, “FY 2020 Budget Request to Congress”, <https://nsf.gov/about/budget/fy2020/index.jsp>

<sup>10</sup> 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](https://www.ecfr.gov/cgi-bin/text-idx?SID=46104990e1c2a6428d3e417781304a9f&mc=true&node=pt2.1.200&rgn=div5#se2.1.200_124)

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) account – supports construction, while operations are funded through the research directorates.

**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.

**Big Ideas** – While it maintains directorates organized around research disciplines, NSF has long supported cross-agency initiatives. As groundbreaking science has become increasingly interdisciplinary or transdisciplinary - the favored term today is “convergent” - the agency has experimented with different ways to break down cultural and institutional boundaries between disciplines. In 2016, Dr. Córdoba unveiled 10 new ideas to drive NSF’s long-term research agenda.

The 10 Big Ideas for Future NSF Investments are “meant to define a set of cutting-edge research agendas and processes that are uniquely suited for NSF’s broad portfolio of investments, and will require collaborations with industry, private foundations, other agencies, science academies and societies, and universities.”<sup>11</sup> The Big Ideas are divided into research and enabling ideas.<sup>12</sup>

Research Ideas

- Harnessing the Data Revolution
- Future of Work at the Human-Technology Frontier
- Navigating the New Arctic
- Quantum Leap
- Understanding the Rules of Life
- Windows on the Universe

Enabling Ideas

- Growing Convergence Research
- NSF INCLUDES
- Mid-scale Research Infrastructure
- NSF 2026

**Convergence Accelerator** – Starting with the FY 2019 budget request, NSF initiated a new model for accelerating goal-driven research in areas of national importance. The Convergence

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<sup>11</sup> NSF, “10 Big Ideas for Future NSF Investments,” [https://www.nsf.gov/about/congress/reports/nsf\\_big\\_ideas.pdf](https://www.nsf.gov/about/congress/reports/nsf_big_ideas.pdf)

<sup>12</sup> An explanation of the 10 Big Ideas can be found here: [https://www.nsf.gov/news/special\\_reports/big\\_ideas/](https://www.nsf.gov/news/special_reports/big_ideas/)

Accelerator stands separately from the research directorates and is divided into individual tracks. Each Convergence Accelerator track will be a time-limited entity that supports multidisciplinary research on specific topics or themes.

## BUDGET REQUEST HIGHLIGHTS

The Administration’s FY 2020 budget request includes \$7.066 billion for NSF in FY2020, a \$1.009 billion decrease (-12.5 percent) from the FY2019 enacted level of \$8.075 billion. NSF has six appropriations accounts: Research and Related Activities (R&RA), Education and Human Resources (EHR), Major Research Equipment and Facilities Construction (MREFC), Agency Operations and Award Management (AOAM), National Science Board (NSB), and Office of Inspector General (OIG). The proposed cuts would come primarily from three accounts: R&RA by \$857 million (13.1 percent), EHR by \$87 million (9.5 percent), and MREFC by \$73 million (24.5 percent). Since the FY 2019 spending plan for NSF has not yet been approved by Congress, this charter will compare the requested funding for programs within these accounts with NSF spending in FY 2018.

Program Activity	FY 2018 Actual	FY 2019 Enacted	FY 2020 Request	Change FY 2020 - 2018		Change FY 2020 - 2019	
				Amount	Percent	Amount	Percent
Research and Related Activities (R&RA)	6380.38	6520.00	5662.96	-717.42	-11.2	-857.04	-13.1
Education and Human Resources (EHR)	903.87	910.00	823.47	-80.40	-8.9	-86.53	-9.5
Major Research Equipment and Facilities Construction (MREFC)	186.30	295.74	223.23	36.93	19.8	-72.51	-24.5
Agency Operations	328.51	329.54	336.89	8.38	2.6	7.35	2.2
National Science Board	4.30	4.37	4.10	-0.20	-4.6	-0.27	-6.2
Inspector General	15.09	15.35	15.35	0.26	1.7	0.00	0.0
<b>AGENCY TOTAL</b>	<b>7818.43</b>	<b>8075.00</b>	<b>7066.00</b>	<b>-752.43</b>	<b>-9.6</b>	<b>-1009.00</b>	<b>-12.5</b>

**Research** – The Administration’s FY 2020 budget proposal includes a \$717 million (11.2 percent) cut to the R&RA account spread across the six research directorates relative to spending in FY 2018. Within this reduced budget, the Administration proposes increased or sustained support for priority research disciplines as follows: \$492 million for artificial intelligence, \$106 million for quantum science, and \$268 million for advanced manufacturing. The budget also includes continued support for the 10 Big Ideas, with a total investment of nearly \$690 million. Two of the big ideas, the Future of Work and Harnessing the Data Revolution, are the focus of the first two Convergence Accelerator tracks. Each of these tracks are funded at \$30 million with the intention to leverage \$20 million from external partnerships.

The proposed cut to research activities at NSF would result in 1,000 fewer early-stage research grants being awarded. The GEO and MPS directorate budgets are cut by 13 percent and 17 percent, respectively, and cuts to the remaining research directorates range from 8-10 percent.

Under this proposal, the agency-wide proposal funding rate would fall to 21 percent, and as low as 18 percent for the CISE and SBE directorates.

**Education** – The request proposes a \$80 million (9 percent) cut for the Education and Human Resources directorate. This smaller budget includes increased funding for the Advanced Technological Education (ATE) program<sup>13</sup> (+\$9 million or 14 percent) and the Discovery Research PreK-12 program<sup>14</sup> (+\$6 million or 7 percent), however funding for most programs is reduced. The Robert Noyce Teacher Scholarship Program<sup>15</sup> is cut by \$17.5 million (27 percent), the NSF Research Traineeship (NRT) program<sup>16</sup> is cut by \$4 million (8 percent), and the Graduate Research Fellowship Program (GRFP)<sup>17</sup> is cut by \$28 million (10 percent).

In addition to discipline-specific research activities, each research directorate allocates a portion of its budget to support education activities. Education investments across research directorates are cut by \$78 million (35 percent) relative to FY 2018. With this budget, NSF activities would support 5,000 fewer researchers and postdoctoral associates, 6,500 fewer graduate and undergraduate students, and 24,000 fewer K-12 teachers and students.

**Broadening Participation** – While one of the Foundation’s Big Ideas, NSF INCLUDES,<sup>18</sup> is provided with a \$2 million (11 percent) increase, the budget proposal calls for cuts to nearly all other programs in NSF’s broadening participation portfolio, a total reduction of \$168 million (17 percent). For instance, the Established Program to Stimulate Competitive Research (EPSCoR) program<sup>19</sup> is cut by \$19 million (11 percent) and the HBCU Excellence in Research program<sup>20</sup> is cut by \$10 million (51 percent).

**Facilities** – The budget proposal provides \$223 million to continue the construction of three ongoing major research infrastructure projects – the Antarctic Infrastructure Modernization for Science (AIMS)<sup>21</sup>, the High Luminosity-Large Hadron Collider (HL-LHC)<sup>22</sup>, and the Large Synoptic Survey Telescope (LSST)<sup>23</sup>. Also included is funding to support design activities for

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<sup>13</sup> The ATE program supports curriculum development; professional development of college faculty and secondary school teachers; career pathways; and other activities with an emphasis on two-year Institutions of Higher Education.

<sup>14</sup> The Discovery Research PreK-12 program supports research and development of STEM education.

<sup>15</sup> The Robert Noyce Teacher Scholarship Program provides educational opportunities for STEM majors and professionals to encourage them to become K-12 math and science teachers.

<sup>16</sup> The NRT program supports the development of innovative models for educating and training STEM graduate students.

<sup>17</sup> The GRFP program will be able to support 1,600 new fellows in FY 2020, compared with 2,000 in FY 2018.

<sup>18</sup> The INCLUDES program supports broadening participation research and the development of a diverse STEM workforce.

<sup>19</sup> The EPSCoR program supports improved research competitiveness for eligible geographic jurisdictions.

<sup>20</sup> The HBCU Excellence in Research Program supports improved research capacity and competitiveness of HBCUs.

<sup>21</sup> The AIMS project will replace major facilities at McMurdo Station, Antarctica, one of three permanent stations that comprise the U.S. presence in Antarctica, to meet anticipated science support requirements for the next 35 to 50 years.

<sup>22</sup> The HL-LHC project will upgrade the ATLAS and CMS detectors to enable them to record and analyze the large amounts of data produced by the upgraded LHC accelerator.

<sup>23</sup> The LSST, located in Chile, is an 8.4-meter optical telescope designed to carry out surveys of nearly half the sky.

potential future research facilities, including \$400,000 for Advanced LIGO Plus (LIGO A+)<sup>24</sup> and \$4 million for NSF’s next leadership-class computing facility.<sup>25</sup>

To assist the research directorates in supporting the operations and management (O&M) of major facilities, and ease the budget pressure on core research activities, the request includes \$10 million for a Facilities Operations Transition pilot program funded out of the Integrative Activities account. This funding is divided among three NSF facilities within the first five years of their operational life – the Ocean Observatories Initiative (managed by the GEO directorate), the National Ecological Observatory Network (BIO), and the Daniel K. Inouye Solar Telescope (MPS). The managing research directorates remain responsible for 90 percent of the O&M funding for these facilities.<sup>26</sup>

**Mid-Scale Research Infrastructure** – The proposal includes \$75 million for mid-scale research infrastructure, split between the R&RA account (for projects in the \$6-20 million range) and the MREFC account (for projects in the \$20 – 70 million range). The mid-scale research infrastructure program is designed to address the gap in funding opportunities between the Major Research Instrumentation (MRI) and MREFC programs.<sup>27</sup> Support for mid-scale research infrastructure is in high demand, as demonstrated by the more than \$3 billion in high-impact project ideas the agency received in response to a 2017 Request for Information.<sup>28</sup>

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<sup>24</sup> The LIGO A+ instrument upgrades will increase the volume of space surveyed by a factor of four to seven.

<sup>25</sup> NSF’s current leadership-class computing resource, Blue Waters at the University of Illinois at Urbana-Champaign (UIUC), will complete its operational cycle in December 2019. The next leadership-class computing system, the recently-funded Frontera system at the University of Texas at Austin, will be fully operational by July 2019.

<sup>26</sup> A 2018 NSB report called for greater flexibility within the MREFC account to supplement the responsibility of the research directorates for facilities (<https://www.nsf.gov/pubs/2018/nsb201817/nsb201817.pdf>). The budget request cites “challenges that would be introduced by maintaining separate construction and operations funding in the MREFC line” as the reason for requesting this funding in the R&RA account instead.

<sup>27</sup> Mid-scale research infrastructure includes projects ranging in cost from \$20 - \$60 million.

<sup>28</sup> NSB, “Bridging the Gap: Building a Sustained Approach to Mid-scale Research Infrastructure and Cyberinfrastructure at NSF,” <https://www.nsf.gov/nsb/publications/2018/NSB-2018-40-Midscale-Research-Infrastructure-Report-to-Congress-Oct2018.pdf>