LEWIS–BURKE ASSOCIATES LLC

Analysis of the President's FY 2019 Budget Request for Federal Research, Health, and Higher Education Programs

Updated National Science Foundation Section

Prepared by Lewis-Burke Associates LLC
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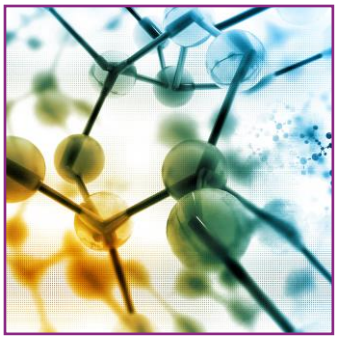

Government Relations for Research & Education

National Science Foundation

The information below is provided as an addendum to *Lewis-Burke Associates LLC Analysis of the President's FY 2019 Budget Request for Federal Research, Health, and Higher Education Programs* of February 13, 2018. This document reflects the full National Science Foundation fiscal year 2019 budget request, released on February 28, 2018.

President Trump's FY 2019 budget request includes $7.472 billion for the National Science Foundation (NSF), 0.4 percent below the FY 2017 level.

- The Administration had planned to propose extremely deep cuts to NSF of almost 30 percent below FY 2017 levels. However, due to the new budget agreement for FY 2018 and FY 2019, the Administration would add $2.2 billion back into the NSF budget request, enabling essentially flat funding overall and a 2.4 percent increase for the Research and Related Activities (R&RA) account that funds all NSF research directorates.
- The budget request would prioritize the ten Big Ideas for Future Investment, devoting $342 million in new funding, while individual research divisions would see cuts ranging from 1 to 11 percent. Big Ideas funding would be available to support research, education, and infrastructure across all NSF-supported disciplines.
- NSF has been held flat for several years and this request would continue that trend. NSF has several congressional champions, but they have mostly sought to protect the agency rather than grow it. It remains to be seen whether the community and champions can shift focus under this new budget paradigm to enable funding growth.

New and Signature Initiatives

Big Ideas for Future Investment

Almost all new initiatives in the budget request are devoted to the ten Big Ideas for Future Investment. These themes were first introduced by Director France Córdova in May 2016 and have been the subject of several initial funding opportunities in FY 2017 and FY 2018. The Big Ideas include:

- Research Ideas
  - Harnessing the Data Revolution
  - The Future of Work at the Human-Technology Frontier
  - Windows on the Universe: The Era of Multi-Messenger Astrophysics
  - The Quantum Leap: Leading the Next Quantum Revolution
  - Understanding the Rules of Life: Predicting Phenotype
  - Navigating the New Arctic
- Process Ideas
  - Mid-Scale Research Infrastructure
  - NSF 2026: Seeding Innovation
  - NSF INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science): Enhancing Science and Engineering Through Diversity
  - Growing Convergent Research at NSF

The budget request would provide $30 million in funding for each of the **research ideas**, which NSF states would be new money on top of ongoing pilot efforts started by individual directorates. Funding

for each Big Idea would be under a lead directorate, but the initiatives would continue to be led by cross-directorate working groups that would determine specific thrusts and investments.

NSF also proposes two new $30 million **Convergence Accelerators** for the Harnessing the Data Revolution and Future of Work at the Human-Technology Frontier Big Ideas. These accelerators would seek partnerships with other agencies, industry, foundations, and international organizations to support translational research, testbeds, infrastructure access, and workforce considerations. Both accelerators would be managed by the Office of Integrative Activities (OIA).

In addition to the funding proposed for the research ideas, NSF would provide investments for each of the process ideas:

- **Mid-Scale Research Infrastructure:** $60 million would be provided under OIA, although elsewhere in the Foundation funding would be reduced for existing mid-scale and research resources programs by $37 million. These research resources programs are not entirely dedicated to mid-scale, so it is not clear exactly how much increased investment mid-scale would see under the budget request.
- **Growing Convergence Research (GCR):** NSF would provide $16 million to identify compelling convergent research challenges and fund exploratory science, engineering, and workforce efforts to tackle these challenges. GCR would be managed under OIA.
- **NSF INCLUDES**: NSF would provide $20 million, an increase of 42 percent, to continue efforts to spur new collaborative paradigms for meeting broadening participation goals. The increased funding would support the INCLUDES Alliances, which are currently being competed.
- **NSF 2026:** $6.5 million would be provided to spur development of new Big Ideas, fund high-risk/high-reward research, as well as support portfolio analysis and evaluation for NSF overall and the Big Ideas specifically. NSF 2026 would be managed under OIA.

Antarctic Infrastructure Modernization for Science (AIMS)
The budget request would devote $104 million to a new construction project that would replace existing NSF facilities at McMurdo Station. The project is expected to cost $355 million total over five years with all of the funding being requested through the **Research and Related Activities** account.

Proposed Reductions and Terminations

Outside of the Big Ideas and AIMS investments, many other programs would see reductions. These include many Obama-era initiatives that were already slated to wind down, Graduate Research Fellowships, CAREER awards, and several education programs. Note that apart from major cross-cutting initiatives and certain STEM programs, the budget request provides no detail about how or whether individual divisions would apply reductions across their core activities.

Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS)
The INFEWS initiative would be reduced to $16 million, 71 percent below the FY 2017 level, as it heads towards a planned sunsetting in FY 2020. INFEWS is an NSF-wide interdisciplinary initiative begun in FY 2016 that aims to understand, design, and model the interconnected food, energy, and water (FEW) systems. Several directorates would end their INFEWS investments in FY 2019, leaving only the Directorate for Engineering (ENG), the Directorate for Geosciences (GEO), and the Directorate for Social, Behavioral, and Economic Sciences (SBE) participating.

Risk and Resilience
The Risk and Resilience initiative would end as planned in FY 2019. The initiative aimed to improve predictability and risk assessment and increase resilience to extreme events to ensure minimal impact on quality of life, society, and the economy. GEO would continue to support the Prediction of and Resilience against Extreme Events (PREEVENTS) program at the FY 2017 level of $17 million. ENG and SBE would end their support of $9 million and $3 million, respectively, which had been focused on the Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP) program. Going forward, research focused on risk and resilience in ENG and SBE would be funded through core programs.

Understanding the Brain (UtB)
The Understanding the Brain (UtB) initiative would be supported at $129 million in FY 2019, down 19 percent from its FY 2017 level. For FY 2019, NSF would continue to fund cross-cutting programs, core neuroscience programs in individual directorates, as well as efforts to establish national research infrastructure. Changes to UtB investments would vary widely by directorate. The Directorate for Biological Sciences (BIO) would continue almost all of its investment at $46 million (down 0.8 percent from FY 2017) while the Directorate for Mathematical and Physical Sciences (MPS) would halve its contribution (down 48 percent to $13 million). Other directorate reductions range from 14 to 36 percent below FY 2017 levels. UtB is planned to continue until FY 2020.

Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS)
The request would terminate funding as planned for the CEMMSS initiative, which focused on materials, advanced manufacturing, robotics, and cyber-physical systems, and contributed to interagency priorities from the Obama Administration including the Materials Genome Initiative (MGI), the Advanced Manufacturing Partnership (AMP), and the National Robotics Initiative (NRI). CEMMSS research totaled $296 million in FY 2017, and the request notes that the program achieved its programmatic goals. NSF plans to continue developing cross-cutting programs related to CEMMSS thrusts, such as smart systems, advanced materials, robotics, cyber-physical, and autonomous systems.

Additional Proposed Reductions (all comparisons are to FY 2017 levels)

- **Graduate Research Fellowships:** Down 15 percent to $271 million.
- **CAREER:** Down 11 percent to $251 million. Funding would stay relatively steady in BIO and ENG while GEO, MPS, and SBE would see major reductions ranging from 15 to 37 percent.
- **Research Experiences for Undergraduates (REU):** Down 15 percent to $80 million.
- **Programs funded by H-1B nonimmigrant Petitioner Fees:** These programs are expected to decrease as NSF revenue from H-1B fees is projected to be $100 million, 30 percent below FY 2017 revenue.
    - **NSF Scholarships in STEM (S-STEM):** Down 11 percent to $75 million.
    - **Innovative Technology Experiences for Teachers and Students (ITEST)**: Down 29 percent to $25 million.
- **Robert Noyce Scholarship Program:** Down 24 percent to $47 million.
- **STEM + Computing (STEM+C) Partnerships:** Down 30 percent to $45 million. STEM+C would not run a competition in FY 2019 and will instead shift to providing co-funding to other programs in both the Directorate for Computer and Information Science and Engineering (CISE) and the Directorate for Education and Human Resources (EHR) for research focused on computer science education.

Additional Terminations

- **BIO Doctoral Dissertation Improvement Grants (DDIG):** Divisions of Environmental Biology and Integrative Organismal Systems would no longer accept proposals. Other BIO divisions had already stopped participating in this program, which was funded at $2 million in FY 2017.
- **East Asia and Pacific Summer Institutes for U.S. Graduate Students (EAPSI):** According to the budget request, EAPSI, which was funded at $960,000 in FY 2017, has met its stated objectives to foster student-initiated professional relationships and catalyze future collaborations. NSF will continue to seek larger-scale projects and will adapt EAPSI best practices into future programs.
- **International Offices:** NSF plans to close its three overseas offices in Beijing, Brussels, and Tokyo. The request states that this is part of a new model for international engagement. Staff will instead focus on short-term expeditions to select partner countries.

Ongoing Areas of Interest

Cybersecurity

The Secure and Trustworthy Cyberspace (SaTC) program would be supported at $129 million in FY 2019, 5.5 percent below the FY 2017 level. SaTC is planned as a seven-year investment from FY 2014 through FY 2020, with emphasis on cybersecurity research at NSF expected to continue beyond FY 2020. The Cybercorps Scholarships for Service (SFS) program would stay essentially flat with its FY 2017 level at $55 million.

Innovation Corps (I-Corps™)

The I-Corps program would be funded at $30 million, 0.5 percent above the FY 2017 level. NSF would continue to fund I-Corps Nodes, Sites, and Teams.

Improving Undergraduate STEM Education (IUSE)

The President's budget request would include $102.5 million for the Improving Undergraduate STEM Education (IUSE) umbrella, a 0.4 percent increase over the FY 2017 level. IUSE is an NSF-wide effort to improve undergraduate STEM education that includes individual programs in EHR and individual research directorates. For FY 2019, NSF would include $15 million for IUSE: Hispanic Serving Institutions, the same level as FY 2017, to promote research on effective student learning at HSIs, incentivize institutional transformation, and enhance research on building capacity at HSIs. Note that all of the FY 2017 funding for IUSE:HSI has been carried over to be spent in FY 2018.

Graduate Education

Beyond the Graduate Research Fellowship Program (GRFP) mentioned above, the NSF Research Traineeships (NRT) would receive $52 million in funding for FY 2019, 1.4 percent below the FY 2017 level. NSF plans to explore several pilot activities related to graduate education in FY 2019. These include collaborations between EHR and individual research directorates to expand internship opportunities with new industry partners, as well as exploration by the Office of International Science and Engineering (OISE) of potential ways to strengthen international experiences for graduate students. NSF also plans to continue activities under the Non-Academic Research internships for Graduate Students Dear Colleague Letter issued in May 2017. Core research in graduate education would emphasize STEM workforce development.

Science, Technology, Engineering, and Mathematics (STEM) Education

Beyond programs discussed above, many NSF STEM programs would see flat or very close to flat funding in FY 2019, including broadening participation programs such as the Louis Stokes Alliances for Minority

Participation (LSAMP), Advancement of Women in Academic Science and Engineering Careers (ADVANCE), Alliances for Graduate Education and the Professoriate (AGEP), as well as NSF's main K-12 and informal education programs Discovery Research preK-12 and Advancing Informal STEM Learning (AISL). EHR Core Research would also remain essentially flat at $67.5 million.

Source: The full NSF FY 2019 Budget Request can be viewed at: https://www.nsf.gov/about/budget/fy2019/toc.jsp.

National Science Foundation

(in millions of $)

	FY 2017 Actual	FY 2019 Request	FY 2019 Request vs. FY 2017
NSF, total	**7,504.10**	**7,472.00**	**-32.10 (0.4%)**
Research and Related Activities	**6,006.51**	**6,150.68**	**144.17 (2.4%)**
Biological Sciences	742.22	738.16	-4.06 (0.5%)
Computer and Information Science and Engineering	935.93	925.42	-10.51 (1.1%)
Engineering	930.92	921.43	-9.49 (1.0%)
Geosciences	825.62	852.98	27.36 (3.3%)
Mathematical and Physical Sciences	1,362.43	1,345.32	-17.11 (1.3%)
Social, Behavioral, and Economic Sciences	270.89	246.19	-24.7 (9.1%)
International Science and Engineering	48.96	48.50	-0.46 (0.9%)
Office of Polar Programs	467.85	534.54	66.69 (14.3%)
Integrative Activities	420.27	536.72	116.45 (27.7%)
US Arctic Research Commission	1.43	1.42	-0.01 (0.7%)
Education and Human Resources	**873.37**	**873.37**	**--**
Major Research Equipment and Facilities Construction	**222.78**	**94.65**	**-128.13 (57.5%)**
Agency Operation and Award Management	**382.06**	**333.63**	**-48.43 (12.7%)**
National Science Board	**4.27**	**4.32**	**0.05 (1.2%)**
Office of Inspector General	**15.10**	**15.35**	**0.25 (1.6%)**

LEWIS–BURKE ASSOCIATES LLC

440 First Street, NW
Suite 700
Washington, D.C. 20001
t: 202.289.7475
www.lewis-burke.com