

MAJOR INVESTMENTS IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) GRADUATE STUDENTS AND GRADUATE EDUCATION

Overview

A U.S. science, technology, engineering, and mathematics workforce with advanced preparation in research and innovation, and in professional fields such as cybersecurity and STEM teaching, is essential for the progress of science and engineering (S&E). Today, emerging fields of S&E increasingly demand collaborations that span institutions, disciplines, and national boundaries, and require the use of sophisticated data infrastructure, instruments, and networks of researchers. Computationally intensive and data-enabled science in areas such as artificial intelligence and quantum information science is dramatically changing the knowledge and experience required of researchers and other STEM professionals across all fields. Thus, the preparation of graduate students in STEM must continue to evolve to provide a supply of scientists and engineers who not only meet the needs of the STEM enterprise, but who also have the knowledge, skills, and preparation to advance it and lead innovation in academia and the private and public sectors.

Investing in discoverers—that is, building a diverse and talented next-generation of STEM research leaders and professionals in leading-edge scientific areas, across sectors and through inclusive processes—is an important NSF focus and aligns with Administration and Congressional priorities. A major portion of NSF’s overall investment in graduate education and graduate students supports research assistants funded through research grants. The Division of Graduate Education (DGE) also supports graduate students through other mechanisms such as traineeships, scholarships and fellowships.

Goals

The goal of NSF’s investments in STEM graduate education and STEM graduate students is to prepare a diverse workforce with advanced research training that is equipped to transform the frontiers of S&E, and to prepare professionals to participate and innovate in STEM intensive careers. This goal is based on the following framework¹ to:

1. *Advance Science and Engineering Research*: Support graduate students and graduate education to enable long-term contributions of new knowledge at the frontiers of science and engineering.
2. *Broaden Participation to Promote Excellence in Research and Build the Next Generation STEM Workforce*: Recruit graduate students from a variety of geographic, demographic, social, and educational backgrounds to promote the advancement of science and a highly qualified professional workforce.
3. *Build Effective Models of Graduate Education and Workforce Development*: Support the development and use of innovative models and evidence-based approaches in graduate education, including education and research about promising practices and program effectiveness.

FY 2021 Investments

NSF’s two major agency-wide programs in graduate education are the NSF Research Traineeship (NRT) program and the Graduate Research Fellowship Program (GRFP). EHR’s Division of Graduate Education leads management for both programs. NSF-wide working groups guide the administration of these programs. Both programs contain design elements recommended in major national reports² as ways to

¹ National Science Foundation (2016). NSF Strategic Framework for Investments in Graduate Education. National Science Foundation, Alexandria, VA. Retrieved from: www.nsf.gov/pubs/2016/nsf16074/nsf16074.pdf.

² National Academy of Sciences, Engineering, and Medicine. 2018. Graduate STEM Education in the 21st Century. Washington,

better prepare graduates for a broad range of careers. The NRT has two complementary components: (1) training grants that focus on developing researchers in high priority interdisciplinary research areas; and 2) the Innovations in Graduate Education (IGE) research program through the initiation of research on the development and implementation of bold, new, and potentially transformative approaches to STEM graduate education and training. GRFP identifies and supports the next generation of outstanding STEM researchers. Both programs provide professional development opportunities for graduate students, including internships and international research experiences. Ongoing evaluation and monitoring of the programs and students involved in NRT and GRFP provide rich data that will be used for gaining a better understanding of graduate program experiences and interventions, monitoring career outcomes longitudinally, and contributing to improving the understanding of STEM professional workforce development.

There are several other programs at NSF that focus on developing sectors of the STEM workforce and provide support to students in testing new models and approaches to graduate education. For example, the CyberCorps®: Scholarship for Service (SFS) program, led by EHR, addresses the national need for a cybersecurity workforce. The Robert Noyce Teacher Scholarship program (Noyce) provides fellowship support to members of the master teacher cohort at the graduate level and funds innovation and development in STEM teacher education approaches. The Louis Stokes Alliances for Minority Participation's Bridge to the Doctorate (LSAMP-BD) track and NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) support the successful entry and transition of underrepresented and underserved populations into STEM graduate education and into the STEM workforce. This broad suite of programs contributes substantially to the NSF investment in graduate education of the STEM research and education workforce of the future.

NSF Research Traineeship

The goals of NRT are to support highly effective training of STEM graduate students in interdisciplinary research areas of national priority, as well as to create and promote innovative, effective, and scalable models for STEM graduate student training. In FY 2021, NRT will expand to include a special focus on traineeships in artificial intelligence and artificial intelligence engineering.

The NRT program is distinguished by its emphasis on training for multiple career pathways, rotating priority research themes with an emphasis on future scientific challenges, inclusion of both masters and doctoral students, and availability of the training components to both NRT-funded students and other graduate students who may want to take advantage of these training opportunities. NRT addresses interdisciplinary graduate education through two approaches: traineeships and fundamental education research. Traineeships are dedicated to effective training of STEM graduate students in high-priority interdisciplinary research areas using a comprehensive training model that is innovative, evidence-based, and aligned with changing workforce and research needs. This training includes development of technical and professional skills for both research and research-related careers within and outside academia. Fundamental education research is addressed through the Innovations in Graduate Education (IGE) component of NRT, which focuses on test-bed projects aimed at piloting, testing, and validating innovative and potentially transformative approaches to graduate education, including activities such as career preparation, mentoring, partnerships, and internships. NSF expects to fund about 17-20 traineeships and up to \$8.0 million in fundamental research in graduate education.

DC: The National Academies Press. Retrieved from: www.nap.edu/catalog/25038/graduate-stem-education-for-the-21st-century; American Chemical Society Presidential Commission (2012). Advancing graduate education in the chemical sciences. American Chemical Society, Washington, DC. Retrieved from: www.acs.org/content/dam/acsorg/about/governance/acs-presidential-graduate-education-commission-full-report.pdf; Biomedical Research Workforce Working Group (2012). Biomedical Research Workforce Working Group Draft Report. National Institutes of Health, Bethesda. Retrieved from https://acd.od.nih.gov/documents/reports/bmw_report.pdf

Major Investments in STEM Graduate Students and Graduate Education

NRT Funding
(Dollars in Millions)

	FY 2019 Actual	FY 2020 (TBD)	FY 2021 Request
BIO	\$3.32	-	-
CISE	7.20	-	-
EHR	33.04	-	61.87
ENG	2.50	-	-
GEO	2.77	-	-
MPS	4.54	-	-
OPP	0.72	-	-
Total	\$54.09	-	\$61.87

In FY 2020, NRT funding is consolidated into EHR.

Graduate Research Fellowship Program

The goal of GRFP is to help build the STEM human capital necessary to ensure the Nation’s leadership in advancing innovations in S&E. GRFP selects, recognizes, and financially supports graduate students with demonstrated high potential for excellence in STEM careers. Applications are welcome from students in disciplines supported by NSF, including STEM, STEM education, or STEM interdisciplinary areas. In FY 2021, GRFP will be funded at \$275.28 million. This will support 1,600 new fellows with a cost of education allowance of \$12,000 and a stipend of \$34,000. The GRFP program will continue to align awards with NSF and Administration research priorities, including AI, QIS, and other industries of the future.

GRFP Funding by Account

(Dollars in Millions)

	FY 2019 Actual	FY 2020 (TBD)	FY 2021 Request
Education and Human Resources	\$142.26	-	\$137.64
Research and Related Activities	142.29	-	137.64
Total	\$284.55	-	\$275.28
Number of New Fellows	1,976		1,600
Projected Fellows on Tenure ¹	5,705		5,800

¹ Fellowship tenure status is the period of time during which fellows actively use the fellowship award to pursue an advanced degree in a STEM or STEM education field.

CyberCorps®: Scholarship for Service

The SFS program addresses cybersecurity education and workforce development by providing funding to institutions for developing educational programs and interventions in cybersecurity and for awarding scholarships to undergraduate and graduate students in those programs. In return for their scholarships, tuition, fees, health insurance, travel, and book allowances, recipients work after graduation for a federal, state, local, or tribal government organization in a position related to cybersecurity for a period equal to the length of the scholarship. The SFS program also supports research to improve cybersecurity education through the Secure and Trustworthy Cyberspace: Education program (SaTC-EDU).

SFS Funding

(Dollars in Millions)

FY 2019	FY 2020	FY 2021
Actual	(TBD)	Request
\$55.00	-	\$52.13

Additional Programs and Activities Supporting STEM Graduate Education and Workforce Development

Louis Stokes Alliances for Minority Participation-Bridge to the Doctorate (LSAMP-BD)

The LSAMP program assists universities and colleges in diversifying the STEM workforce by increasing the number of STEM baccalaureate and graduate degrees awarded to populations historically underrepresented in STEM disciplines: African Americans, Alaska Natives, American Indians, Hispanic Americans, Native Hawaiians, and Native Pacific Islanders. The LSAMP program provides funding to alliances comprised of multiple degree-granting organizations that can implement comprehensive and sustained strategies that result in the graduation of well-prepared, highly qualified students from underrepresented groups. The LSAMP-BD is a targeted activity where established alliances provide post-baccalaureate fellowships for students to successfully transition from master’s degrees and/or earn STEM doctoral degrees and be competitive in the STEM workforce.

In FY 2021 LSAMP will focus largely on undergraduate students and the competition for the LSAMP BD activity will be on hold to review the different tracks of LSAMP and anticipate having a revised solicitation by FY 2021.

NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)

NSF established the S-STEM program in accordance with the American Competitiveness and Workforce Improvement Act of 1998 (P.L. 105-277), as modified by P.L. 106-313 and P.L. 108-447 in 2005. The Act reflects the national need to increase substantially the number of American scientists and engineers. The S-STEM program provides institutions with funds for student scholarships to encourage and enable low-income, academically talented U.S. students with demonstrable financial need to enter the STEM workforce or STEM graduate school following completion of an associate, baccalaureate, or graduate degree in STEM fields. The program emphasizes the importance of recruiting students to STEM disciplines, mentoring and supporting students through degree completion, and partnering with employers to facilitate student career placement in the STEM workforce. S-STEM provides individual scholarships of up to \$10,000 per year, depending on cost of attendance and unmet financial need. S-STEM expects to fund about 300 Masters or PhD students in FY 2021.

In addition to the long-standing scholarship support, S-STEM projects contribute to the knowledge base of research in education by carrying out research on factors such as recruitment and retention of STEM students. S-STEM is funded through H-1B Nonimmigrant Petitioner Account receipts.

Robert Noyce Teacher Scholarship (Noyce)

The Noyce program supports talented STEM professionals to become K-12 STEM teachers. It also supports experienced, exemplary K-12 STEM teachers to become leaders and innovators in STEM education at their school or district.

Categories of Noyce Support for Graduate Education

Track	Outcome	Eligible Individuals	Support	Length of Commitment to Teach in High-need Schools
Scholarships and Stipends	Highly effective K-12 STEM teachers in high need schools/districts	STEM professionals	One-year scholarship to become certified/licensed teacher	2 years
Teaching Fellowship			One-year Scholarship to complete a master's degree in education and salary supplement* during teaching commitment	4 years
Master Teaching Fellowships	Highly effective K-12 teacher leaders in STEM education in high need schools/districts	K-12 STEM Teachers without a master's degree	One-year Scholarship to complete a master's degree and salary supplement during teaching commitment	5 years**

*The salary supplements support participation in mentoring and professional development to increase the Fellow's effectiveness in the classroom and/or as teacher leaders.

**The Master Teaching Fellows continue teaching in a high need school and/or school district while they are pursuing their master's degree.

The Noyce Teaching Fellowships and Master Teaching Fellowships track expects to fund about 160 fellows in FY 2021.

Additional Programs Supporting STEM Graduate Education and Workforce Development

(Dollars in Millions)

Program	FY 2019 Actual	FY 2020 (TBD)	FY 2021 Request
LSAMP-BD	\$8.60	-	-
S-STEM	5.00	-	2.00
Noyce Teaching and Master Teaching Fellows	22.83	-	3.78
Total	\$36.43	-	\$5.78