

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

Overview

A science and engineering workforce with advanced research training is essential for transforming the frontiers of science. NSF's commitment to advancing science, technology, engineering, and mathematics (STEM) and developing human capital in tandem has been a hallmark of NSF's investments since its founding in 1950. As the 21st century progresses, the nature and conduct of STEM are evolving rapidly. Increasingly, research is undertaken as a team effort, with collaborators across institutions and across national boundaries. Interdisciplinary approaches are needed to solve complex societal problems and fuel the production of scientific advances. The growth of computationally intensive and data-enabled science has changed the knowledge and experience requirements of scientists across fields. Along with these changes, graduate training in STEM also must continue to evolve in order to provide a supply of scientists and engineers who not only meet the needs of the emerging STEM enterprise, but who have the knowledge, skills, and preparation to advance it, both within and outside of academia.

NSF makes a substantial investment in STEM graduate education through traineeship and fellowship mechanisms, although the majority of NSF's investment in graduate students comes through faculty research grants supporting research assistants.¹ To underscore the importance of these investments, NSF is developing a five year strategic plan for its investments in graduate students and graduate education. This plan builds on four related efforts: 1) the recommendations of the National Science and Technology Council's Committee on Science, Technology, Engineering, and Mathematics Education (Co-STEM) 5-Year Strategic Plan²; 2) on-going interagency discussions about leveraging assets; 3) recent national reports on graduate education^{3,4,5,6}; and 4) NSF-wide efforts to ensure that its many forms of investment in graduate education form a coherent agency strategy.

Approach

In FY 2015, NSF is introducing improvements to the signature Graduate Research Fellowship program (GRF), expanding the new NSF Research Traineeship Program (NRT), and incorporating the Cybercorps: Scholarship for Service (SFS) program into the agency's investments in graduate education. NSF also will begin developing an agency-wide strategic plan for investments in graduate education.

In addition, evaluation of the impact of different forms of NSF graduate education investment over time is a priority for collaborations led by the Directorate for Education and Human Resources (EHR) with the National Center for Science and Engineering Statistics and the NSF-wide Evaluation and Assessment Capability.

¹ At NSF, about 40,000 graduate students are supported annually at a level of about \$1 billion. These funds are distributed across traineeships (6-8 percent), fellowships (10-15 percent), and research assistantships in individual grants and centers (80 percent).

² National Science and Technology Council, Committee on STEM Education (2013) *Federal Science, Technology, Engineering and Mathematics (STEM) 5-Year Strategic Plan*
www.whitehouse.gov/sites/default/files/microsites/ostp/stem_stratplan_2013.pdf.

³ Council of Graduate Schools (2012) *Pathways through Graduate School and Into Careers*,
http://pathwaysreport.org/rsc/pdf/19089_PathwaysRept_Links.pdf

⁴ National Institutes of Health (2012) *Biomedical Research Workforce Working Group Report*,
http://acd.od.nih.gov/biomedical_research_wgreport.pdf

⁵ American Chemical Society (2012) *Advancing Graduate Education in the Chemical Sciences*,
www.acs.org/content/dam/acsorg/about/governance/acs-commission-on-graduate-education-summary-report.pdf

⁶ National Research Council (2012) *Research Universities and the Future of America*,
www.federalrelations.wisc.edu/docs/FutureofAmericaU.pdf

Investment Framework

In FY 2015, two major areas of NSF investment in graduate education, fellowships and traineeships, will be addressed as initial steps toward a coherent agency-wide strategy.

Graduate Research Fellowship (GRF) Program

The goal of GRF is to help build the U.S. STEM human capital necessary to ensure the Nation’s leadership in advancing science and engineering and innovation. GRF selects, recognizes, and financially supports graduate students with demonstrated high potential for excellence in STEM and potential for excelling in their ultimate chosen career. Applications are welcomed from students in all STEM disciplines and in STEM interdisciplinary areas. Building on efforts in FY 2013 and FY 2014, GRF awardees will be offered the opportunity to participate in a suite of professional development experiences through which they will be able to gain specialized expertise in critical areas in FY 2015. This includes opportunities such as internships in industry or government laboratories, work on projects of interest to federal agencies, specialized or advanced training, or international experiences.

GRF Funding by Account

(Dollars in Millions)

	FY 2013	FY 2014	FY 2015
	Actual	Estimate	Request
Education and Human Resources	\$121.46	\$150.00	\$166.72
Research and Related Activities	121.49	150.00	166.72
Total	\$242.95	\$300.00	\$333.44

Totals may not add due to rounding.

NSF Research Traineeship (NRT) Program

A key goal of NSF’s graduate investments is to support the design and testing of new models of graduate education and new approaches to graduate education partnerships. In support of this goal, NRT is being designed to create and promote new, innovative, effective, and scalable models for STEM graduate student training in emerging research emphasis areas. NRT also will provide a mechanism for developing a knowledge base about the implementation and impact of innovative graduate traineeship programs and graduate education policies.

The program will build on what has been learned through the Integrative Graduate Education Research Traineeship (IGERT) program, the Graduate STEM Fellows in K-12 Education (GK-12) program, and other relevant NSF-sponsored efforts. The NRT program is distinguished from IGERT and GK-12 by its emphasis on training for multiple career pathways, rotating priority research themes, inclusion of both master’s and doctoral students, a broader definition of trainees, and greater budgetary and programmatic flexibility.

Initially, NRT will have one priority research theme – Data-Enabled Science and Engineering – but proposals on other cross-cutting, interdisciplinary theme designed to create innovative graduate education approaches will be encouraged. The program will also support an Innovation in Graduate Education track to develop and study innovative graduate education models and conduct research needed to inform implementation, adaptability, and scalability.

NRT Funding by Directorate¹

(Dollars in Millions)

	FY2013 Actual	FY 2014 Estimate	FY 2015 Request
Biological Sciences	\$4.57	\$3.93	\$3.31
Computer and Information Science and Engineering	10.25	6.89	7.59
Education and Human Resources ²	24.14	26.33	28.38
Engineering	6.63	5.38	4.38
Geosciences	7.65	4.41	5.86
Mathematical and Physical Sciences	5.29	4.46	4.48
Social, Behavioral, and Economic Sciences	4.91	3.67	4.20
International and Integrative Activities	0.60	-	-
Total	\$64.04	\$55.07	\$58.20

Totals may not add due to rounding.

¹ The FY 2013 Actual level represents Integrative Graduate Education and Research Traineeship (IGERT) program funding. Outyear commitments for IGERT are included in the NRT line and total \$31.41 million in FY 2014 and \$20.36 million in FY 2015.

² EHR's NRT funding includes \$7.0 million for Innovation in Graduate Education (IGE) as a track within the NRT program.

A total investment of \$37.84 million for NRT-specific activities signals NSF's interest in both supporting trainees and encouraging stronger and better documented efforts at innovation and design of graduate programs.

Cybercorps: Scholarships for Service (SFS) Program

Although SFS decreases \$20.0 million below the FY 2014 Estimate to a total of \$25.0 million. Additional funding, \$20.0 million, is provided in FY 2015 by the Opportunity, Growth, and Security Initiative. SFS graduate students increase the number of qualified entrants to the fields of information assurance and computer security, an area vital to our national well-being.

Evaluation Framework

The table below provides a preliminary evaluation framework for NSF investments in graduate students and graduate education.

	Potential Milestones Measure/Indicator	Desired Outcome
Program Development	<ul style="list-style-type: none"> • Development of five-year Strategic Plan for NSF investments in graduate students and graduate education. • Development of solicitations for fellowship and traineeship programs that align with the Strategic Plan for graduate education. • Implementation of effective collaboration across NSF directorates in graduate fellow-ships and traineeship investment. • Identification of agreed-upon 	Graduate STEM investments that: <ul style="list-style-type: none"> • Provide opportunities for training for work in areas of national need. • Develop innovative models with potential for scalability and transformative advances in graduate education. • Increase knowledge base to inform improvements in graduate education. • Provide strategies that promote professional development of graduate students for both academic and non-academic careers. • Establish frameworks for graduate education investments that can be applied

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	<p>outcomes of NSF investments in graduate students and graduate education.</p> <ul style="list-style-type: none"> • Development of expanded opportunities and professional development for GRF and expanded areas of research focus for NRT. 	<p>across fellowship, traineeship and research assistantship investments.</p>
Student Development	<p>Metrics will include:</p> <ul style="list-style-type: none"> • Student educational decisions; degree attainment. • Student preparation in identified areas of national need. • Performance of groups under-represented in STEM. • Quality of education and career development, comparing student experiences based on funding mechanism. 	<p>Diverse population of students who are well-prepared for:</p> <ul style="list-style-type: none"> • A range of career options and potential changes in career paths. • Work in areas of national need. • National leadership in STEM in the private and public sectors.
Career Impact	<p>Metrics will include information concerning:</p> <ul style="list-style-type: none"> • Career trajectories. • Range of career paths; productivity appropriate for careers. • Leadership roles in public and private sectors. 	<p>Diverse workforce that makes significant contributions through graduates who:</p> <ul style="list-style-type: none"> • Succeed in a range of careers. • Conduct research at the frontiers of STEM. • Develop innovations of high impact. • Provide national leadership in the public and private sectors.