A Perspective on Graduate Education from the National Science Foundation

Revitalizing Graduate STEM Education for the 21st Century
Board on Higher Education and Workforce
First Committee Meeting
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10 Big Ideas for Future NSF Investments

**RESEARCH IDEAS**

- **Navigating the New Arctic**
  Improve Arctic observational tools to document rapid changes on multiple scales.

- **Harnesing Data for 21st Century Science and Engineering**
  Generate a world-wide data-enabled future for the U.S. through fundamental research and education in data science.

- **Work at the Human-Technology Frontier: Shaping the Future**
  Develop "smart" technologies and environments to enhance the human experience; assess their impact on human behavior and social systems.

- **Understanding the Rules of Life: Predicting Phenotype**
  Bridge the biggest gap in biological science by determining how the environment influences an organism's unique characteristics.

- **The Quantum Leap: Leading the Next Quantum Revolution**
  Develop ways to access and manipulate the behavior of matter and energy at very small scales to make the next generation technology more accurate and efficient.

- **Windows on the Universe: The Era of Multi-messenger Astrophysics**
  Extend our understanding of the cosmos by building on NSF's unique observational assets.

**PROCESS IDEAS**

- **Growing Convergent Research at NSF**
  Use ideas and technologies from widely diverse fields to bring about solutions to societal problems and profound questions.

- **NSF-Includes: Enhancing Science and Engineering through Diversity**
  Tap the innovation inherent in America's diversity to strengthen the U.S. science and engineering enterprise.

- **Mid-scale Research Infrastructure**
  Develop a nimble process to fund crucial scientific infrastructure projects that fall between traditional funding boundaries.

- **NSF 2050**
  Bold, forward-thinking research that transcends traditional approaches and pushes the frontiers of exploration.
Trends in U.S. Graduate Education

- Greater interdisciplinary and team focus
- Dynamic pathways and careers - students more readily move across fields, institutions, sectors of the economy, and countries
- Greater racial/ethnic diversity, higher proportion of female students
- An increase in international students

These trends are important to understand to reach an important NSF’s strategic objective: *Integrating education and research to produce a diverse STEM workforce with cutting-edge capabilities*. 
Key Recommendation: *Offer a Broader Range of Academic Options*

- To produce more versatile scientists and engineers, graduate programs should provide options that allow students to gain a wider variety of skills.

- To foster versatility, government and other agents of financial assistance for graduate students should adjust their support mechanisms to include new education/training grants to institutions and departments.  

*NAS 1995*
Goals for NSF Investments in Graduate Education

Strategic Framework for Investments in Graduate Education (FY2016-FY2020)

- **Advance Science and Engineering (S&E) Research:** Support graduate students and graduate education to enable long-term contributions of new knowledge at the frontiers of science and engineering.

- **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.

- **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.
Considerations for the Committee

- How can research about learning and about the nature and practice of science help to inform the design of graduate experiences in STEM?

- What is the current state of practice, and what innovations are in place in U.S. graduate education in STEM? What is their impact?

- How can we learn and disseminate to the appropriate constituents what we have learned from large-scale national training experiments such as NSF NRT, PSM, and NIH BEST programs, or initiatives such as NSF INCLUDES?
Scientific Drivers for Graduate Training

The grand challenges of today -- protecting human health; understanding the food, energy, water nexus; exploring the universe at all scales -- will not be solved by one discipline alone. They require convergence: the merging of ideas, approaches and technologies from widely diverse fields of knowledge to stimulate innovation and discovery.