



NATIONAL SCIENCE FOUNDATION
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NSF 18-084

Dear Colleague Letter: STEM Education for the Future

June 11, 2018

Dear Colleagues:

NSF invites proposals to solve educational challenges created by the technology revolution. To effectively respond to many of the problems facing our nation, new scientific advances are needed, as defined in the [Big Ideas for Future NSF Investments](#). Achieving these advances will require changes in what people learn and how they learn it. Through this STEM Education for the Future Dear Colleague Letter (DCL), existing NSF education and workforce development programs encourage innovative proposals to prepare scientists and engineers for work in new contexts created by technology and big data.

Specifically, through this DCL, NSF aims to support STEM educational research and development projects whose results can enable our country to: better prepare its scientific and technical workforce for the future; use technological innovations effectively for education; advance the frontiers of science; and adapt to both new work environments and new education pathways needed to prepare students at all levels for those environments.

Technology, Computation, and Big Data are driving changes to daily life. Computing, sensing, data storage, data access, communication, and hardware technologies continue to change our lives and work. These technologies produce unprecedented volumes of data and vast interconnectivity capabilities, such as data provided by ubiquitous sensing and the Internet of Things. Personal, behavioral, transactional, and environmental data in a myriad of formats (numerical, image, audio, and others) are available at ever greater speeds, propelling innovations such as artificial intelligence-aided automation. Such automation in the home, office, and classroom also challenges long-standing expectations about privacy, security, and the veracity of the underlying data

Although it is expected that technology, computation, and big data will have positive impacts on the human condition, the world still faces persistent societal, cultural, and economic challenges, e.g., hunger, poverty, our dynamic Earth, and energy security. Moreover, we must continue work to ensure equitable access to precisely those technologies that give rise

to these changes. Equally important is the challenge of ensuring equitable access to high quality education, which leads directly to questions important to the NSF: How do these new technologies change the way we learn and do science, math, and engineering? How do we navigate such change? How do we use technological innovations to ensure full participation of all groups in the STEM workforce?

To answer these questions related to learning, researchers will need to cross disciplines, define the potential impact of technologies, and develop new technical competencies. Furthermore, all scientific and technical workers will need new knowledge and skills so they can perform new tasks or perform current tasks with new tools.

This DCL seeks proposals related to harnessing the data revolution and the future of work at the human-technology frontier. This DCL encourages educational research and development proposals that are original, creative, and transformative, and that can help the nation educate the STEM workforce of the future, in contexts of:

- [The Future of Work at the Human-Technology Frontier: Shaping the Future \[FW-HTF\]](#)
- [Harnessing the Data Revolution for 21st Century Science and Engineering \[HDR\]](#)

All proposals responding to this DCL should address education issues related to FW-HTF, HDR, or to both. Proposals can also include activities that are relevant to other NSF Big Ideas.

This DCL will support three categories of proposals:

1. **Proposals focused on educational transformation:** These proposals will leverage technology, computation and/or big data to develop, implement, and analyze educational interventions designed to prepare a diverse workforce, researchers, and innovators of the future. Proposals that explore how students learn to integrate knowledge across disciplines to solve complex problems fall into this category.
2. **Proposals focused on the science of teaching and learning:** These proposals will leverage technology, computation and/or big data to develop, implement, and analyze new tools for assessing and evaluating convergent education strategies that aim to promote student learning at all levels.
3. **Planning grants, Research Coordination Networks, Conference Proposals:** These proposals will create communities of STEM educators to address convergent curriculum and pedagogical challenges across disciplinary boundaries brought about by the human-technology frontier, the data revolution, or both.

This DCL emphasizes proposals that cross departmental and disciplinary boundaries. This DCL encourages original proposals for curricular innovations that cross boundaries, so that students gain the tools and knowledge needed to thrive in the technology revolution and become the creators/innovators of the future.

This DCL encourages proposals that reflect a coordinated effort from interdisciplinary research teams of at least two PIs from different disciplines. Such teams can make learning a convergence experience and accomplish learning goals that are not otherwise achievable. Examples include, but are not limited to: computational skills in an application area such as genetics; automation and sensing in natural and manufactured environments; calculus, modeling and simulation of physical contexts and objects; art, psychology, conceptual design and mechanical design for better product development; or sociology and earth sciences to address adaptation to our environment. Proposals that use convergence approaches to instill the development of needed non-technical abilities for the 21st century are also appropriate, including ones that focus on development of teamwork, higher level thinking, problem solving, creativity, adaptability, and the ability to communicate across disciplinary boundaries.

In summary, competitive proposals will propose an approach that reflects convergence in education and human resource development, using technology and data beyond disciplinary boundaries to create student outcomes that will benefit society.

Responding to the STEM Education for the Future DCL

Proposals responding to this DCL should be submitted by the due date of the applicable funding opportunities listed below.

To determine whether a research topic is within the scope of this DCL, principal investigators are strongly encouraged to contact the cognizant NSF Program Officer(s) of the participating program(s) to which they plan to submit their proposal. These programs include:

Program	Program Link and Solicitation	Due dates
EHR Accelerating Discovery: Educating the Future STEM Workforce (AD)	AD (PD 18-1998)	April 2, 2018 - January 16, 2019
DUE Improving Undergraduate STEM Education: Education and Human Resources [i]	IUSE: EHR (NSF 17-590)	Accepted anytime (Exploration and Development Tier) Dec 11, 2018 (Development and Implementation Tier)
DUE Advanced Technological Education [ii]	ATE (NSF 17-568)	October 4, 2018
DGE Innovations in Graduate Education [iii]	IGE (NSF 17-585)	September 27, 2018
HRD Historically Black		

Colleges and Universities - Undergraduate Program ^[iv]	HBCU-UP (NSF 18-522)	See solicitation
HRD Tribal Colleges and Universities Program ^[v]	TCUP (NSF 16-531)	See solicitation
HRD/DUE Improving Undergraduate STEM Education: Hispanic-Serving Institutions (HSI Program) ^[vi]	HSI	See program page
DRL Innovative Technology Experiences for Students and Teachers ^[vii]	ITEST (NSF 17-565)	August 8, 2018
DRL Advancing Informal STEM Learning ^[viii]	AI SL (NSF 17-573)	November 7, 2018
BIO/EHR Research Coordination Networks in Undergraduate Biology Education ^[ix]	RCN-UBE (NSF 18-510)	January 22, 2019
EEC Research in the Formation of Engineers ^[x]	RFE (NSF 17-514)	February 28, 2019
GEO Ocean Education Program ^[xi]	OCE	Contact Elizabeth Rom, elrom@nsf.gov
GEO Polar Special Initiatives Program ^[xii]	OPP	Contact Elizabeth Rom, elrom@nsf.gov

To ensure proper consideration, principal investigators must indicate the relevant Big Idea(s) in the title, the overview statement of the Project Summary, and the Project Description. For example, the title of a proposal about the Future of Work at the Human Technology Frontier and Rules of Life should begin with "FW-HTF/RoL" and a proposal addressing educational challenges relevant to Harnessing the Data Revolution should precede its title with "HDR." Table 1 lists the NSF Big Ideas and designated acronyms. In summary, proposals responding to this DCL:

- a. Should focus on education and/or workforce development in the context of the Future of

- Work at the Human-Technology Frontier, Harnessing the Data Revolution, or both.
- b. May intersect with additional Big Ideas for Future NSF Investment.
 - c. Should include PIs from different disciplines.
 - d. Must be submitted to one of the programs listed in this DCL.
 - e. Must comply with the relevant program/solicitation-specific requirements.
 - f. Must present novel ideas or approaches (high risk/high reward proposals are encouraged).
 - g. Must have titles that adhere to the naming convention noted above.

Table 1. NSF's Six Research Big Ideas for Future NSF Investment

The Future of Work at the Human-Technology Frontier	FW-HTF
Harnessing the Data Revolution	HDR
Understanding the Rules of Life: Predicting Phenotype	RoL
Navigating the New Arctic	NNA
Windows on the Universe: The Era of Multi-Messenger Astrophysics	MMA
The Quantum Leap: Leading the Next Quantum Revolution	QL

Sincerely,

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[i]The IUSE: EHR program supports projects that have the potential to improve student learning in STEM through development of new curricular materials and methods of instruction, and development of new assessment tools to measure student learning in science and engineering classrooms.

[ii]The Advanced Technological Education (ATE) program focuses on the education of technicians for the high-technology fields that drive our nation's economy. The program involves partnerships between academic institutions and industry to promote improvement in the education of science and engineering technicians at the undergraduate and secondary school levels. The ATE program supports curriculum development; professional development of college faculty and secondary school teachers; career pathways; and other activities.

[iii]The IGE program is designed to encourage the development and implementation of bold, new, and potentially transformative approaches to STEM graduate education and training. IGE projects pilot, test, and validate novel approaches and generate the knowledge required to add to our understanding of graduate student learning, thereby allowing others to adapt/adopt successful, evidence-based approaches.

[iv]HBCU-UP is committed to enhancing the quality of undergraduate STEM education and research at Historically Black Colleges and Universities (HBCUs) as a means to broaden participation in the nation's STEM workforce. The HRD HBCU-UP tracks realize this purpose by providing awards to develop, implement, and study innovative approaches for making dramatic improvements in the preparation and success of HBCU undergraduate students so that they may participate successfully in graduate programs and/or careers in science, technology, engineering, and mathematics (STEM) disciplines.

[v]The Tribal Colleges and Universities Program (TCUP) provides awards to Tribal Colleges and Universities, Alaska Native-serving institutions, and Native Hawaiian-serving institutions to promote high quality science (including sociology, psychology, anthropology, economics, statistics, and other social and behavioral sciences as well as natural sciences and education disciplines), technology, engineering, and mathematics (STEM) education, research, and outreach. Support is available to TCUP-eligible institutions.

[vi]The HSI Program seeks to enhance the quality of undergraduate STEM education at HSIs and to increase retention and graduation rates of undergraduate students pursuing degrees in STEM fields at HSIs. In addition, the HSI Program seeks to build capacity at HSIs that typically do not receive high levels of NSF grant funding.

[vii]I TEST is a research and development program that supports projects to promote PreK-12 student interests and capacities to participate in the STEM and information and communications technology (ICT) workforce of the future

[viii]The AISL program seeks to advance new approaches to and evidence-based understanding of the design and development of STEM learning opportunities for the public in informal environments; provide multiple pathways for broadening access to and engagement in STEM learning experiences; advance innovative research on and assessment of STEM learning in informal environments; and engage the public of all ages in learning STEM in informal environments.

[ix]The goal of the RCN program is to advance a field or create new directions in research or education by supporting groups of investigators to communicate and coordinate their research, training, and educational activities across disciplinary, organizational, geographic, and international boundaries. The RCN-UBE program originated as a unique RCN track to "catalyze positive changes in biology undergraduate education" (NSF 08-035) and is now supported by the collaborative efforts of the Directorate for Biological Sciences (BIO) and the Directorate for Education and Human Resources (EHR). It has been responsive to the national movement to revolutionize undergraduate learning and teaching in the biological sciences. RCN-UBE accepts workshop proposals, incubator proposals, and full RCN proposals in undergraduate biology education.

[x]The RFE program advances research about the underlying processes and mechanisms involved in the formation of engineers by deepening our fundamental understanding of how professional formation is or can be accomplished.

[xi]The OCE Education program supports efforts to integrate ocean research and education. In particular, the program is interested in receiving proposals related to the Ocean

Observatories Initiative (OOI).

[xii]Polar Special Initiatives Program welcomes proposals related to the training of students with "Big Data" tools focusing on polar regions' satellite imagery, digital elevation maps, "3D virtual" ice sheets dynamics and/or proposals related to Navigating the New Arctic.