NSF Dear Colleague Letter 21-033: Advancing Quantum Education and Workforce Development

Webinar #3
August 27, 2021
Outline

- NSF Approach to QISE (by Dr. Tomasz Durakiewicz)
- Advancing Informal STEM Learning (AISL) (by Dr. Julie Johnson)
- CyberCorps Scholarship for Service (SFS) and Secure and Trustworthy Cyberspace Program (SaTC-EDU) (by Dr. Victor Piotrowski)
- Graduate Research Fellowship Program (GRFP) (by Dr. Christopher Hill)
- Innovations in Graduate Education (IGE) (by Dr. Daniel Denecke)
- Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES) (by Dr. Tori Smith)
- Research on Emerging Technologies for Teaching and Learning (RETTL) (by Dr. Amy Baylor)
- Q & A
Quantum Leap: Asking Ambitious Questions

Q1: Are there fundamental limits to how far we can push the entanglement and coherence frontiers for quantum states? Are there limits in time, distance, or scale?

Q2: What can we learn from quantum phenomena in naturally-occurring and engineered quantum systems, including emergent behavior, complexity, quantum-classical boundaries, and their theoretical foundations?

Q3: How do we galvanize the science and engineering community to enable quantum devices, systems, and technologies that surpass classical capabilities?
Our Approach

The 3 C’s

Convergence

Community

Collaboration

Mathematicians & Computer Scientists

Materials Researchers & Chemists

Physicists

Engineers

Quantum Workforce

$C_1 |\text{Materials Researchers & Chemists}\rangle + C_2 |\text{Engineers}\rangle$

$+ C_3 |\text{Physicists}\rangle + C_4 |\text{Mathematicians & Computer Scientists}\rangle$

Electrical, Communications and Cyber Systems

Industrial Innovation & Partnerships

Education and Workforce

Information and Intelligent Systems

Computing and Communication Foundations

Computer and Networked Systems

Advanced Cyberinfrastructure

Materials

Astronomy

Mathematics

Physics

NIST

National Institute of Standards and Technology

U.S. Department of Commerce

Google

IBM

JST

Gordon and Betty Moore Foundation

European Commission

Canadian Institutes of Health Research

NSF

National Science Foundation

MOORE CENTER

Research Program in Quantum Computing
Creating a quantum-smart workforce for tomorrow

**Building Quantum Intuition:** Quantum intuition is the ability to intuitively differentiate between quantum and classical worlds at the very basic level. **LOWERING THE BARRIERS**

**Industry - academia partnerships:** recognize required skills and nature of the content specific training that is needed for a diverse workforce. **EFFICIENCY**

**Enhancing curricula in all levels of education:** early and continued engagement in STEM fields, particularly for underrepresented groups in STEM such as underrepresented minorities and women, is a key factor in retaining and mitigating attrition as students advance to higher grade levels. **INCLUSION AS OPPORTUNITY**

**Interdisciplinary programs:** mathematical algorithms need to be devised, circuit implementations need to be designed, device function needs to be well understood, devices need to be implemented in functional materials, the local environment needs to be controlled, and structural materials are needed to hold everything together. **CONVERGENCE**

**Estimating and tracking future workforce needs:** continuing assessment of specific requirements for workforce is vital, especially in a rapidly evolving landscape of workforce needs. **ASSESSMENT**

**Government Programs to enhance QIS-ready workforce:** supportive of workforce generation goals, with focused efforts undertaken in collaborative mode. **LEVERAGE**

Funding Opportunities for K-12 Education
- **Computer Science for All (CSforAll: Research and RPPs)** $20M
- **Discovery Research PreK-12 (DRK-12)** $64M
- **Innovative Technology Experiences for Students and Teachers (ITEST)** $30M
- **Robert Noyce Teacher Scholarship Program (NOYCE)** $58M

Funding Opportunities for Undergraduate Programs
- **Advanced Technological Education Program (ATE)** $66M
- **Hispanic Serving Institutions Program (HSI)** $11M
- **Historically Black Colleges and Universities - Undergraduate Program (HBCU-UP)** $55M
- **Improving Undergraduate STEM Education Program (IUSE)** $63M
- **Scholarships in STEM Program (S-STEM)** $95M
- **The Louis Stokes Alliances for Minority Participation (LSAMP)** $10M
- **The Centers of Research Excellence in Science and Technology (CREST)** $20M
- **Tribal Colleges and Universities Program (TCUP)** $12M

Funding Opportunities for Graduate Programs
- **Alliances for Graduate Education and the Professoriate (AGEP) program** $8M
- **Innovations in Graduate Education (IGE) Program** $4M
- **NSF Research Traineeship (NRT) Program** $55M

Funding Opportunities for All Educational Levels
- **Advancing Informal STEM Learning (AISL)** $39M
- **EHR Core Research (ECR)** $35M
- **NSF INCLUDES** $20M
- **Research on Emerging Technologies for Teaching and Learning (RETTL)** $19M
- **Secure and Trustworthy Cyberspace (SaTC)** $69M

Dear Colleague Letter: Advancing Quantum Education and Workforce Development, NSF 21-033
The Advancing Informal STEM Learning (AISL) Program
Julie I. Johnson, Ph.D.
Program Officer, Division of Research on Learning
The Landscape for Informal STEM Learning
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.

Current Solicitation: NSF 21-599
Submission deadline: January 18, 2022
All proposals must be submitted using Research.gov or Grants.gov

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504793
AISL Program

❖ **Advancing** – Innovative projects that advance the field through building knowledge via innovative approaches and research.

❖ **Informal** – Learning that is lifelong, life wide, & life deep. Learning that occurs outside formal schooling systems.

❖ **STEM** – Not just focused on science; includes all disciplines funded across NSF.

❖ **Learning** – Learning outcomes typically include: interest, engagement, motivation, behavior, identity, persistence, understanding, awareness, knowledge, use of STEM content and practices, and 21st century skills.
AISL Program - Options

**Project Types**
- Pilot/Feasibility Studies
- Research in Service to Practice
- Innovations in Development
- Broad Implementation
- Literature Reviews, Syntheses, or Meta-analyses
- Conference

**Funding Levels**
- Up to $300,000
- $300,000 - $2M
- $500,000 - $3M
- $1M - $3M
- Up to $250,000
Examples from the AISL Program

Project goals: (1) to make 21st century quantum science comprehensible and engaging to non-expert adult learners and (2) to increase our knowledge about the public's perception and understanding of quantum physics.  https://quantumatlas.umd.edu/

➢ 2115780/5843, Building Quantum Information Science Intuition through Digital Games
Project goal: to create a suite of accessible, engaging digital games for middle schoolers, and study their effectiveness in cultivating intuition around quantum information science.
CyberCorps® Scholarship For Service (SFS)

Dr. Victor Piotrowski, Lead Program Director
National Science Foundation
Secure and Trustworthy Cyberspace (SaTC)

NSF 21-500 – No deadline, submit anytime

- Welcomes proposals that address cybersecurity and privacy and draw on expertise in one or more of these areas: computing, communication and information sciences; engineering; education; mathematics; statistics; and social, behavioral, and economic sciences.

- Proposals must be submitted to one of the following designations:
  - **CORE**: This designation is the main focus of the SaTC research program, spanning the interests of NSF's Directorates for Computer and Information Science and Engineering (CISE), Engineering (ENG), Mathematical and Physical Sciences (MPS), and Social, Behavioral and Economic Sciences (SBE).
  - **EDU**: The Education (EDU) designation will be used to label proposals focusing entirely on cybersecurity education.
  - **TTP**: The Transition to Practice (TTP) designation will be used to label proposals that are focused exclusively on transitioning existing research results to practice.
NSF Secure and Trustworthy Cyberspace (SaTC) -- Education Designation

NSF 21-500 (No Deadline)

- Increase the capacity of US education enterprise to produce professionals in cybersecurity including:
  - Evaluate effectiveness of curricula, competition, games, and other outreach activities
  - Integrate research experiences into cybersecurity degree programs.
  - Develop effective evidence-based curricular and co-curricular activities at K-12, undergraduate and graduate levels
- More than 100 active awards with a total budget of $31M
SaTC-EDU and Industries of the Future

- Develop educational approaches to foster industry-relevant skills for cybersecurity jobs of the future.
- **FY2021**: Building educational capacity and curricular recommendations for AI in Cybersecurity and Cybersecurity and Privacy of AI.

“The Industries of the Future are cross-cutting, convergent, and interdependent fields of research that collectively offer enormous economic potential and are critical to the Nation’s long-term economic and national security.” *NSF Director France Córdova*
Cybersecurity Education in the Age of AI

- NSF Dear Colleague Letter (DCL) NSF 20-072 jointly published by Education (EHR) and Computing (CISE) Directorates
  - the interplay between AI, machine learning, and cybersecurity

- partnerships between AI researchers, cybersecurity researchers, and education researchers in order to inspire novel education and outreach efforts

- workforce with integrated AI and cybersecurity competencies

- informed public that understands the privacy, confidentiality, ethics, safety, and security implications of AI.

- 34 EAGER projects funded by EHR and CISE from 2020-2021
CyberCorps®: Scholarship for Service (SFS) Program
NSF 21-580 – Deadline: July 15, 2022

- Aligns with U.S. strategy to develop a superior cybersecurity workforce.
- Grant awards to institutions of higher education to provide scholarships to undergraduate and graduate students pursuing cybersecurity.
- After graduation, scholarship recipients are required to work for a federal, state, local, or tribal government organization in a cybersecurity-related position for a period equal to the length of their scholarship.
- More than 150 active awards with a total budget of $281M
CyberCorps®: Scholarship for Service (SFS) Program

SUPPORT

• Funding: full tuition plus stipends $25K/$34K and professional development $6K per year, up to 3 years

• Obligation: Summer internship and post-graduation service requirement (work in a government agency for a period equal to the scholarship length)

IMPACT

• 4,040 SFS scholarship recipients (since 2001)

• Placed in 357 government organizations

• B.S. (35%), M.S. (62%), Ph.D. (3%)

• Female (25%), data collection since 2013

• Placement rate 95%
Graduate Research Fellowship Program (GRFP)

Education and Human Resources (EHR)
Division of Graduate Education (DGE)

Presenters
Narcrisha Norman, Ph.D., Program Director
Christopher L. Hill, Ph.D., Program Director

www.nsf.gov/grfp
info@nsfgrfp.org
www.nsfgrfp.org
About NSF GRFP

60,000+ GRFPs Awarded

40+ Fellows have gone on to become Nobel Laureates

Fellow from/in every state

450+ Fellows have become members of The National Academy of Sciences

$34,000 Annual Stipend

$12,000 Cost of Education Allowance

5-Year Fellowship Period

3 Years Financial Support

2020 Competition

12,000+ Applicants

2,000+ Offers

500+ Academic Institutions Represented

2020 Competition

Submit Early

Open to:

Graduate students who are or will be pursuing research-based master's and doctoral degrees in eligible fields of study

nsfgrfp.org

Decision Tree

Format Compliance Check

Eligible Major Fields of Study

Chemistry

Computer and Information Sciences & Engineering

Engineering

Geosciences

Life Sciences

Materials Research

Mathematical Sciences

Physics & Astronomy

Psychology

Social Sciences

STEM Education & Learning Research

Major fields have sub-fields
GRFP

Application Components

Personal profile, education, and work experience
Graduate research plan (2 pages)
Personal, relevant background and future goals statement (3 pages)
Transcripts
Two to three letters of reference
The NSF GRFP recognizes and supports outstanding graduate students in NSF-supported STEM disciplines who are pursuing research-based master’s and doctoral degrees at accredited US institutions. The five-year fellowship includes three years of financial support including an annual stipend of $34,000 and a cost of education allowance of $12,000 to the institution.

**Benefits**

- Undergrad seniors or baccalaureates never in graduate program
- 1st year graduate or currently enrolled BS/MS and completed 3 years
- 2nd year graduate students (< one academic year completed in first graduate degree program)
- 1st year doctoral students directly from BS/MS
- Returning graduate students with > 2-year interruption

**Applicants**

GRFP welcomes applications from individuals who are pursuing full-time research-based master’s and doctoral degrees in science, technology, engineering, and mathematics (STEM) or in STEM Education and who meet the eligibility requirements.

- U.S. citizens, nationals, or permanent residents
- Early-career: undergrad & grad students
- Pursuing research-based master’s and/or doctoral degrees
- STEM or STEM Education
- Full-time enrollment in graduate degree program at accredited, non-profit US institution of higher education
- NO foreign institutions
Reference Writers

Reference letters are a key component of a strong application package. The most effective reference letters provide detailed and specific information about how an applicant meets the NSF Merit Review Criteria of Intellectual Merit and Broader Impacts.

The reference letter should include comments on the applicant’s potential for contributing to a globally-engaged United States science and engineering workforce, statements about the applicant’s academic potential and prior research experiences, statements about the applicant’s proposed research, and any other information to enable reviewers to evaluate the application according to the NSF Merit Review Criteria.

Once the applicant completes the appropriate section of their GRFP application, reference writers will receive an email detailing the requirements for the letter and the process of submission. All reference letters must be submitted online via the GRFP Module and received by the deadline for the current competition.

Can say things about the applicant they may not necessarily say about themselves

https://www.nsfgrfp.org/reference_writers

Reviewers

NSF welcomes scientists and engineers to evaluate the current competition’s applications each year during the annual GRFP review process. Serving as a GRFP Reviewer is an excellent opportunity to apply your research and career expertise to help identify future science and engineering leaders, and to gain valuable perspective to share with faculty and students at your institution.

GRFP recognizes and supports outstanding graduate students pursuing research-based masters and doctoral degrees in science or engineering at accredited US institutions. See the GRF Program Solicitation for more details on GRFP. NSF seeks GRFP panels composed of researchers and educators from a wide range of institutions, geographic locations, and disciplinary and interdisciplinary backgrounds.

https://www.nsfgrfp.org/reviewers
Graduate Research Fellowship Program (GRFP)

Division of Graduate Education

www.nsf.gov/grfp
info@nsfgrfp.org
www.nsfgrfp.org
NSF Innovations in Graduate Education (IGE) Program

Program Solicitation, NSF 20-595

• IGE Project Awards:
  • 6 to 10 awards anticipated in FY 2022 expected to be up to three (3) years in duration with a total budget between $300,000 and $500,000.

• Proposals due: March 25, 2022
  March 25, Annually Thereafter

IGE Program Directors
Daniel Denecke
ddenecke@nsf.gov
Vinod Lohani
vlohani@nsf.gov
NSF Innovations in Graduate Education (IGE) Program

Program Goals

• Pilot, test and validate innovative approaches to graduate education

• Generate knowledge required to customize, implement and encourage broader adoption of these approaches
Strategic Framework for NSF Investments in Graduate Education

- Advance Science and Engineering (S&E) Research

- Broaden Participation to Promote Excellence in Research and Build the Next Generation STEM Workforce

- Build Effective Models of Graduate Education and Workforce Development
IGE Projects Research Topics

- Broadening Participation: 14%
- Professional Development: 76%
- Industry Partnership: 4%
- Time to Degree Completion: 2%
- Gender Bias: 4%
Will generate knowledge about effective approaches to support participation of neurodiverse students in graduate education through:
• A Strength Profile Reporting instrument in which neurodiverse graduate students identify their strengths and challenges.
• A peer connection system and public Reddit platform
• Writing support for students
• Workshops with industry leaders

Research:
• Data from an integrated research plan and evaluation will generate knowledge for scale-up and inform future enhancements of STEM graduate education.
• Research on the efficacy of evidence-based interventions inspired by the framework of positive psychology will inform development of an inclusive graduate education environment.

Example Project: University of Connecticut, “Encouraging the Participation of Neurodiverse Students in STEM Graduate Programs to Radically Enhance the Creativity of the Professional Workforce”
Inclusion Across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science
NSF INCLUDES
Five Design Elements of Collaborative Infrastructure

- Engage the community in a shared vision
- Provide a platform for collaborative action
- Allow for evidence-based decision making
- Build capacity for leadership and communication
- Generate more partnerships, more connections, greater impact
Welcome to the NSF INCLUDES Alliances

Diverse STEM faculty; Inclusive STEM teaching

Hispanic representation in computing

STEM success for rural, first-generation college students

Graduate students in the physical sciences

Accelerated math for community college students

Engagement in coastal geoscience in Island communities

STEM education for the incarcerated and formerly incarcerated

Equity in college admissions

AIICE

Identity-inclusive strategies in computing

ALRISE

Latinx representation in STEM; institutional intentionality; experiential learning

ENGINEERING PLUS

Underrepresented students in engineering

NATIVE FEWS

Indigenous participation in STEM; Food-Energy-Water Systems

TAPDINTO-STEM

Students with disabilities
The NSF INCLUDES Coordination Hub leads, supports, and amplifies the NSF INCLUDES National Network, which aims to accelerate progress towards diversifying the U.S. STEM workforce.
ALLIANCES

Solicitation NSF 20-569

Employing a collaborative infrastructure approach to address a critical broadening participation challenge in STEM at scale.

Letter of Intent Deadlines
October 5, 2020
October 4, 2021

Full Proposal Deadlines
January 26, 2021
January 25, 2022

Letters of Intent and Full Proposals are due by 5 p.m. submitter's local time. A letter of intent is required for all proposal submissions and must be submitted via FastLane by the due dates listed on the solicitation.
THANK YOU

For more information...

www.INCLUDESNetwork.org

NSF INCLUDES Alliances Solicitation Webpage

NSF INCLUDES Special Report to the Nation II

NSFINCLUDES@nsf.gov
NSF 20-612 Research on Emerging Technologies for Teaching and Learning (RETTL)

Amy Baylor, EHR Lead
Overall Scope of RETTL

- *The program funds research in advanced learning technologies in any content area with any participants and in any context
  - RETTL maintains the same spirit of the former Cyberlearning program
  - Includes a focus on Teaching

- *A key requirement is that projects should be exploratory, experimental; those that are risky and potentially transformative are highly encouraged

- Projects should be highly interdisciplinary with team expertise in learning and computer science/engineering
  - RETTL is a cross-directorate program (EHR, CISE, SBE, ENG)

- Projects that advance broadening participation are encouraged
Projects must have research innovations in both teaching/learning and technology.

- Projects should have clear research objectives that integrate teaching/learning and technology.
- RETTL is unique to other NSF programs regarding the requirement for research advances in both areas.

Teaching and/or learning innovation

- For teaching, this includes new teaching processes and approaches (e.g., andragogy and pedagogy), as integrated with the proposed technology in an educational setting.
- For learning, this includes new learning processes, principles, and theories (e.g., cognitive, behavioral, affective, socio-cultural, social, epistemological, problem-based, project-based, developmental, and other perspectives) relevant for how the proposed technology will be situated in a learning setting, to include home, school, or workplace.

Technology innovation

- This includes new and emerging technologies within the teaching and learning context (e.g., AI-driven technologies; virtual, immersive, embodied, interactive, or augmented environments; multimodal modeling/sensing of cognitive or affective states; language and speech processing; learning analytics and dashboards; and robotics).
- The technology innovation should advance fields involving computer science, information science, and/or engineering.
See NSF RETTL Program Page for FAQs
https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504984
Questions and Discussion