National Science Foundation Support of Maker R&D

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Why does the National Science Foundation invest in STEM education?

Basic scientific research is scientific capital…How do we increase this scientific capital? First, we must have plenty of men and women trained in science, for upon them depends both the creation of new knowledge and its application to practical purposes.

Vannevar Bush

Science: The Endless Frontier

The Directorate for Education and Human Resources:

Building the STEM workforce of tomorrow and a STEM literate public by improving STEM learning.

NSF Support of Maker Projects

NSF Makes Several Types of Investments:

1. Research that supports the development of maker technologies

2. Maker education in informal and formal educational settings

3. Support of research on the educational impact of maker education

4. Support of marketing & entrepreneurial projects related to making

1. NSF Research Support for 3-D printing and custom manufacturing

- Early/continuing funding for additive manufacturing, totaling approximately $200 million from more than 600 grants awarded from 1986-2012

- Example: Engineering Directorate's (SBIR) grants to two key early firms in additive manufacturing field to develop the selective laser sintering process (high powered laser is used to fuse small particles into precise 3-D shapes)

- Example: Helisys to commercialize the sheet lamination process (sheets glued together and cut to shape with knife or laser cutter)

2. NSF Support of Maker Education

- Active tinkering can engage people of all ages in learning science, technology, engineering and mathematics (STEM). Tinkering Studio at the San Francisco Exploratorium http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=131761
- Makerspace at Massachusetts high school lets diverse students design new technologies http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=135609
- From Problem to Product (I2) takes high school students through the entire process of inventing a device, software or other technology http://www.nsf.gov/awardsearch/showAward?AWD_ID=1311981

3. NSF-supported research on the Educational Impact of Making

- A Stanford University project is researching what learning happens after tinkerers leave the Exploratorium tinkering space.
- A Northwestern University project is investigating how reflective interactions between parents and children (ages 6-8) during making/ tinkering activities ultimately impact child engagement in STEM.
- A Georgia Tech project is research the incorporation of Maker activities into upper-level computer science courses to see how maker activities will improve knowledge transfer & interdisciplinary work.

4. NSF Support of Marketing & Entrepreneurial Projects: I-Corps

- The NSF Innovation Corps (I-Corps™) prepares scientists and engineers to extend their focus to the commercial world for research results that show immediate potential.
- I-Corps is a public-private partnership program that teaches grantees to identify valuable product opportunities that can emerge from academic research, and offers entrepreneurship training to student participants.
- The curriculum is administered via online instruction and on-site activities through one of several I-Corps nodes.
- https://www.nsf.gov/news/special_reports/i-corps/

5. NSF Support of Marketing & Entrepreneurial Projects: SBIR

- NSF's SBIR program provides funds for early-stage research and development (R&D) at small businesses.
- NSF encourages proposals from a diversity of entrepreneurs -- new and seasoned – to commercialize a transformative idea or innovation.
- How to apply: https://seedfund.nsf.gov/apply/

Directorate for Education and Human Resources (EHR)

Division for Research on Learning in Formal and Informal Settings (DRL)

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- Innovative Technology Experiences for Teachers & Students (ITEST)
- Advancing Informal STEM Learning (AISL)
- Discovery Research PreK-12 (DR PreK-12)

Innovative Technology Experiences for Students and Teachers (ITEST)

ITEST Program Overview

- ITEST promotes PreK-12 student interest and involvement in STEM and related careers
- ITEST supports innovative strategies that:
  - Increase student awareness of STEM and ICT careers.
  - Motivate students to pursue the education necessary to participate in those careers.
  - Provide students with technology-rich experiences that develop their knowledge of related content and skills needed for entering the STEM workforce.
  - Broaden participation

ITEST Solicitation (15-599)

- Three project types: Exploratory, Strategies and SPREAD
- Funded through H1-B Work Visa Revenue
- Additional Solicitation Specific Criteria related to broadening participation for all ITEST proposals.
- **Proposal Deadline: August 8, 2018**
- Solicitation Link: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5467
- Resource Center: STELAR, www.stelar.edc.org

Anticipated ITEST Program Funding Amount: $20,000,000

ITEST Per Project Funding Amount: up to $2,000,000

Advancing Informal STEM Learning (AISL)

Photo Source: Pacific Science Center & CENTC, ISE/AISL Supplement

AISL Program Overview

- **Advances new *approaches to and understanding of* the design and development of STEM learning in informal environments for public and professional audiences.**
- **Investments should be of interest and utility to public audiences, informal STEM practitioners, and decision-makers.**
- **Priorities: knowledge-building, innovation, strategic impact, and collaboration.**

Anticipated ASL Program Funding Amount: $33,000,000 to $44,000,000

Estimated AISL Per Project Funding Amount: $50,000 - $3,000,000

AISL Solicitation

- **Supports Several Project Types: from early stage R& D to broad implementation; also conferences, workshops & research syntheses**
- **Additional Solicitation Specific Criteria for projects that include a goal of broadening participation.**
- **Proposal Deadline: Nov. 7, 2018**
- **Resource Center: Center for Advancement of Informal Science Education (CAISE), www.informalscience.org**
- **AISL Solicitation: https://www.nsf.gov/pubs/2017/nsf17573/nsf17573.htm**

Discovery Research PreK-12 (DRK-12)

Discovery Research PreK-12 (DRK-12) Program Overview

- DRK-12 supports integrated Research and Development of Resources, Models , and Tools in the service of STEM learning and learning environments

- Goals: enhanced student achievement in STEM, preparation for the scientific workforce, and improved science literacy

- Focus: learning that takes place during the 12-14 years students are enrolled in the formal classroom learning environment

Discovery Research PreK-12

Anticipated ITEST Program Funding Amount: $57,000,000

Estimated ITEST Per Project Funding Amount: $450,000 - $5,000,000

- DRK-12 has three major research and development strands: Assessment; Learning; Teaching
- Proposal Deadline: Nov. 14, 2018
- Solicitation:https://www.nsf.gov/pubs/2017/nsf17584/nsf17584.htm
- Resource Center: Cadre, www.cadrek12.org

Contact Program Officers About Your Project

- Examine the websites of the relevant programs
- Prepare a 1-2 page summary of your project
- Address the merit review criteria
- Contact one of the listed Program Directors with questions about relevance of your project
- Not required but program officers can give you excellent feedback

More NSF Support for Maker Projects: Undergraduate

- Improving Undergraduate Stem Education: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505082

- Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf10544&org=DGA

Making and Tinkering Resources

Select Publications

- *Empirical Studies on the Maker Movement, a Promising Approach to Learning: A Literature Review* Papavlasopoulou, S. et al.
- *Math in the Making: Reflections for the Field* Pattison, S. et al.
- *The Makerspace Movement: Sites of Possibilities for Equitable Opportunities to Engage Underrepresented Youth in STEM* Calabrese Barton, A. et al.
- *The Promise and the Promises of Making in Science Education: A Literature Review* Bevan, B.
- *Envisioning the Future of the Maker Movement: https://www.asee.org/documents/papers-and-publications/papers/maker-summit-report.pdf*

Math in the Making

Questions?

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