STEM + Computing Partnerships Program
STEM+C

Proposal Deadline: March 29, 2017

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Program Lead

"To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…"

Program Overview

- **Computing** is now seen as integral to the practice of other STEM disciplines (geoscience, bioscience / modeling and simulation) as examples

- **Computing** - refers to the understandings, concepts, and competencies used in computational approaches to problem solving, such as *computational thinking, computational science, data science*, and *computer science*

- **Computing/Computational thinking**, as part of traditional STEM disciplinary learning, will prepare students in the essential skills, competencies, and dispositions for succeeding in a computationally-dependent world.

- **Computing/Computational thinking**, as part of traditional STEM disciplinary learning, will allow students to creatively apply and adapt computation across STEM and other domains.

Core Aspects of the STEM+C Program

I. **Advance research** on the integration of computational thinking and computing activities in early childhood through high school (pre-K-12) science, technology, engineering, and mathematics (STEM) education

II. **Prepare students** to confront the emerging challenges in computational and data-enabled science and engineering. Accordingly, the solicitation broadens the definition of computing to include computational science, data science, human computer interfaces, and cybersecurity.

III. **Prepare teachers to** help their students to better understand the creative application of computing in scientific exploration and problem solving in other disciplines made possible by advances in computation.

❖ Students need a deeper understanding of essential concepts, methods and wide-ranging applications of computer science, as well as hands-on exposure to the process of algorithmic thinking, use of computational techniques for real-world problem solving, exposure to modeling and abstraction, systems thinking, and understanding and management of complexity.

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Opportunities for R&D

Defining computational thinking in the context of pre-K-12 STEM teaching and learning:

STEM+C expects to contribute to the discovery of the nature of computational thinking itself and how it is demonstrated within other disciplines**.**

- ✓ There's a scarcity of research informing how to teach computational thinking in the early grades or consideration for age-appropriate learning (NRC, 2011c., p.4).

- ✓ R&D for pure and applied research on computational areas STEM education.

STEM+C is seeking research to build the evidence base for effective pedagogy, and effective design and development to study innovative interventions that can make both STEM disciplinary learning and computing increasingly more relevant.

- ✓ R&D to advance teacher education (pre-service) and development of inservice teachers

- ✓ R&D for new computational-oriented learning in pre-K-12: courses, curricula, pedagogy, pedagogical environments.

Opportunities for R&D

R&D Opportunities to Advance Applications of Computing in STEM fields

- ✓ visualizations of scientific concepts

- ✓ modeling and simulation in engineering design,

- ✓ use of high performance computing for physics,

- ✓ climate research and weather modeling,

- ✓ molecular chemistry,

- ✓ computational biology

- ✓ bioinformatics

Funding Categories

Exploratory Integration: (up to $1,250,000); max. duration two years.

Development of prototypes; conduct pilot testing; study areas of practice; or conduct research to provide proof-of-concept and preliminary evidence. prototypes or pilots may be expanded in future proposals to the program.

Design & Development: (up to $2,500,000); max. duration three years.

Build upon education education research and practice demonstrating promise in classrooms, schools, informal learning settings, or other settings, or propose entirely new innovative interventions for design and testing. Projects are expected to result in a completed product ready for further research or implementation.

Field-Building Conferences & Workshops: (up to $250,000); max. duration two years.

Conferences, workshops, and special projects that lead to a better understanding of the integration of computing into STEM disciplinary teaching and learning, and/or the integration of STEM into computer science disciplinary teaching and learning. It is expected that proposed work will be address emerging research and practice in this area.

Elements of Proposals

Research

✓ Projects are required to conduct research.

✓ Research is to be the driving part of development work. Work should be situated within a framework for studying the proposed intervention.

✓ Proposals should explicitly state research questions; why research is important to the field; methods to answer research questions and/or test hypotheses; population samples should be described with rationale for sample selection; and types of data to be collected, including methods for data collection. A Data Management Plan is required as a supplementary document.

Intervention types

- ✓ Invent, pilot, or modify traditional STEM activities, courses, and other interventions to infuse computational approaches.

- ✓ May use types of media, technologies, and/or design new tools to create, build, and invent products or computational solutions to domain-specific problems, including interventions needed for learning in and out of school.

- ✓ Products and tools can be developed to study engagement of learner reasoning, systems thinking, and understanding of scientific models, simulations, and visualizations.

- ✓ Develop competencies for student analysis, interpretation, and synthesis of data and self-made discoveries using scientific visualizations for instruction

- ✓ Develop curriculum, course materials, assessments, pedagogy, or new foci for pre-service and in-service teacher preparation.

Evaluation

- ✓ **All proposals must include a strategy for objective independent review of the project.** An external review panel, advisory board, or a third-party evaluator may be proposed (see NSF proposal preparation guidelines). The external critical review should be sufficiently independent and rigorous to influence the project's activities and improve the quality of its findings.

- ✓ Competitive proposals will (1) describe the expertise of the external reviewer(s); (2) explain how that expertise relates to the goals and objectives of the proposal; and (3) specify how the PI will report and use results of the project's external critical review process.

- ✓ The Advisory Board and/or external evaluator should have sufficient methodological expertise to provide an independent review of the integrity of proposed education research activity and review of designs and activities (including theoretical frameworks, data collection plans, analysis plans, and reporting plans). Proposers should identify ways to determine levels of technical quality as needed.

Teacher Preparation & Professional Development Interventions

- ✓ Research-based hypotheses on how to support pre-service and in-service teachers in understanding STEM + computing in their instruction might propose to study new pedagogical approaches to teacher education or invent, pilot, or modify one or more courses or a curriculum to infuse computational approaches into traditional science, technology, or infuse any STEM content into computer science, or both, or develop a new curriculum, course materials, assessments, pedagogy, design new pedagogical environments, or new foci for pre-service education and in-service teacher professional development.

- ✓ Research-based hypotheses on how to advance new pedagogy or teaching practices that prepare teachers to effectively facilitate students' computational learning and thinking might propose to study new strategies for teacher preparation.

- ✓ Research-based hypotheses on pre-service teacher education might engage two- and four-year institutions to improve prospective teachers' understanding of computation and computational thinking sufficient to engage pre-K-12 students in real-world science and engineering problems.

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Collaborators - Partnerships

- ✓ **PIs must include** computing and/or computational thinking in one or more disciplinary-specific fields of science, technology, engineering or math (STEM) and/or may also address STEM content integration in computer science education; thus, **it is required to have interdisciplinary expertise on the project team.**

- ✓ PIs are encouraged to broaden the expertise of the project team by including discipline-specific teachers and faculty; school personnel and district leadership; educational, developmental, and social psychologists; social and learning scientists; education technologists; out-of-school practitioners, researchers, and informal educators; education media and technology developers; representatives from business, industry, and school districts to inform workforce career direction; or other expertise specific to the needs of the project to advance objectives.

- ✓ If the project is addressing issues of underrepresentation in STEM and computing, proposals must include appropriate expertise representative of the respective communities and populations participating in the project.

Who May Submit Proposals

- ✓ **Categories of proposers eligible to submit proposals** are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E.

- ✓ **Anticipated Type of Award:** Continuing Grant or Standard Grant

- ✓ **Estimated Number of Awards:** 25 to 35
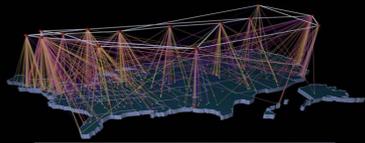
- ✓ **Anticipated Funding Amount:** $49,895,000

  Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

Who May Serve as PI: There are no restrictions or limits.

Limit on Number of Proposals per Organization: no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI: no restrictions or limits

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Questions?