



Testimony of

**Joan Ferrini-Mundy, Ph.D.
Assistant Director
Directorate for Education and Human Resources
National Science Foundation**

Before the

**Committee on Science, Space, and Technology
U.S. House of Representatives**

June 4, 2013

STEM Education: The Administration's Proposed Reorganization

Good afternoon Chairman Smith, Ranking Member Johnson, and other distinguished members of the Committee on Science, Space, and Technology. My name is Joan Ferrini-Mundy and I am the National Science Foundation's Assistant Director overseeing Education and Human Resources (EHR). I appreciate the opportunity to testify before you today on Federal investment in science, technology, engineering, and mathematics (STEM) education, and to focus on the role of the National Science Foundation.

Overview: National Science Foundation and Education and Human Resources

The National Science Foundation (NSF) is the only Federal agency dedicated to the support of basic research and education across all fields of science and engineering. The "Organic Act" of 1950, the original legislation for NSF, included authorization of activities in education that would contribute to producing the scientific and engineering manpower needed for the Nation. Thus, from the beginning, one of the stated objectives of NSF was to strengthen basic research and education in the sciences and engineering. Within NSF, the Directorate for Education and Human Resources provides the focus for NSF's investments to advance STEM learning, scientific literacy, and a globally competitive science and engineering workforce. The Directorate's unique mission is to support the preparation of a diverse, innovative STEM workforce and a STEM-literate citizenry through investments in research and development on STEM education and learning. In carrying out its mission, the Directorate benefits from the advice and participation of engineers and scientists from all fields across the NSF, a unique advantage for the development and management of educational programs in the rapidly changing world of science and technology.

STEM-literate citizens are needed to support science and engineering. STEM workers play critical roles in scientific discovery, technological progress, and innovation. And according to the *Science and Engineering Indicators of 2012*, workers in STEM occupations on average have higher wages and lower levels of unemployment than those in non-STEM occupations. Women and minority groups, including blacks, Hispanics, and Native Americans, continue to have low levels of participation in STEM. The challenge for the Nation, then, is to produce an inclusive workforce with the STEM skills to power our 21st century economy. To respond to this challenge, we must improve STEM education at every level, enabling STEM learning both inside and outside school, to excite and inspire students to persist in learning and applying STEM skills and expertise.

EHR research and development grants, selected through the highly competitive NSF merit review system, are designed to advance knowledge about how to improve STEM learning and teaching. Our mission encompasses teaching and learning from P-16 through post-graduate levels, the education of teachers and administrators, and informal education in out-of-school settings, as well as studies relating to the implementation of innovations and models across STEM education. The outcomes of this research and development can be, and are, leveraged by other Federal agencies as well as non-governmental organizations, schools, and businesses that wish to improve STEM education and participation.

National Science and Technology Council (NSTC) Committee on STEM Education Strategic Plan and the FY 2014 Proposed STEM Education Re-organization

NSF has a history of collaboration with the White House Office of Science and Technology Policy (OSTP) and other Federal agencies to address national priorities and common interests in STEM education and workforce development. The National Science and Technology Council's Committee on STEM Education (known as CoSTEM) is co-chaired by NSF Acting Director Dr. Cora Marrett. I was a member of the Fast-Track Action Committee on Federal Investments in STEM Education, chartered by the Committee on STEM Education, that developed the *Federal Science, Technology, Engineering, and Mathematics (STEM) Portfolio of 2011*, describing how 13 Federal agencies utilized \$3.4 billion in fiscal year 2010 to support STEM education. The Portfolio report has been crucial in the development of the CoSTEM Strategic Plan for Federal STEM education investment.

Mr. Leland Melvin, of the National Aeronautics and Space Administration (NASA), and I co-chair the Federal Coordination in STEM Education Task Force. Together with representatives from other Federal agencies, we have led the development of the five-year Strategic Plan to better coordinate Federal programs on STEM education. This Plan proposes building new models for leveraging assets and expertise across agencies and building and using evidence-based approaches across agencies to improve the impact of the Federal STEM education investment. Members of the Federal Coordination in STEM Education Task Force include representatives from Federal agencies as well as from the Executive Office of the President (EOP), including OSTP and the Office of Management and Budget (OMB), who have participated in discussions on how STEM education may be strengthened with coherent, cohesive programs to better serve all of our communities.

As an NSF assistant director, I participate with the other assistant directors, office heads, and NSF leadership each year in developing NSF's budget requests. These discussions always include ample opportunities to propose and plan for mechanisms for collaborations within the NSF on areas of interest across the Foundation, including education and workforce development. For the FY 2014 budget request, the President proposed consolidation of several NSF programs in the area of undergraduate education, a proposal that will be anchored by bringing together three major programs in EHR. The budget development process also involves close interaction with the EOP, particularly OMB.

In addition to NSF's internal consolidation proposal, the Administration has proposed a government-wide strategic reorganization of STEM education efforts to more effectively and efficiently realize the benefit of Federal investments. I welcome this opportunity to highlight NSF's proposed FY 2014 activities in two key areas of the proposed government-wide STEM reorganization – undergraduate education and graduate fellowships. I am especially excited about the prospects of collaboration and synergy across agencies that may be realized through implementation of the CoSTEM Strategic Plan, and include additional information about NSF's role in K-12 STEM education and learning STEM in informal environments.

Undergraduate Education. The Committee on Science, Technology, Engineering, and Mathematics Education has identified undergraduate STEM education as a priority. The President's Council of Advisors on Science and Technology's *Engage to Excel* report of 2012 identifies the need "for about one million more STEM professionals than the U.S. will produce at the current rate over the next decade if the country is to retain its historical preeminence in science and technology." NSF has a set of programs that invest in the improvement of undergraduate STEM education, an NSF focus area for decades. As one example of success, NSF support for a "STEM Talent Expansion Program" at Indiana University-Purdue University Indianapolis led to a 25 percent increase in STEM degrees over the past three years through the use of peer mentoring, facilitated community college transfers, and a high school-to-college transition program.

NSF's FY 2014 Budget Request includes a new NSF-wide activity called Catalyzing Advances in Undergraduate STEM Education (CAUSE). CAUSE comprises three large programs within EHR's Division of Undergraduate Education (Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics; Widening Implementation & Demonstration of Evidence-Based Reforms; and Science, Technology, Engineering, and Mathematics Expansion Program), and elements of undergraduate programs from NSF's other directorates and offices. CAUSE is a natural evolution and consolidation of the NSF's ongoing internal efforts to couple STEM disciplinary expertise with education research expertise to better understand and improve undergraduate STEM learning and persistence of students from all groups and to support STEM workforce development. CAUSE will provide coherence across NSF undergraduate education programs to maximize the effectiveness of NSF investments. The intent of CAUSE is to build on NSF's unique strengths across the STEM disciplines and STEM education to focus sustained research on ways to improve undergraduate STEM education. In addition, the CAUSE framework, as it evolves, allows for incorporation of undergraduate improvement goals that are shared across Federal agencies, consistent with implementation of the proposed reorganization and the

CoSTEM Strategic Plan. In the proposed reorganization, NSF would become the government-wide lead agency for undergraduate STEM education in FY 2014.

Graduate Fellowships. NSF has a long history of successfully managing and implementing an agency-wide graduate fellowship program. NSF's Graduate Research Fellowship (GRF) Program celebrated its 60th year in December of 2012, having been in operation almost as long as the NSF itself. This program invests in students in any STEM field who have demonstrated potential for significant achievements in science and engineering. These investments have paid off well: Among the more than 200 Nobel laureates who have had NSF support, 40 were selected as Graduate Research Fellows. NSF's Graduate Research Fellows also are well represented among government leaders, business executives, writers, and members of the National Academies. As described in the FY 2014 Budget Request, the NSF's Graduate Research Fellowship Program will be expanded into a National Graduate Research Fellowship (NGRF) Program that will address areas of significant national need, in some cases by incorporating "targeted opportunities" that allow Fellows to gain specialized experiences and training in key STEM areas of particular interest to mission agencies.

The Interagency Working Group on STEM Graduate Fellowships, including representatives from the NSF and other CoSTEM agencies, has been meeting since 2010 to share best practices in the administration of U.S. Federal graduate fellowship programs, and is now extending its work to collaborate on designing NGRF. As described in the FY 2014 Budget Request, the proposed design of the NGRF program will include opportunities for Fellows to obtain technical and professional development specified by other federal agencies. NSF has already implemented targeted opportunities in GRF – examples include Graduate Research Opportunities Worldwide (GROW), a program that enables graduate research fellows to participate in research activities with scientists in partner countries around the world, and the Engineering Innovation Fellows Program, which provides summer research opportunities on-site for fellows in host companies. If NGRF is implemented, management of NGRF will include mechanisms for representatives from other federal agencies to be involved in the selection of Fellows and to determine how Fellows will participate in the specialized technical and professional development relevant to their agencies. Within both the proposed reorganization and the strategic plan, NSF is committed to creating access and opportunities for the large pool of exceptional graduate fellows to participate in training critical to the missions of a range of agencies and to greater research and professional development opportunities than they had previously.

K-12 STEM education and learning STEM in informal environments. The CoSTEM Strategic Plan includes priority areas for improvement of K-12 STEM education and also for increasing and sustaining youth and public engagement in STEM. NSF has been investing in research and development relevant for both of these areas for many decades and supports a large community of science, technology, engineering, mathematics, and education experts who are developing the STEM learning tools and models for tomorrow. The knowledge and evidence generated by NSF-funded research and development produces tested innovations that can be brought to scale through partners with extensive reach such as the U.S. Department of Education and the Smithsonian Institution. For example, many of the projects funded by the Mathematics and Science Partnerships program of the Department of Education are using assessment tools, and technical support for these tools, that were developed

through funding from a variety of programs at NSF. Among the most widely used are the *Misconceptions Oriented Standards-based Assessment Resource for Teachers* – developed at the Harvard Smithsonian Center for Astrophysics; *Assessing Teacher Learning About Science Teaching* – developed at Horizon Research, Inc.; and *Learning Mathematics for Teaching* – a joint project of researchers at the University of Michigan and Harvard University. Another example of how NSF’s “upstream” investments can eventually go to scale is the LASER project. In the 1990s, the NSF invested in the Smithsonian Institution’s *Leadership and Assistance for Science Education Reform Center (LASER)*, which focused on assisting school districts develop five-year strategic plans for implementing a high-quality, inquiry-based science program using appropriate curriculum materials (many of which were developed with funding from NSF). In 2010, the Department of Education’s Investing in Innovation Fund made an award for “The LASER Model: A Systemic and Sustainable Approach for Achieving High Standards in Science Education,” a grant of more than \$25 million to the Smithsonian Institution to conduct a five-year randomized-controlled student trial to validate the LASER strategic planning development model in three regions: rural North Carolina; northern New Mexico; and the Houston Independent School District. This project is a good example of NSF’s longstanding collaborative relationship with the Smithsonian, which we will expand in future.

NSF also makes significant investments to support STEM learning in informal environments. For example, the Advancing Informal STEM Learning (AISL) program supports innovation in anywhere, anytime, lifelong learning through investments in research, development, infrastructure, and capacity-building for STEM learning outside formal school settings. Awards in the AISL program must address how the research and development in their projects advance the field of informal STEM learning, provide innovation at the frontier of informal learning, and/or broaden participation to provide greater access to STEM-learning opportunities for underserved audiences such as racial and ethnic minorities, women and girls, and those with disabilities or learning differences. Examples of informal science models funded by the Advanced Informal STEM Learning program include citizen science projects that engage youth and the general public in conducting scientific research, so that they learn science concepts and understand the process of doing science as they assist researchers with collecting and analyzing data. One example is the *Community Collaborative Rain, Hail, and Snow Network*, which involves 14,000 volunteer scientists of all ages in 50 states who measure precipitation from their homes, schools, public areas, and businesses. Using rain gauges, snow rulers, and hail pads, they collect data and post it to the project web site for research scientists to access. Originating at the Climate Control Center at Colorado State University, this non-profit community-based network is now sponsored by Federal agencies and local and state organizations such as the Texas Floodplain Management Association and the Wyoming Farm Service Agency. A second tested model funded by AISL is the *Portal to the Public* program based at the Pacific Science Center in Seattle, Washington; it provides professional development for scientists so that they can effectively communicate their current research with students and other public audiences. Evaluation of this project is now determining how this model works in different kinds of institutions around the country.

Summary

In summary, the CoSTEM Strategic Plan provides a significant resource through which the CoSTEM agencies can work together to improve the impact of Federal STEM education investments. The priority areas of the Strategic Plan and the proposed government-wide STEM education reorganization are aligned, and the Plan and the reorganization also share the common principles of commitment to evidence, efficiency, and coordination. I look forward to the participation of the National Science Foundation in forging the partnerships with other agencies that will provide a coherent, cohesive set of STEM education investments around national priorities for the benefit of the Nation.

I will be pleased to answer any questions that the Members may have.