

**Testimony of
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Chairman Boehlert and Members of the Committee, I appreciate the opportunity to testify before you on topics of great importance, the National Science Foundation's (NSF) role in improving K-12 science and math education as well as the complementary efforts with those of other federal agencies.

NSF believes that Federal agencies must work in concert to ensure that every student has the opportunity to learn challenging science, technology, engineering, and mathematics (STEM). Today, I will describe examples of NSF's unique contributions to our Nation's larger effort to strengthen K-12 education. NSF's investments in discovery, learning, and innovation have a longstanding record of boosting the nation's economic vitality and competitive strength.

Today's young people face a world of increasing global competition. We depend on the excellence of U.S. schools and universities to provide students with the wherewithal to meet this challenge and to make their own contributions to America's future. This larger context provides a rationale for setting "bolstering K-12 education" as one of NSF's four priorities for fiscal year 2007.

To maintain America's pre-eminence in science and engineering, we must augment our Nation's research enterprise by fostering innovation in K-12 science and mathematics education. Sustained federal support will be critical to a comprehensive approach, including:

- Research on STEM learning for both teachers and students;
- Development of challenging STEM instructional materials;
- Assessment of student and teacher knowledge;
- Evaluation of project and program impacts; and
- Implementation of proven STEM interventions in the Nation's schools.

NSF Education and Human Resource (EHR) Directorate Programs

The Foundation's K-12 STEM education programs are administered primarily through the Education and Human Resource (EHR) Directorate, although programs in the Research and Related Activities Account also support K-12 education and outreach activities. Within the EHR directorate, all programs focus on educational research, development, and evaluation in the STEM disciplines.

For example, within EHR's proposed Division of Research on Learning in Formal and Informal Settings, programs will support a range of activities, including research on: (1) learning; (2) developing and testing new materials and curricula; (3) new pedagogical techniques; (4) content and pedagogy education for K-12 teachers; (5) educational activities outside of the classroom; and (6) the application of new technologies to education.

These programs are vital cogs in our Nation's K-12 STEM education machinery. The role of the NSF in K-12 science and mathematics education is to support research and development pilot-studies in the areas of cognitive science, education, curriculum development, and teacher professional development resulting in the production of materials and practices which can be evaluated empirically and then made available by NSF and/or other agencies. Examples of projects of which the NSF is proud include the Merck Institute for Science Education's summer institutes and the University of Pennsylvania Science Teachers Institute's Master's programs. Examples of other interesting programs and projects follow.

- In line with the Administration's focus on the vital national priority of K-12 STEM education, NSF will invest in a new effort in 2007. **Discovery Research K-12** focuses research on three well-defined challenges: (1) developing effective science and mathematics assessments for K-12; (2) improving science teaching and learning in the elementary grades; and (3) introducing cutting-edge discoveries into K-12 classrooms. The program builds on our previous efforts in curriculum development, capacity building, and teacher preparation, and will provide additional information on how to strengthen K-12 science and math education.
- EHR's new **Research and Evaluation on Education in Science and Engineering** program will fund two types of projects. *Synthesis projects* will identify areas where the knowledge base in either evaluation or education research is sufficient to support strong scientific claims, identify areas of importance to education research and practice, and propose methods for synthesizing findings and drawing conclusions that will inform our work across the K-12 landscape. *Empirical projects* will identify areas that have the potential for advancing discovery and innovation at the frontiers of STEM learning.
- In 2007, we will also increase funding for the **Graduate Teaching Fellowships in K-12 Education** program, or GK-12, in order to support an estimated 1,000 graduate fellows. This program has been particularly successful in encouraging effective partnerships between institutions of higher education and local school districts by pairing graduate students and K-12 teachers in the classroom.
- The **Robert Noyce Scholarship program** encourages talented STEM majors and professionals to become K-12 mathematics and science teachers. For example, the Dowling College Noyce program is addressing the critical shortage of science and math teachers in the Long Island and New York City areas by providing

scholarships for math and science majors in the teacher-training program. Also with Noyce funding, Wayne State University and Detroit Public Schools are increasing the number of individuals with strong science and mathematics backgrounds who are teaching in Detroit schools through their “Teaching for the Future” initiative. All Noyce Scholars are paired with faculty mentors who work with the Scholars during their college years as well as their early careers.

- Through the **Master Science Educators** program, the state of Oregon has trained 166 volunteer 4-H Wildlife Stewards who work in partnership with 4-H Extension and local schools across the state. These volunteers have assisted over 13,400 students and nearly 450 teachers in creating, using, and sustaining wildlife habitat education sites on school grounds for improving science learning. The program has won 18 state, regional, and national awards including the 2005 Wildlife Society National Group Achievement Award.
- Through the **Math and Science Partnership** (MSP) program, NSF assumed important responsibilities to build capacity for implementing the President's No Child Left Behind vision for K-12 education. NSF's MSP is a research program to develop and assess the impact of innovative partnerships between higher education departments of mathematics and science, schools of education, and local school districts on improving K-12 student achievement in mathematics and science. NSF is currently evaluating data collected from the on-going MSP projects to identify promising materials and methods that can be disseminated across the country through the consolidated MSP program at the Department of Education.

This extensive list of examples underscores that NSF programs support all subgroups of students—from those holding great promise to those struggling academically and from those underrepresented in STEM fields to those from low-income families. NSF considers advice and information gathered from a diverse set of outside sources, including direct indications of Congressional interest; studies produced by the National Research Council; workshops and national conferences sponsored by NSF; reviews conducted by the National Science Board; and NSF's own strategic planning and budget reviews by the Office of Management and Budget (OMB) in order to strike a balance among the programs reaching out to various groups of students.

To maximize our reach, we also support complementary enrichment activities that support school-based STEM curricula and standards and provide opportunities for in-depth learning and engagement beyond the school day. We also hope to interest young people in science at an early age and strive to help maintain that interest.

- For example, “PEEP and the Big Wide World,” is an award-winning animated series that gives wings to the innovative idea of teaching science to preschoolers. This show is the newest addition to The Learning Channel's and Discovery Kids' commercial- and sponsor-free programming block, “Ready Set Learn!” Actress

Joan Cusack narrates the show, which breaks new ground by teaching toddlers basic scientific concepts and skills like measuring, comparing, and estimating.

- In another example, NSF is funding a demonstration project called NSF Academies for Young Scientists, which engages K-8 students in out of school STEM learning while helping teachers develop and adopt strategies that effectively retain students' interest in STEM and prepare them for secondary-level work.
- The need for steady, sustained investment is illustrated by the success of *Connected Mathematics*, a middle-school curriculum now estimated to have between 20 and 25 percent of the middle-school textbook market. It is the best selling set of materials for that market by its publisher. The project, supported long-term by NSF and Michigan State University, is paying off with a documented improvement in student mathematics achievement on district and state tests.

For over 50 years, NSF has engaged prominent scientists, mathematicians, and educators in the development of K-12 instructional materials. From this experience, we realize that education systems are complex. Change sometimes comes slowly, and there are few, if any, quick fixes. Supporting the research and development that enables the development of creative, sound STEM education models and strategies requires steady-stream resources. As part of this iterative process, NSF encourages proposals to refine educational questions and problems that need addressing, create model experiments, identify appropriate test beds and partners, and finally to observe and evaluate the changes over time.

Integration of Research and Education

By supporting hands-on, inquiry-based learning and direct exposure to contemporary scientific methods and discoveries, NSF makes additional important contributions to K-12 education. We value highly the integration of research and education, a concept permeating all of our programs.

This agency-wide priority is being addressed through the Research and Related Activities (R&RA) Directorates in partnership with the EHR Directorate. We reflect the need for this integration in our merit-review process through a criterion known as "Broader Impacts." Therefore, research grants commonly include specific educational activities for K-12 students.

In some cases, Foundation programs purposefully mandate the integration of research and education. For example, NSF's CAREER program, which provides stable and enabling research funding for junior investigators, explicitly requires educational activities, many of which involve K-12 students.

On the other hand, K-12 teachers gain hands-on experience in science through NSF's Research Experiences for Teachers program. Supported by R&RA Directorates, this program places K-12 teachers in the laboratories of NSF-supported researchers. The educational components of NSF-supported Science and Technology Centers also improve K-12 education through activities, such as workshops, curricula development, and research internships for students and teachers.

Numerous other programs within our R&RA Directorates target the improvement of K-12 education. Some examples follow.

- Science of Learning Centers, which are large-scale, long-term Centers, extend the frontiers of knowledge on learning of all types and create the intellectual, organizational, and physical infrastructure needed for the advancement of learning research.
- Geosciences Teacher Training improves the quality of geosciences instruction at middle and high school levels.
- Centers for Ocean Science Education Excellence promote ocean education as an exciting vehicle to interest students in science and enhance science education.

Program Assessment

As with all basic research, many of NSF's investments in research and education require years to develop and, thus, outcomes can be judged only retrospectively. Nevertheless, assessing the performance of our programs is critical to all of the Foundation's strategic planning efforts.

NSF employs a multiple, mixed- methods approach to evaluation. The effectiveness and impact of our investments are determined in multiple ways using qualitative and quantitative techniques, including external assessment by Committees of Visitors and the Advisory Committee on Government Performance and Results Act (GPRA) Performance Assessment, and by using the analytic Program Assessment Rating Tool (PART) developed by OMB. PART assesses program performance in four areas: purpose, strategic planning, program management, and program results. It also complements and reinforces GPRA, emphasizing the link between budget and performance. Resulting PART ratings inform the budget process and highlight areas in need of improvement.

Our science education programs have additional evaluation requirements.

- All EHR solicitations require every education EHR project to have a sound project-level evaluation.

- Selected education programs have a program-specific on-line data- collection system to monitor program activities and outputs, such as the number of students obtaining STEM degrees, on an annual basis and to document trends over time.
- Third-party program or thematic evaluations are also used to determine the impact of various programs. These studies are conducted so that in any given year approximately a third of the education programs will be engaged in evaluation planning and evaluation capacity building efforts, another third will be involved in on-going evaluation studies, and the other third will have recently completed their independent evaluation studies.

Interagency Coordination

NSF is not alone in its awareness of the need to evaluate the effectiveness of its programs. Notably, the Academic Competitiveness Council (ACC), which is led by Secretary Spellings and includes representatives from Federal agencies with STEM education programs, had its initial meeting on March 6th. The ACC will identify and assess Federal math and science education programs and make recommendations for coordinating Federal spending on STEM education. In addition, through interagency groups organized under the auspices of the National Science and Technology Council, NSF is taking a leadership role along with several other agencies, including the U.S. Department of Education (ED), to share program successes and develop government-wide strategies for addressing educational needs as well as making information and programs more accessible to the external community.

NSF also works with other Federal agencies in a variety of other ways. For example, Dr. Donald Thompson, the Assistant Director for Education and Human Resources, is part of the “Tiger Team,” along with his counterparts at the National Institutes for Health (NIH), the National Aeronautics and Space Administration (NASA), ED and DOE. The team focuses on STEM education issues that the agencies can collaboratively address, including creating better science assessments. Additionally, NSF has had a particularly active collaboration with ED since the early 1990’s. The results include the co-funding of major studies, such as the National Research Council’s *Adding it Up: Helping Children Learn Mathematics* (2001) and *Learning and Understanding: Improving Advanced Study of Science and Mathematics in America’s High Schools* (2002), as well as active participation in Department of Education initiatives, such as the Mathematics and Science Initiative (2000-2005) that planned and executed Mathematics and Science Summits for the Nation.

Most recently, NSF has collaborated with ED on the MSP programs—defining program linkages necessary to consolidate the programs at the Department of Education. NSF has also participated with ED in the Title I Taskforce on improving the learning of mathematics in Title I schools as well as the co-development of a pilot version of a Title I Toolkit (2005-present) to identify resources for state and district leaders on improving mathematics teaching and learning in Title I schools.

In summary, NSF complements the efforts of the other agencies through our focus on research and development for education in order to strengthen the infrastructure in STEM education. These efforts include attracting students to the teaching profession; providing pre- and in-service teacher training; developing curricula; supporting informal learning; and funding education research. Other agencies, especially ED, have a greater responsibility for implementation.

Conclusion

In line with the Administration's American Competitiveness Initiative, NSF has specific missions to prepare and sustain a world-class STEM workforce for the future and to foster the scientific literacy of all of our citizens. Ideally, all students should have access to a series of challenging STEM opportunities that begin at the elementary level and continue seamlessly as they progress through their secondary school careers.

Further, the Nation's competitiveness depends on fostering creativity and innovation in all Americans. NSF takes this idea very seriously, and all of our programs seek to broaden participation in STEM by attracting and retaining underrepresented groups in the STEM enterprise. All proposals to NSF must address two criteria: intellectual merit *and broader impact*.

We look forward to continuing to contribute our important parts of the larger K-12 education equation. I hope the breadth of the provided examples signifies the importance of this issue to NSF.

Thank you, Mr. Chairman, for the opportunity to testify on a topic of great importance to the Nation. I would be happy to respond to any questions you might have.