Testimony of
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Chairman Mollohan, Ranking Member Wolf, and distinguished members of the Subcommittee, my name is Harold Pratt and today I am presenting testimony on behalf of the National Science Teachers Association (NSTA). I have been actively involved in science education for 53 years as a classroom teacher, as a district science supervisor, and as a curriculum developer. At the national level I was a staff member at the Center for Science, Mathematics, and Engineering Education at the National Research Council (NRC) and I was a Senior Program Officer for the NRC when that group and others developed the National Science Education Standards in the mid-1990s. I was president of NSTA in 2001-2002 and continue to actively work as a consultant and author.

Thank you for this opportunity to provide testimony about the state of science education in the United States. To begin I would like to start with some positive trends we are seeing in science education before I outline many of the challenges we face.

First and foremost, we would like to thank this committee and the Congress for the increased funding for the science agencies in the ARRA and recent omnibus for FY2009. While these increases are very good for science and the science education initiatives at the agencies, it is important that Congress continues work to fully fund the AMERICA COMPETES Act.

Second, science educators nationwide are thrilled with President Obama's pledge to make math and science education a national priority and his promise to improve science assessments; to help math and science students with college aid; and to increase the number of science and math graduates.

Another bright spot is the science education research conducted over the past few years, largely with funding from the National Science Foundation, in the areas of student learning.

One example of this promising research is the NSF-sponsored study reported in the NRC publication *Taking Science To School, Learning and Teaching Science in Grades K-8.* This research tells us young children are capable of learning far more complex and abstract ideas than we had previously realized and how students learn science concepts over time. Thanks to this research, we know that children can learn complex science ideas by actively engaging in science investigations; by working with peers; by using specialized ways of talking and writing; and by doing mechanical, mathematical and computer-based modeling.

Mr. Chairman we believe that this research, as well as other types of research focusing on knowledge and cognitive development from the NSF and other agencies, has the potential to revolutionize the way science is taught and learned. Unfortunately, very little of this research finds its way into the majority of classrooms where it can have an impact.

Linking research to practice is one of the leading challenges in science education today. The problem is two fold. First, we simply must find better ways to link the community of science education researchers, including those in the federal agencies, with one another and with schools. Second, we must effectively disseminate and actively implement the vast research findings that can and will have an impact on our schools and classroom teachers. Last fall the STEM Education Coalition urged the National Science Foundation and Congress to provide more funding for the dissemination and implementation of current NSF education research and products. Critical research in science education must be implemented in our classrooms nationwide and used in a manner leading to increased student achievement in the sciences.

In addition to providing more schools and teachers with critical research on student learning and other issues, as a nation **we must improve the quality and quantity of the science provided at the elementary level.** Increasing the number of science and math graduates relies more on our success at the elementary level than many people realize. Many district and school administrators are not placing enough focus on the quality and the amount of science education that is provided to our young students. In fact many elementary schools have reduced the amount of science education their students are receiving or have eliminated it altogether because of pressure to show achievement in other subjects. Last year The Center on Education Policy, a respected think tank that monitors No Child Left Behind, examined the amount of time spent during the school week on core academic subjects. The CEP found that since NCLB became law a majority of districts cut time on science instruction at the elementary level by at least 75 minutes per week in science.

The NSF-funded study National Survey of Science and Math Education also shows that elementary school science teachers are lacking in content preparation, especially in the physical sciences. 75 percent of the elementary teachers in the survey reported they felt well qualified to teach language arts and reading, and 60 percent said they felt qualified to teach mathematics, but only about 25 percent reported they felt well qualified to teach science. Our youngest students deserve better, especially at a time when science instruction is critical to laying the foundation for their future learning and critical thinking skills and their decisions to pursue a future in STEM.

Another area of concern is the **quantity and quality of professional development provided to elementary teachers and all teachers of science.** Long-term, coherent, reform-based professional development is essential. All teachers of science must have a sufficient knowledge of science, knowledge of how students learn science, and knowledge of how to plan effective instruction. Ongoing quality professional development should be coherent with other activities and focus on content knowledge

and active learning. [1] While it commonplace for most businesses to invest funding in staff training, very few budgeted dollars go to teacher professional development.

In an NSTA survey conducted earlier this month of more than 3,400 teachers, 58 percent said they did not have enough professional development opportunities in science. 67 percent reported they experienced less than 5 hours a month of professional development during the school year (a total of approximately 50 hours during the school year). Research tells us that it takes at least 80 hours of professional development to bring about meaningful change in teaching behaviors.[2]

The preparation of science educators is another issue facing the science education community. In its *National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System*, the National Science Board called for a review of teacher education programs and how well prospective teachers are grounded in academic content in the subjects they will teach. The NSB encourages higher education leaders to strengthen K–8 teacher education programs so that they provide a deeper understanding of the content knowledge necessary to teach mathematics and science.

NSF and others must also work to change university culture in fundamental ways to bridge the cultural divide between the schools of arts and science and schools of education and their efforts to encourage and retain more students in STEM fields. More collaboration between these communities would lead to stronger teacher preparation programs in science and mathematics. This area of focus for NSF would go a long way in improving the 'system' of education.

Improving science standards and assessments is another key issue in science education and we look forward to the President's agenda in this area. Research from the Trends in International Math and Science Study (TIMSS) tells us that current state science standards contain far too many topics to teach. In fact our recent survey indicates that teachers want to know how to teach fewer topics in-depth. Efforts to clarify the key concepts of the current standards in science, which can then be coordinated with curriculum, assessments, and teacher professional development, are essential. NSTA is currently working with Achieve, the National Academies, and AAAS on an initiative to

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[1] Garet, M.S., Porter, A., Desimone, L., Birman, B., & Yoon, K. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal,* 38(4), 915-945.

[2] Supovitz, J., & Turner, H. (2000). The effects of professional development on science teacher practices and classroom culture. *Journal of Research on Science Teaching*, 37(9), 963-980.

clarify science standards and identify core science concepts that will provide much needed guidance to our schools and classroom teachers.

No discussion of quality science education would be complete without mentioning the high school laboratory experience. Unfortunately the news in this area continues to be bad. In 2005 the NRC report *America's Lab Report Investigations in High School Science* found that **most students had a poor experience in the science laboratory.** The report found that teachers were not prepared to run labs, state exams did not effectively measure lab skills, the quality of lab equipment was widely diverse, and that the very definition of what constitutes a "laboratory" experience is still being debated in far too many schools. For an experience that is vital in science more could be done to delineate the guidelines for science laboratories, connect laboratories to the science of today, provide better training for high school teachers, and emphasize labs in the middle grades.

Finally, many school districts are finding it hard to **recruit, retain and support teachers of science.** As pointed out in the report *An American Imperative* from the Business Higher Education Forum, the United States will need almost 280,000 science and math teachers in the next few years.

Teacher retention is a major concern because it is unlikely the current system can quickly produce the needed numbers of science teachers. The teacher is the single most important factor in the education equation. Good teachers must be supported and encouraged to remain in the teaching profession. The National Commission on Teaching and America's Future reported in 2003 that approximately a third of America's new teachers leave teaching sometime during their first three years of teaching; almost half leave during the first five years. Research from NSF and from NSTA tell us that the "teacher shortage" in science education may be due to early exits because of conditions of schooling such as lack of administrative support and student motivation.

Teacher compensation is also an issue. The average beginning teacher salary in the 2004–2005 school year was $31,753 [3] while the average salary for recent science and engineering bachelor's degree recipients in 2003 was $40,900.[4] The national average salary for public teachers in 2005–06 was $49,026[5] while the median annual earnings (regardless of education) in S&E occupations were $67,780.[6]

Obviously science educators with degrees in science fields have many other lucrative career options. The competition for teachers is quite extensive. While we applaud the NSF Noyce Scholarship program and other initiatives to get STEM majors into the field, frankly we are not doing everything we can to attract our best and brightest into teaching.

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[3] The American Federation of Teachers' (AFT) *Survey and Analysis of Teacher Salary Trends 2005, p. 9*

[4] NSB, *Science and Engineering Indicators 2008* (NSB-08-1) (http://www.nsf.gov/statistics/seind08/),

[5] Rankings & Estimates: Rankings of the States 2006 and Estimates of School Statistics 2007, National Education Association, December 2007)

[6] NSB, *Science and Engineering Indicators 2008* (NSB-08-1) (http://www.nsf.gov/statistics/seind08/),

Mr. Chairman, I have presented what we believe are some of the key challenges to science education today:

- Linking research to classroom practice
- Improving elementary science education
- Improving the quantity and quality of professional development provided to teachers of science, including elementary teachers
- Better preparation of science educators
- Improving science standards and assessments
- Improving the quality of high school laboratory experiences; and
- Attracting, retaining and supporting teachers of science.

As I mentioned earlier, we applaud the funding this committee has provided to many of STEM education programs at the agencies under the jurisdiction of this committee. K-12 education programs at NASA have sought to attract and retain students in STEM disciplines with educational opportunities for students, teachers and faculty.

NOAA Environmental Literacy Grants have made it possible to deliver educational materials to thousands of teachers and students.

We are especially pleased with the increased funding for NSF's Education and Human Resources Directorate (EHR) in both the stimulus bill and the Omnibus legislation. Programs under the NSF EHR Directorate have provided STEM education with new ideas, new technologies, new curriculum, new resources and materials, and new talent from which new ideas will continue to flow. This is vital to our knowledge base in STEM education, and to our continued economic prosperity, national security, and workforce preparation.

NSTA would like to see **additional resources to the NSF so the agency can continue and expand upon its research and development efforts in science and math education.** This funding should include a greater emphasis on the dissemination and implementation of research more broadly into the classroom environments. We talk about pockets of excellence here and there, largely funded with NSF dollars, but very little of the research generated from these initiatives reaches the majority of classrooms or results in a substantial increase in student achievement or more students pursuing science. Additional funding would allow the NSF to explore innovations in all domains of science education and it would support programs at the proper scale to ensure an impact on science learning.

Second, as the Report of the Academic Competitiveness Council and the Government Accounting Office report (GAO-06-114*) Higher Education: Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends* have pointed out, **federal STEM programs at the federal agencies, including the agencies under the jurisdiction of this committee and the Department of Education, Department of Energy, and the DoD, need to be better coordinated in a systemic manner that first truly identifies the needs of teachers, schools, and districts so that federal dollars can be used to best address these needs.**

NSTA supports a provision in H.R. 6104, Enhancing Science, Technology, Engineering, and Mathematics Education Act of 2008, introduced in the last Congress by Representative Honda, that calls for the **Office of Science and Technology Policy to create a standing committee on STEM Education within the National Science and Technology Council with the responsibility of coordinating and focusing all Federal STEM education programs so they meet the primary needs of teachers and schools.**

Third, **Congress can encourage decision makers in schools to invest more in a long-term commitment to teacher professional development**. Federal research aimed at teacher professional development and increased funding for professional development will help state and local school districts provide science-specific professional development to both pre-service and in-service teachers. We need to help end the isolation that many classroom science teachers feel by providing more time for structured professional development training; collaboration among teachers; study groups, and lesson study.

In addition, elementary teachers need opportunities to deepen their knowledge of the science content of the K-8 curriculum. One of the most significant recommendations the NRC makes in *Taking Science To School* is "Federal Agencies that support professional development should require that the programs they fund incorporate the four strands of science proficiency, focus on core ideas in science and enhance teachers' science content knowledge, knowledge of how students learn science, and knowledge of how to teach science."

Finally, we urge Congress to provide funding for the America Competes Act, including the Partnerships for Access to Laboratory Science provision (Section 4015 of the America COMPETES Act) that would create a pilot program at NSF to study laboratories in science, which could include studies into helping teachers implement laboratories, the design and sequencing of laboratories, and essential aspects of effective laboratory instruction.

Mr. Chairman and members of the committee, elementary to college science educators are very encouraged by the Administration's strong commitment to science and math education. Exciting new research currently underway can have a huge impact on the teaching and learning of science, but only if it is properly funded and implemented in the classroom. We thank you for stronger funding for science education, and believe a coordinated effort to focus all Federal STEM education programs so they better meet the primary needs of teachers and schools is necessary and will also go a long way to address many of the challenges I have outlined here today. I thank you for this chance to testify here today and look forward to answering any questions you may have.