

**Rising Above The Gathering Storm:
Energizing and Employing America for a
Brighter Economic Future**

**Concerning S. 2198
Protecting America's Competitive Edge – Education
Science and Math Teacher Provisions**

Statement of

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And

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of the 21st Century
Committee on Science, Engineering, and Public Policy
Division on Policy and Global Affairs
The National Academies**

before the

**Subcommittee on Education and Early Childhood Development
Committee on Health, Education, Labor, and Pensions
U.S. Senate**

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Mr. Chairman and members of the Committee.

Thank you for this opportunity to appear before you on behalf of the National Academies' Committee on Prospering in the Global Economy of the 21st Century. As you know, our effort was sponsored by the National Academy of Sciences, National Academy of Engineering and Institute of Medicine (collectively known as the National Academies). The National Academies were chartered by Congress in 1863 to advise the government on matters of science and technology.

During my testimony, I will focus on the challenges that we are facing in K through 12 education. The committee believes the education issue is the most critical challenge the United States is facing if our children and grandchildren are to inherit ever-greater opportunities for high-quality, high-paying jobs. Our solution and recommendations to respond to the nation's challenge in K—12 science and mathematics education are the committee's top priority.

In examining the issue of K—12 science and mathematics education, the committee found facts such as the following:

- In 1999, 68% of US 8th grade students received instruction from a mathematics teacher who did not hold a degree or certification in mathematics.ⁱ
- In 2000, 93% of students in grades 5-9 were taught physical science by a teacher lacking a major or certification in the physical sciences (chemistry, geology, general science, or physics).ⁱⁱ
- According to a recent survey, 86% of US voters believe that the United States must increase the number of workers with a background in science and mathematics or America's ability to compete in the global economy will be diminished.ⁱⁱⁱ

The committee then made the recommendation we call “10,000 Teachers, 10 Million Minds” which proposes increasing America's talent pool by vastly improving K—12 science and mathematics education.

In developing its action steps to reach this goal, the committee first focused on what part of K—12 science and mathematics education was of greatest concern. The committee immediately recognized that many of the teachers of these subjects do not have sufficient education in these fields, and its recommendations respond to that concern.

Today, I will focus on the committee’s proposed actions related to improving the quality of our teachers. Tomorrow, Peter O’Donnell, another member of the National Academies committee, will discuss the committee’s proposed actions related to enlarging the pipeline of students who are prepared to enter college and graduate with a degree in science, mathematics, engineering, or computer science.

Of all its 20 action steps, the committee’s highest priority is a program that would annually recruit 10,000 of America’s brightest students to the K–12 science and mathematics teaching profession. The program would recruit and train excellent teachers by providing scholarships to students obtaining bachelor’s degrees in science, technology, engineering, or mathematics while gaining concurrent certification as K–12 science and mathematics teachers. They would accomplish this by taking some pedagogy courses along with their major courses. Over their careers each of these teachers would educate 1,000 students, so that each annual cadre of teachers educated in this program would impact 10 million minds.

The program would provide merit-based scholarships of up to \$20,000 a year for 4 years for qualified educational expenses, including tuition and fees, and would require a commitment to 5 years of teaching service in public K–12 schools. A \$10,000 annual bonus would go to program graduates working in underserved schools in inner cities and rural areas.

To provide the highest-quality education for undergraduates who want to become K–12 science and mathematics teachers, it would be important to award matching grants, perhaps \$1 million a year for up to 5 years, to as many as 100 universities and colleges to encourage them to establish integrated 4-year undergraduate programs leading to bachelor’s degrees in science, engineering, or mathematics *with concurrent teacher certification*.

This program, modeled after a very successful program in Texas (and which is being replicated in California), takes advantage of those people who are already in science, mathematics, engineering, and technology higher education programs and offers them the ability to get into teaching. It also incorporates in-classroom teaching experiences, master K-12 teachers, and

ongoing mentoring—the combination of which produces highly qualified teachers with the skills and support to remain effective in the classroom.

Our second action step focuses on strengthening the skills of 250,000 current K–12 science and mathematics teachers through summer institutes, Master’s programs, and Advanced Placement and International Baccalaureate (AP and IB) professional development programs. Each of these activities also builds on very successful model programs that can be scaled up to the national level.

In the case of the summer institutes, the committee recommends that the federal government provide matching grants for state-wide and regional 1- to 2-week summer institutes to upgrade the content knowledge and pedagogy skills of as many as 50,000 practicing teachers each summer. The material covered would allow teachers to keep current with recent developments in science, mathematics, and technology and allow for the exchange of best teaching practices. The Merck Institute for Science Education for K-6 teachers is a model for this recommendation.

For the science and mathematics master’s programs, the committee recommends that the federal government provide grants to universities to develop and offer 50,000 current middle-school and high-school science, mathematics, and technology teachers (with or without undergraduate science, mathematics, or engineering degrees) 2-year, part-time master’s degree programs that focus on rigorous science and mathematics content and pedagogy. This program’s master’s teachers would provide leadership for all the programs included in our K-12 science and mathematics education recommendation. Teachers who complete this program would receive federally-funded \$10,000 stipends annually for up to 5 years provided they remain in the classroom and engage in teacher leadership activities. Once the 5-year limit has been reached, teachers could pursue national certification for which many states offer a financial basis. The model for this recommendation is the University of Pennsylvania Science Teachers Institute.

In the case of AP, IB, and pre-AP or pre-IB training, the committee recommends that the federal government support the training of an additional 70,000 AP or IB and 80,000 pre-AP or pre-IB instructors to teach advanced courses in mathematics and science. Assuming satisfactory performance, teachers may receive incentive payments of up to \$2000 per

year, as well as \$100 for each student who passes an AP or IB exam in mathematics or science. There are two models for this program: the Advanced Placement Incentive Program and Laying the Foundation, a pre-AP program.

These teachers would then participate in our proposed program, which will be discussed in more depth tomorrow by Peter O'Donnell, that would create opportunities and incentives for middle school and high school students to pursue advanced work in science and mathematics. The committee recommends that the number of students who take at least one AP or IB mathematics or science exam should be increased to 1.5 million by 2010. The committee also recommends setting a goal of tripling the number of students who pass those tests to 700,000. Students would receive incentives to both take and pass the exam including a rebate of 50% of their examination fee and a \$100 mini-scholarships for each passing score on an AP or IB science or mathematics examination.

Why are we doing this? Because many of the science and mathematics teachers who are teaching these subjects have no background in the subjects that they are teaching. It is very hard for someone who does not have a physics education to turn students on to physics, because many lack a fundamental understanding of the subject. Teachers with strong content knowledge, either through a bachelors or Masters program, who also have strong pedagogy skills and access to ongoing skills updates can be truly effective in encouraging students to enter science, mathematics, and technology fields.

The PACE legislation package is harmonious with our recommendations and proposes actions for educating a new workforce with up-to-date knowledge in science and engineering. This critical challenge spans from K-12 through doctoral and post-doctoral education. We are particularly pleased that the PACE Acts include major programs across agencies to provide scholarships for students who study science, engineering, or mathematics and concurrently earn certification and commit to teaching. We believe that the bills' programs to strengthen skills of teachers through masters programs, workshops, and training for effective Advanced Placement and International Baccalaureate instruction are excellent.

By taking the actions proposed in the National Academies Gathering Storm report, we believe that the United States will be better positioned to compete as a country for high-quality, high-paying jobs for all Americans.

Thank you for providing me with this opportunity to testify before the committee. I would be pleased to answer any questions you have about the report.

Notes:

ⁱ National Science Board. 2004. *Science and Engineering Indicators 2004* (NSB 04-01). Arlington, VA: National Science Foundation. Chapter 1.

ⁱⁱ National Center for Education Statistics (2004), Schools and Staffing Survey, 2004. "Qualifications of the Public School Teacher Workforce: Prevalence of Out-of-Field Teaching 1987-88 to 1999-2000 (Revised)," p. 10 (<http://nces.ed.gov/pubs2002/2002603.pdf>)

ⁱⁱⁱ The Business Roundtable. 2006. "Innovation and U.S. Competitiveness: Addressing the Talent Gap. Public Opinion Research." January 12. Available at: <http://www.businessroundtable.org/pdf/20060112Two-pager.pdf>