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 K—12 Student Provisions

Statement of

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Committee on Science, Engineering, and Public Policy
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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.

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, mathematics, engineering, and technology education are the committee's top priority.

In examining the issue of K-12 science and mathematics education, the committee found the following:

- Fewer than one-third of US 4th grade and 8th grade students performed at or above a level called "proficient" in mathematics; "proficiency" was considered the ability to exhibit competence with challenging subject matter. Alarmingly, about one-third of the 4th graders and one-fifth of the 8th graders lacked the competence to perform even basic mathematical computations.[i]
- In 1995 (the most recent data available), US 12th graders performed below the international average for 21 countries on a test of general knowledge in mathematics and science.[ii]
- US 15-year-olds ranked 24th out of 40 countries that participated in a 2003 administration of the Program for International Student Assessment (PISA) examination, which assessed students' ability to apply mathematical concepts to real-world problems.[iii]
- 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.[iv]
- American youth spend more time watching television[v] than in school.[vi]

- Because the United States does not have a set of national curricula, changing K-12 education is challenging, given that there are almost 15,000 school systems in the United States and the average district has only about 6 schools.[vii]

Yesterday, Roy Vagelos, another member of the National Academies committee, discussed the committee's actions related to improving the quality of America's K-12 science and mathematics teachers. This includes recruiting 10,000 of America's brightest students to the teaching profession and strengthening the skills of 250,000 current teachers through training and education programs.

These recommendations will provide public schools in the US with outstanding math and science teachers on a scale equal to the size of the problem. The recommendations are based on six concepts:

1. High standards
2. Measurable results
3. Integrated curriculum for math and science for grades 6-12
4. Quality teacher training that is based on content
5. Incentives to teachers and students based on academic results
6. Implementation vehicle in each state to manage the programs to ensure quality control and accountability

There is general agreement that these six concepts will strengthen education, especially in math and science.

Today, I will focus on the actions we recommend that are designed to improve opportunities for students to learn and master advanced mathematics and science. This includes the Advanced Placement Incentive Program and developing rigorous, but voluntary, national K-12 science and math curricula. In addition, I will briefly discuss two other activities the committee the committee believed it was useful to expand—statewide specialty high schools and inquiry-based learning through summer internships and research opportunities for students.

The top program that the committee proposes for students involves enlarging the pipeline of students who are prepared to enter college and graduate with a degree in science, engineering, or mathematics by increasing the number of students who pass AP and IB science and mathematics courses. The proposed program 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 from 380,000 in 2004 to 1.5 million by 2010.

The committee also recommends setting a goal of tripling the number of students who pass those tests from 230,000 in 2004 to 700,000 by 2010. 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.

The reason we are encouraging more students to participate in AP/IB courses is because research has shown that those students who take AP/IB courses are twice as likely to enter and complete college as those who do not.

There is an AP incentive program in the Dallas public schools. It is based on the highly successful Advanced Placement program of the College Board which offers college-level courses taught in high school by high school teachers. Students who score a 3, 4 or 5 on AP exams are eligible for credit at most colleges and universities in the United States. For all students, especially minority students, AP is an educational coin that cannot be devalued. A "3" on an AP exam in typical high schools across America is just as good as "3" on an AP exam at The Boston Latin School. AP has a proven track record with high standards and measurable results.

New concepts were added in Dallas to strengthen the College Board's AP program:

- Financial incentives for teachers and students based on exam results.
- Master AP teachers who teach at least one AP course and help mentor the new AP teachers in their school.

- Teacher training that is high quality, content-based and specifically designed for AP success. The College Board's excellent summer institutes for teachers are essential to the success of AP teachers.
- More time on task for students, including tutoring outside school hours and prep sessions on Saturdays.
- Professional management of the program by a nonprofit statewide organization run by outstanding AP teachers.
- The program is voluntary and open to all teachers and students.

The academic focus of the AP Incentive Program is the seven AP math and science courses: calculus, statistics, computer science, biology, chemistry, physics and environmental science. AP English Language and English Literature are also included. The incentives are shown in Exhibit 1.

In 1995, the O'Donnell Foundation began an AP incentive program in ten high schools in the Dallas Independent School District (DISD). This district of 158,000 students has a 93% minority enrollment and 82% of the students are economically disadvantaged. Nevertheless, students are achieving outstanding AP results.

Thirty-three percent of the junior and senior students in the Dallas incentive schools take at least one AP exam in math, science or English. This is over 2 times greater than the national average. (Exhibit 2)

In 2005, students took 3567 exams, an increase of 9.4 times since the year before the program began in 1995. (Exhibit 3)

While the number of candidates and exams taken are important, the real measure of AP success is the number of passing scores. Passing scores on AP exams in math, science and English have increased 7.6 times during the ten years of the program. (Exhibit 4)

Success among minority students is even more dramatic. Since the inception of the Dallas AP incentive program, the number of African-American and Hispanic students passing AP exams in college-level math and science and English has increased nearly 18 times, from 29 in 1995 to 517 in 2005. (Exhibit 5)

To compare one school to another or to a state or to the US, results can be measured per 1000 juniors and seniors. Today Dallas minority students pass nearly three times as many AP exams in math, science and English as minority students in the U.S. (Exhibit 6)

Female students have increased their passing scores in AP math, science and English by 8.4 times in ten years. (Exhibit 7)

Data from the Dallas model demonstrates that AP works for all types of students. The success rate of minority and female students is especially encouraging as they will be a very important part of our future workforce.

The Dallas AP incentive model is a partnership between the local school district and the private sector, with private donations supporting teacher training, as well as teacher and student incentives. At about the same time that the Dallas incentive program began, the State of Texas authorized and funded the Texas AP Incentive Program which provides state-funded incentives for teacher training ($450 a year per teacher) and exam stipends of $30 per student. The state incentive program, also, has seen impressive gains in AP participation. Passing scores on AP math, science and English are up 3 times in Texas. (Exhibit 8) Results for minority students in the same subjects are up 4.8 times under the state-funded incentive program in Texas. (Exhibit 9)

It is very important to note that AP enables US students to successfully compete internationally in math and science. Our AP calculus student score higher than students in <u>every</u> other country on the TIMSS test math problems, whereas the US was second from the bottom. Our AP physics students scored above all but one country, whereas the US was the very bottom. (Exhibit 10)

Also important to our country's future is the high rate at which AP students earn college degrees. In Texas public universities, the six-year graduation rate for AP Anglo students is 72%, compared to 30% for those who did not pass an AP exam. AP Hispanic students have a six-year graduation rate of 62%, compared to 15% for those who did not pass AP exams. And 60% of African-American students graduate in six years, while only 17% of those who did not pass AP graduate in that time. (Exhibit 11)

Consider that lifetime earnings for a person with a bachelor's degree are over $2 million. This will end poverty for that person. It is especially important for minorities.

With these encouraging results from both private and state AP incentive programs, Texas has taken the next steps to accelerate AP success.

1) Private donors created a non-profit organization, Advanced Placement Strategies, Inc. (APS) to implement AP incentive programs on a broad scale. APS is run by master AP teachers. They manage programs in the schools and are also responsible to the private donors for managing their financial support. APS is proving to be a successful implementation vehicle for expanding AP in Texas. It operates in 69 school districts in Texas, in 198 high schools and 308 middle schools. APS is currently training nearly 7800 AP and pre-AP teachers. APS operates by three-way partnerships among the school district, a private donor in the local community and APS.

The Gathering Storm report states that implementation of the AP-IB and pre-AP-IB recommendations in each state "would require the creation of a non-profit organization staffed by talented master teachers who would help local schools manage the program and enforce high standards."

2) Recognizing that education should begin in the 6th grade to enlarge the pipeline of AP students, APS developed a series of teachers' guides, called "*Laying the Foundation*," for each grade, six through eleven, in pre-AP math and science. The guides are designed to help teach the content and analytical skills that students need to master beginning in the 6th grade in order to be successful in AP math and science in the 11th and 12th grades. Pre-AP teachers are required to complete an intensive training course. Beginning in the spring of 2006, end-of-course tests modeled on the national AP exam, will be available to measure student progress in each of the benchmarks that are essential to good understanding of AP concepts. (Exhibit 12)

The National Academy report recommends training 80,000 teachers currently in the classrooms to be outstanding pre-AP and IB teachers of math and science. This is critical given the disturbing numbers of teacher who teach outside their own field of study. According to the National Center for Education Statistics in 1999-2000, 69% of mathematics teachers and 93% of physical science teachers in grades 5-8 had no major or certification in mathematics or science. When fully deployed, pre-AP will provide an

enormous boost for all students giving them an early start and putting a focus on the important goal of graduating both from high school and from college.

In summary, Advanced Placement is a program that works to improve academic performance. Incentives work to accelerate the growth of AP, especially among minorities. We have the data to prove it. I believe that the Senate can support these concepts with the confidence that they will work.

Of particular interest to National Academy committee is the ability of programs such as the University of California College Prep Program to reach currently underserved areas or populations of students with specific learning needs through online access to teachers and tutors.

The committee is pleased that this proposed action is part of the President's American Competitiveness Initiative.

The committee also proposes that high-quality teaching be fostered with world-class curricula, standards, and assessments of student learning. Here, the committee recommends that the Department of Education convene a national panel to collect, evaluate, and develop rigorous K–12 materials that would be available free of charge as a *voluntary* national curriculum.

The model for this recommendation is Project Lead the Way (PLTW)—a national program with partners in public schools, colleges and universities, and the private sector. PLTW is now offered in 45 states and the District of Columbia. The project has developed a 4-year sequence of courses that, when combined with college preparatory mathematics and science, introduces students to the scope, rigor, and discipline of engineering and engineering technology. PLTW also has developed a middle school technology curriculum, Gateway to Technology. Students participating in PLTW courses are better prepared for college engineering programs than those exposed only to the more traditional curricula. Comprehensive teacher education is a critical component of PLTW, and the curriculum uses cutting-edge technology and software that require specialized education. Continuing education supports teachers as they implement the program and provides for continuous improvement of skills.

The committee also proposed expansion of two additional approaches to improving K-12 science and mathematics education that are already in use—statewide specialty schools and inquiry-based learning.

Statewide specialty high schools are an effective way to increase student achievement in science and mathematics by providing an intensive learning experience for high-performing students. These schools immerse students in high-quality science and mathematics education, serve as testing grounds for curricula and materials, provide in-classroom educational opportunities for K–12 teachers, and have the resources and staff for summer programs to introduce students to science and mathematics.

One model for this program is the North Carolina School of Science and Mathematics (NCSSM), which opened in 1980. NCSSM enrolls juniors and seniors from most of North Carolina's 100 counties. NCSSM's unique living and learning experience made it the model for 16 similar schools around the world. It is the first school of its kind in the nation—a public, residential high school where students study a specialized science and mathematics curriculum. At NCSSM, teachers come for a "sabbatical year", and the school has a structure and the personnel it needs to offer summer institutes for outstanding students.

Inquiry-based learning such as summer research programs stimulate student interest and achievement in science, mathematics, and technology should be encouraged—particularly those designed to stimulate low-income and minority student participation. These programs frequently involve several institutions or public–private partnerships

The PACE legislation package is harmonious with our committee's recommendations and proposed actions for educating a new workforce and leadership in science and engineering. We are particularly pleased that the PACE-Education bill's Advanced Placement and International Baccalaureate's program authorizes the Secretary of Education to award grants to nonprofit entities to work with local school districts to provide training to teachers to teach Advanced Placement or International baccalaureate (AP/IB) and pre-AP/IB programs and that it also had the goal of increasing the number of students who take pre-AB/IB and AP/IB courses and who pass the AP/IB exams in mathematics and science.

By taking the actions proposed in the National Academies Gathering Storm report, we believe that excellent teachers and increasing numbers of students meeting high academic standards will become the academic reality. When this happens, 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 Center for Education Statistics.. (2006), "The Nation's Report Card: Mathematics 2005." See http://nces.ed.gov/nationsreportcard/pdf/main2005/2006453.pdf

[ii] National Center for Education Statistics (1999), *Highlights from TIMSS* http://nces.ed.gov/pubs99/1999081.pdf.

[iii] National Center for Education Statistics (2005), "International Outcomes of Learning in Mathematics Literacy and Problem Solving: PISA 2003 Results from the U.S. Perspective," pp. 15 & 29 (http://nces.ed.gov/pubs2005/2005003.pdf).

[iv] 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

[v] American Academy of Pediatrics. "Television- How it Affects Children." Available at http://www.aap.org/pubed/ZZZGF8VOQ7C.htm?&sub_cat=1 The American Academy of Pediatrics reports that "Children in the United States watch about four hours of TV every day"; this works out to be 1460 hours per year.

[vi] National Center for Education Statistics. 2005. *The Condition of Education*. Table 26-2 Average Number of Instructional Hours Per Year Spent in Public School, By Age or Grade of Student and Country: 2000 and 2001. Available at http://nces.ed.gov/programs/coe/2005/section4/table.asp?tableID=284. NCES reports that in 2000 US 15 year-olds spent 990 hours in school, during the same year 4th graders spent 1040 hours.

[vii] National Center for Education Statistics (2006), "Public Elementary and Secondary Students, Staff, Schools, and School Districts: School Year 2003–04" .http://nces.ed.gov/pubs2006/2006307.pdf.