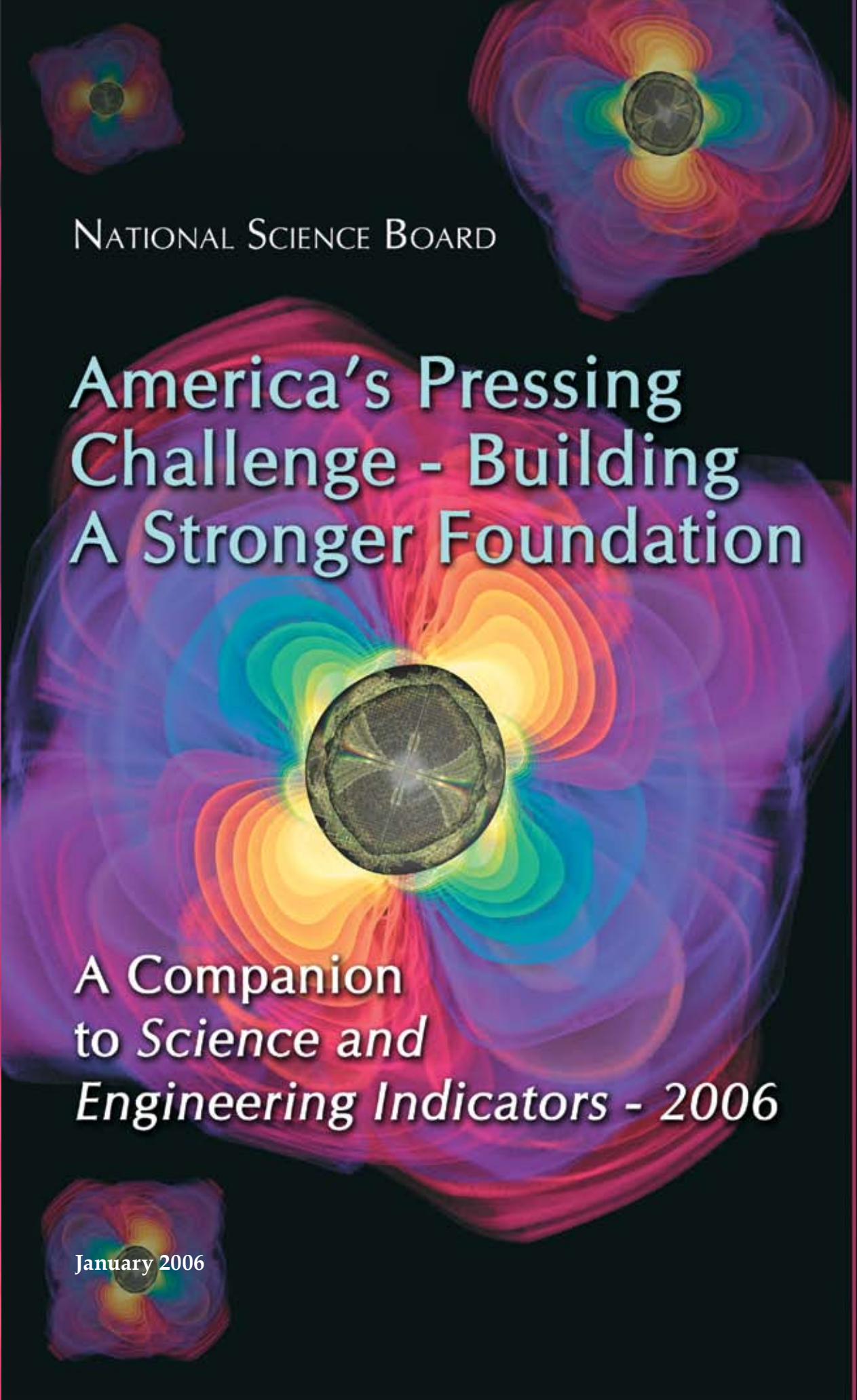

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America's Pressing Challenge - Building A Stronger Foundation

A Companion to *Science and Engineering Indicators - 2006*

January 2006

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National Science Board

Dear Colleague:

As part of our mandate from Congress, the National Science Board supervises the collection of a very broad set of quantitative information about U.S. science, engineering and technology, and every 2 years publishes the data and trends in science and technology in our *Science and Engineering Indicators (Indicators)* report. On occasion, the data reveal trends that raise important policy concerns that the Board brings to the attention of the President, Congress, and the public in the form of a "companion" policy statement to the *Indicators* report. The 2006 volume of *Indicators* reinforces the Board's continuing and growing concern with the condition of U.S. pre-college education in science, technology, engineering, and mathematics (STEM).

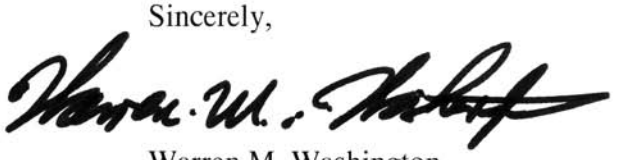
It is absolutely essential for our Nation's long-term prosperity and security that we remain a world leader in science and technology. Precollege STEM education is the foundation of that leadership – it must receive our highest priority as a Nation. Many reports by eminent bodies over decades have expressed concern and offered solutions to observed failures in our STEM education system. Despite these admirable efforts in both sounding the alarm and recommending solutions, our Nation continues to slip further behind in the science and mathematics achievement of U.S. students relative to international peers. The intractability of this widely recognized systemic failure is alarming.

This National Science Board Companion Piece, *America's Pressing Challenge – Building a Stronger Foundation*, identifies priorities for ensuring a world-class education in STEM fields for all Americans:

- strong public support for the value of STEM education for all students and citizens,
- a high quality teaching workforce,
- appropriate opportunities to learn for all students,
- effective guidance counseling on STEM education and careers, and
- assessment tools that reinforce learning in STEM fields.

Our Nation must devote the necessary resources now to revitalize our precollege STEM education system. We cannot wait for a new *Sputnik* episode to energize our population to rise to this challenge – we must recognize the existing crisis and take the necessary actions. We urge all Americans to join us in a national commitment to a world-class STEM education, the foundation for future U.S. science and technology-based prosperity and security.

Sincerely,



Warren M. Washington
Chairman

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Mathematics and Science Achievement Is Critical

Nearly a quarter century ago, the National Science Board's Commission on Precollege Education in Mathematics, Science and Technology[1] assessed the state of U.S. precollege education in the subject fields and found it wanting. In the intervening years, we have failed to raise the achievement of U.S. students commensurate with the goal articulated by that Commission — that U.S. precollege achievement should be "best in the world by 1995" — and many other countries have surpassed us.[2] Not only are they not first, but by the time they reach their senior year, even the most advanced U.S. students perform at or near the bottom on international assessments.[3] There is now an even more pressing need to build a new foundation. The *Science and Engineering Indicators 2006* report clearly describes the extent of the dilemma; the time to act is now!

In 1983 the U.S. Department of Education's National Commission on Excellence in Education published the report, *A Nation At Risk*. This document stated: "By the year 2000, U.S. students will be the first in the world in mathematics and science achievement," expressing alarm on the "rising tide of mediocrity [in education] that threatens our very future as a Nation and a people."[4] Despite these two reports – *A Nation At Risk* sounding the alarm and the NSB Commission report recommending solutions – and many others since then, we continue to slip further behind.

The Nation is now well into the 21st century and not since the Soviet Union's launch of the *Sputnik* satellite – 47 years ago – has the need to improve science and mathematics education in America been as clear and as urgent as it is today. The converging trends and stresses within our Nation's K-12 science and system are clearly documented in the recently published NSB report, *Science and Engineering Indicators 2006*.

Relative ranking of U.S. students on international assessments gauges U.S. students' performance against peers in other countries and economies. Among Organisation for Economic Co-operation and Development (OECD) nations participating in a recent assessment of how well 15-year-old students can use mathematics and science knowledge, U.S. students were at or near the bottom of the 29 OECD members participating.[5]

Another international assessment, Trends in International Mathematics and Science Study (TIMSS), showed U.S. student performance is weak at higher grade levels of the precollege system. Seventeen-year-olds scored below the international average on the most recent assessment for that age group. On TIMSS advanced mathematics and science assessments, U.S. students who had taken advanced coursework in these subjects performed poorly compared to their counterparts in other countries.[6] Long-term trends in degree taking also show decline in U.S. student completion of natural science and engineering (NS&E) degrees relative to other countries, dropping from 3rd on the rate of baccalaureate attainment in these fields to 14th from 1975 to 1999 among 19 economies measured at both times. The decline in U.S. rank indicates that other economies are building up the NS&E capabilities of their populations and labor forces more rapidly than the U.S.[7]

…the generation of scientists and engineers who were motivated to go into science by the threat of Sputnik in 1957 and the inspiration of JFK are reaching their retirement years and are not being replaced in the numbers that they must be if an advanced economy like that of the United States is to remain at the head of the pack. — The World is Flat

…math and science are the keys to innovation and power in today's world, and American parents had better understand that the people who are eating their kids' lunch in math are not resting on their laurels. — Still Eating Our Lunch: Singapore, New York Times.

— Thomas Friedman, 2005

The critical lack of technically trained people in the United States can be traced directly to poor K-12 mathematics and science instruction. Few factors are more important than this if the United States is to compete successfully in the 21st century.

— National Academies, 2005

If the U.S. is to maintain its economic leadership and compete in the new global economy, the Nation must prepare today's K-12 students better to be tomorrow's productive workers and citizens. Changing workforce requirements mean that new workers will need ever more sophisticated skills in science, mathematics, engineering and technology. Scientific and engineering occupations are expected to continue to grow more rapidly than occupations in general, with a projected 70 percent greater increase by 2012 (26 percent versus 15 percent overall), or 1.25 million additional science and engineering (S&E) jobs.[8] Long-term the growth in S&E occupations has far exceeded that of the general workforce — with more than four times the annual growth rate of all occupations since 1980.[9]

This emerging workforce, consisting of degreed and highly skilled technical workers, will need to begin developing their mathematical and science skills early in their educational career. In addition, the rapid advances in technology in all fields mean that even those students who do not pursue professional occupations in technological fields will also require solid foundations in science and math in order to be productive and capable members of our Nation's society.

We simply cannot wait until our students turn 18 years old to begin producing the intellectual capital necessary to ensure this future workforce; the time is now to get serious about this problem and better sharpen our efforts at all grade levels, in order to dramatically accelerate progress, lest we find our Nation in severe workforce and economic distress.

Challenges for K-12 Science and Mathematics Education

The K-12 elementary and secondary school indicators clearly point out that the Nation is not seeing uniform improvements in student achievement in mathematics and science. Average mathematics scores on national assessments rose during the 1990s and early 2000's; however, performance in science has not improved. Furthermore, there are far too many performance disparities in mathematics and science of students from disadvantaged populations, both urban and rural, who lag far behind their peers. These disparities start as early as kindergarten, persisting across grades, and in most cases widen over time.[10]

International comparisons between 1995 and 2003 showed some improvement for U.S. eighth grade students in both math and science in the TIMSS assessment. This test measures mastery of curriculum-based knowledge and skills. However, scores for fourth graders generally remained flat over the same period. In 2003 the Program for International Student Assessment (PISA) tests, which measure students' ability to apply scientific and mathematical concepts and skills, was administered to U.S. 15-year-olds. U.S. students scored below the international average. It should be noted that TIMSS included both developed and developing nations; the international averages for PISA are based on scores for the 30 OECD countries, countries which are industrialized. The comparison of these two international tests points out the difference between memorizing facts, as in the TIMSS, and applying knowledge, as in the PISA. Each of these two tests has its merits. However, application of one's knowledge is much more important than the direct recall of information.[11]

There remains growing inequality of K-12 students' access to solid science and mathematics education, as well as the necessary science and mathematical courses and prerequisites for entering colleges and universities. This will threaten to widen the educational gap that already exists between different economic strata and between the Nation's majority and growing minority population. Many students are faced with a lack of challenging courses, while other students, especially black and Hispanic minorities and students in rural areas, are not offered or are discouraged from taking such courses. Asians/Pacific Islanders were generally more likely than students from other racial/ethnic groups to complete advanced mathematics and science courses, and whites were more likely than blacks and Hispanics to complete advanced courses.[12]

Participation in science and engineering in college is uneven across demographic groups in our population. Our domestic college age population (18- to 24-year-olds) is projected to stop growing, stabilizing at about 30 million from 2010 to 2025; however, groups currently underrepresented in NS&E fields – black, Hispanic and Native American – will account for an increasing share of the college age population, growing from 32 percent in 2010 to 38 percent in 2025.[13] Hispanics will account for 90 percent of the increase in underrepresented minorities.

A High Quality Science and Mathematics Teaching Workforce Is Key

Research shows that a child who has teachers with the knowledge and skills needed to teach mathematics and science effectively in precollege grades is more likely to be able to close the achievement gaps that he or she experiences and be prepared as an individual for success in work and life. The number of certified science and math teachers at the middle and high school levels is down, science education for pre-service teachers at our Nation's education schools appears to be less rigorous compared to other subjects, and elementary teachers do not feel qualified teaching science.[14] College graduates entering the teaching profession tended to have somewhat lower than average academic skills as evidenced by their lower rates of participation in rigorous academic courses in high school, lower achievement tests and lower entrance exams scores than students in other majors.[15]

Nationally between 17 percent and 28 percent of public high school science teachers, depending on field, and 20 percent of mathematics teachers lacked full certification in their teaching field in 2002; the problem was proportionally higher for middle grades. Although most mathematics and science teachers hold a bachelor's degree, many are teaching subjects for which they have had little or no training; this "out-of-field" teaching is most prevalent in rural[16] and urban districts and high poverty areas. These districts reported difficulty acquiring and retaining well-qualified mathematics and science teachers.[17]

America's high schools are obsolete. By obsolete, I don't just mean that our high schools are broken, flawed, and under-funded – though a case could be made for every one of those points. By obsolete, I mean that our high schools – even when they're working exactly as designed – cannot teach our kids what they need to know today…This isn't an accident or a flaw in the system; it is the system.

— Bill Gates, 2005

Teacher Compensation Needs To Be Competitive

Despite the rise in school enrollments and the chronic teacher shortages faced by many school districts, a recently released state-by-state report shows teacher salary levels have barely budged, complicating the Nation's efforts to attract and retain qualified science and math teachers. Over the last decade, teacher salaries have remained nearly flat, growing 2.9 percent in inflation-adjusted dollars. Fifteen states saw real declines in average teachers' salaries between the 1993-94 and 2003-04 school years, adjusted for inflation. States with average salaries declining five percent or more are: Alaska (-14.3%), Kansas (-10.4%), Connecticut (-9.4%), Wisconsin (-6.3%), and New York (-5.2%). Teacher salaries averaged $44,367, just about $2,598 above what they were in 1972 (after adjusting for inflation).[18] About 22.5 percent of science and mathematics teachers who left the profession between 2000 and 2001 reported they did so for better salary and benefits.[19] To make precollege science and math teaching more competitive with other career opportunities, resources must be provided to compensate teachers of mathematics, science and technology comparably to similarly trained S&E professionals in other economic sectors.[20]

Over this decade the Nation will need at least 2 million new teachers[21] because of teacher attrition, retirement and increased student enrollment. These will include 240,000 science and mathematics teachers in middle and high schools.[22] Yet research shows that more than one third of all new teachers leave the profession within 3 years and one half leave within 5 years, often due to poor working conditions and low salaries.[23]

This Nation must make compensation for precollege science and math teaching competitive with other science, technology, engineering and mathematics (STEM) career opportunities if we are to recruit and retain the best teachers in science and mathematics.

Teacher Development Must Respond to Need

By 2002, 48 states had implemented policies to promote participation in teacher professional development and improve the quality of training; however, professional development experiences in many school districts in the late 1990's mainly consisted of one-time workshops with little follow-up. Most teachers attend programs for improvement for only a few hours a year, far below the minimum of 60 to 80 hours that some studies show are needed to bring about meaningful change in teaching behaviors.[24]

This lack of professional development articulates directly into the classroom. With the advances in science and technology, it cannot be expected that teachers will understand – and then teach students – about the advances in DNA sequencing, or cloning, or a myriad of other scientific breakthroughs if they have not themselves had a solid scientific foundation. Obviously this lack of professional development has a direct bearing on the content knowledge of our teachers and on their classroom practices.

New Communication Technologies Offer New Challenges and Opportunities for Educators

We are educating a generation of technology "natives," who have grown up using sophisticated communications and information technologies. This fact alone has helped to transform the way technology is being used and integrated into classroom instruction. The question arises: is this technology used only to gather information or to enhance the student's knowledge? Since the 1990's school systems have invested heavily in how to integrate information technology (IT), as a paper-based system does not make much sense to this generation of students.

At the time of this report, the effectiveness of IT in classroom instruction other than tutorials has not been demonstrated — despite the technological sophistication of students — and there have been no improvements in mathematics and science achievement.[25] However, with the number of students gaining access to technology, we will begin to see advances emerge in our Nation's classrooms. These may include simulations, specialized laboratories, Web research, data collection, analysis projects based outside the school, and experiences and communications with experts or even other students for projects.

The challenge for K-12 education to reach our increasingly technologically sophisticated K-12 student body will require that we shift professional development for teachers in IT away from just learning to use the computer towards more effective use in supporting instructional goals and instruction. This is important because, despite the fact that students know how to use technology, they do not have the grasp of the science and engineering that underlie that technology.

Standards for Education: What Gets Measured Gets Taught

Although K-12 science instructional practices have improved greatly in the past few years, many schools are still not providing the quality science education outlined in the National Science Education Standards (NSES), even with the U.S. fully immersed in efforts to meet the educational accountability requirements set forth by the Federal No Child Left Behind Act of 2001 (NCLB), which took effect in 2002. Under the provisions of the act, states receiving Title I funding must develop academic content standards in mathematics and science by academic year 2005, with assessments for mathematics in each grade from 3 through 8 beginning in 2005. Beginning in academic year 2007, districts must assess student science performance once in elementary school and once in middle school.[26]

Experience has shown us, in education, what gets measured gets taught. Science and mathematics are fundamental skills. They teach us to think critically and analytically. Therefore, assessments must measure more than simple recall. They must measure problem-solving skills. Measurements should support student learning that enhances the application of knowledge.

Findings and Recommendations

These challenges and many more at the K-12 level must be addressed now. We don't have time to wait for a "21st Century *Sputnik*" that will focus attention on these critical needs. Five years ago, The National Commission On Mathematics and Science Teaching for the 21st Century report asked: "As our children move toward the day when their decisions will be the ones shaping a new America, will they be equipped with the mathematical and scientific tools needed to meet those challenges and capitalize on those opportunities?"[27]

Producing the intellectual capital necessary for nurturing, and ensuring the success of America's future generations of scientists and engineers in this increasingly "flat world"[28] – where our international competitors are catching up and exceeding the U.S. in education in mathematics, science and technology – needs to be one of this Nation's highest priorities. Mathematics, science and technology education in our K-12 schools will only improve if we:

Gain Public Support

- Ensure that school administrators, and other "gate-keepers" of science and mathematics education, value skills and knowledge in mathematics, science and technology for those who intend to make careers in these fields but also because they are vital to the Nation's overall workforce and society in a global economy.

- Educate the public on the importance of providing compensation for precollege science and math teachers that is competitive with other STEM career opportunities.

- Provide information that increases the public's knowledge of, and appreciation for, the importance of science and technology in the context of quality of life, economic prosperity, and national security. Informed citizens who have knowledge of basic science facts, concepts, and vocabulary will have an easier time following new reports and participating in public discourse on issues pertaining to science and technology.

Develop and Retain a High Quality Mathematics and Science Teaching Profession

- Provide beginning math and science teachers with induction programs for retention and development.

- To attract and retain precollege science and mathematics teachers, resources must be provided to compensate teachers of mathematics, science and technology comparably to similarly trained S&E professionals in other economic sectors.

- Provide quality, sustained professional development experiences for all K-12 science and mathematics teachers that will: increase and deepen content knowledge, promote a variety of pedagogical approaches and develop questioning strategies, which will advance higher order thinking of all their students.

- Encourage higher education leaders to strengthen K-8 teacher education programs to provide a deeper understanding of the content knowledge necessary to teach mathematics and science.

- Invest in research on teaching and learning that will better inform development of science and mathematics curricula and pedagogical approaches.

- Review teacher education programs focusing on the extent to which prospective teachers are grounded in academic content in the subjects they will teach.

We know – and this report demonstrates – that there is a need to make drastic changes within the Nation's science and mathematics classrooms. If not, our Nation risks raising generations of students and citizens who do not know how to think critically and make informed decisions based on technical and scientific information.

Provide Students Appropriate Opportunities to Learn

- Devote equal time to mathematics, reading and science during the school day, especially in the elementary classrooms. Using inquiry oriented, hands-on experiences that bridge to relevant content will enable students to develop the necessary thinking skills and technical academic language to be successful.

- Educators need effective strategies and instructional materials which will reach this Nation's growing English Language Learners population in order to provide opportunities for all students to develop their mathematical and scientific skills to the limits of their abilities. Regardless of academic ability, language skills and socio-economic status all students will become full citizens of our increasingly technology-based world.

- Engage students at an early age in the career opportunities in science, technology, engineering and mathematics (STEM) careers. Expand incentives for students to study in the STEM fields and enter STEM careers, especially students in underrepresented groups.

- Involve parents, non-classroom-based science educators (museums, zoos, parks and recreation centers), and community and business organizations in fostering and enhancing experiences in K-12 mathematics and science.

Prepare Guidance Counselors to Provide Quality Career Guidance

- Provide guidance counselors the necessary training and information about STEM careers, both degreed and non-degreed. These counselors can play an important role in shaping students' choice of courses, finding the right college, taking admissions tests, filing applications and finding financial aid, in order that they will be prepared better to pursue these careers.

Use Assessments to Reinforce Learning

- Improve science and mathematics assessments to demonstrate the student's ability to think and apply knowledge by developing tests that measure both the subject knowledge and overall student understanding of math and science concepts.

- Use technology simulations for students to actually demonstrate understanding of experimental design so that assessments are not just recall of information.

- Develop more expertise among teachers and administrators on how to use student assessments to inform and improve teaching and learning.

Conclusion

America's competitive edge in this "flat world," its strength and versatility, all depend on an educational system capable of producing young people and productive citizens who are well prepared in science and mathematics. We know – and this report demonstrates – that there is a need to make drastic changes within the Nation's science and mathematics classrooms. If not, our Nation risks raising generations of students and citizens who do not know how to think critically and make informed decisions based on technical and scientific information. Nor will they have a firm grasp of academic language necessary to advance into STEM careers and produce the innovation and discovery necessary to maintain our Nation's prosperity for the future.

Endnotes

1. National Science Board Commission on Precollege Education in Mathematics, Science and Technology, *Educating Americans for the 21st Century* (Washington, DC: National Science Foundation, 1983, CPCE-NSF-04).
2. National Science Board, *Science and Engineering Indicators 2006* and *Science and Engineering Indicators 2004* (Arlington, VA: National Science Foundation, NSB 04-01, 2004 and NSB 06-01, 2006, respectively) report the domestic trends on the National Assessment of Education Progress (NAEP) assessment. These data show that student performance in mathematics improved modestly from 1973 to 1999 for 9, 13, and 17-year-olds. In general, declines occurred in the 1970s, followed by increases in the 1980s and early 1990s and relative stability since that time until the 2004 assessment, when the 9-year-old average scores increased by 9 points. For 17-year-olds, the average performance dropped from 1973 to 1982, rose from 1982 to 1992, and remained about stable thereafter. For science, average student performance improved from the early 1970s to 1999 for 9 and 13-year-olds so that, in spite of a drop in the 1970s, average performance modestly exceeded the earliest measure on the NAEP by 1999. For 17-year-olds, though declines of the 1970s and early 1980s were recouped somewhat, the average score in 1999 still fell below the score in 1969 when the NAEP first assessed 17-year-olds for science. (*Indicators 2004*, p. 1-7 and 2006, p 1-19).
Indicators 2006, p 1-23. The Program for International Study Assessment (PISA), first conducted in 2000 shows that U.S. students perform below the average levels in mathematics and science literacy attained by students in the developed world in 2003, and declined since 2000 in performance in science relative to peer nations.
3. *Indicators 2004*, p 1-14. For advanced students in mathematics, 11 out of 15 participating countries scored higher than the U.S. and no country scored significantly lower. In the advanced physics assessment, U.S. students tied with Australia for the lowest score.
4. The Department of Education National Commission on Excellence in Education, *A Nation At Risk*, 1983, http://www.ed.gov/pubs/NatAtRisk/risk.html, accessed 5 December 2005.
5. *Indicators 2004*, p 1-4.
6. *Indicators 2006*, p 1-23.
7. National Science Board, *The Science and Engineering Workforce – Realizing America's Potential*, (Arlington, VA: National Science Foundation, NSB 03-69, 2003) http://www.nsf.gov/nsb/documents/2003/nsb0369/: p 13.
8. *Indicators 2006*. Bureau of Labor Statistics projection, *Indicators 2006*, Table 3-2.
9. NSB 03-69, p 7.
10. *Indicators 2006*, p 1-5.
11. *Indicators 2006*, p 1-5.
12. *Indicators 2006*, p 1-5.
13. NSB 03-69, citing U.S. Bureau of the Census, Population Division, Projections of the Resident Population by Age, Sex, Race and Hispanic Origin: 1999 to 2001 (Washington, DC: 2000), p 14.
14. *Indicators 2006*, pp 1-31 to 1-35. On teacher perceptions of preparedness, SB Hudson, KC McMahon, CM Overstreet, *The 2000 National Survey of Science and Mathematics Education: Compendium of Tables*, (Chapel Hill, NC: Horizon Research, Inc., Prepared with support from the National Science Foundation under grant number REC-9814246, March 2002), tables on "Teachers' Perceptions of Their Preparation for Each of a Number of Tasks," Grades K-4, 5-8, 9-12, pp 2.2-2.5.
15. *Indicators 2006*, p 1-6.
16. *Indicators 2006*, p 1-34. JD Stern, *The Condition of Education in Rural Schools* (Washington, DC: U.S. Department of Education, Office of Educational and Research Improvement, 1994), p 34, states that,"About one of five teachers in both rural and non-rural settings was responsible for subjects for which they were not academically prepared or certified. In rural areas …24 percent of science teachers lacked academic majors or certification compared to 18 percent of the teachers ... in non-rural settings."
17. The National Commission on Mathematics and Science Teaching for the 21st Century, *Before It's Too Late* (Washington, DC: U.S. Department of Education, 2000, <http://www.ed.gov/americacounts/glenn>, accessed December 2005), p 19, reported that percentages of under-qualified teachers are much greater in high poverty and urban schools.
18. National Education Association, Rankings and Estimates: *Rankings of the States 2004 and Estimates of School Statistics 2005*, (Washington, DC: National Education Association, 2005), p 10.
Alicia R. Williams, Nancy Protheroe, and Willa Cooke, *Salaries and Wages Paid Professional and Support Personal in Public Schools, 2004-2005*, 32nd Edition, (Arlington, VA: Educational Research Service, 2005). According to the Educational Research Service, though average salaries in real dollars declined from 1994-95 to 2004-05 for classroom teachers by $1,628, larger school systems of over 10,000 enrollment experienced an increase. Minimum scheduled salaries for teachers — typically for those with a bachelor's degree and no teaching experience — also increased.
19. *Indicators 2006*, Table 1-12, "Public school teacher leavers who rated various reasons as very or extremely important in their decision to leave profession: 2000-1", shows the self-reported importance of salary.
20. *Indicators 2006*, p 1-37 to 1-38, reported a recent study of weekly wages of teachers and other white collar occupations from 1996 to 2003 showed the teachers' weekly wages consistently and considerably lagged behind those of other workers with similar education and experience and that this gap had enlarged over time (Allegretto, Corcoran, and Mishel 2004).
21. National Center for Education Statistics, Predicting the need for newly hired teachers in the United States to 2008-09, (Washington, DC: U.S. Department of Education, NCES 1999-026, 1999, <http://mces/ed/gpv/pubs99/1999026.pdf>, accessed 6 December 2005), p 9.
22. The National Commission on Mathematics and Science Teaching for the 21st Century, *Before It's Too Late: A Report to the Nation from The National Commission on Mathematics and Science Teaching for the 21st Century*, (Washington, DC: U.S. Department of Education, 2000, <http://www.ed.gov/americacounts/glenn>, accessed 6 December 2005), p 29.
23. Richard M. Ingersoll, "Is There Really A Teacher Shortage?" (Washington, DC: The Consortium for Policy Research in Education and The Center for the Study of Teaching and Policy, September 2003), Figure 4; and Teacher Turnover, *Teacher Shortages, and the Organization of Schools* (Seattle, WA: University of Washington, January 2001), p 17.
24. *Indicators 2006*, 1-37.
25. *Indicators 2006*, 1-45 to 1-48.
26. No Child Left Behind Act, 2001.
27. *Before It's Too Late*, p 6.
28. Thomas L. Friedman, *The World Is Flat: A Brief History of the Twenty-first Century* (New York: Farrar, Straus, and Giroux, 2005).

Sidebar quotes

Thomas L. Friedman —

- *The World Is Flat*, p 256.
- "Still Eating Our Lunch – Singapore," *New York Times*, 16 September 2005.

National Academies, Committee on Science, Engineering and Public Policy, *Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, (Washington, DC: National Academies Press, 2005), p 5-3.

Bill Gates, Co-founder, Bill and Melinda Gates Foundation, Prepared Remarks, National Education Summit on High Schools, 26 February 2005 <http://www.gatesfoundation.org/MediaCenter/Speeches/BillgSpeeches/BGSpeechNGA-050226.htm>, accessed 12 December 2005.

For Digital copies of this report: http://www.nsf.gov/statistics/seind06/

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