TAPPING AMERICA'S POTENTIAL

The Education for Innovation Initiative

AeA

Business Roundtable

Business-Higher Education Forum

Computer Systems Policy Project

Council on Competitiveness

Information Technology Association of America

Information Technology Industry Council

Minority Business RoundTable

National Association of Manufacturers

National Defense Industrial Association

Semiconductor Industry Association

Software and Information Industry Association

TechNet

Telecommunications Industry Association

U.S. Chamber of Commerce

GOAL:

Double the number of science, technology, engineering and mathematics graduates by 2015

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July 2005

To Leaders Who Care about America's Future:

Fifteen of our country's most prominent business organizations have joined together to express our deep concern about the United States' ability to sustain its scientific and technological superiority through this decade and beyond. To maintain our country's competitiveness in the 21st century, we must cultivate the skilled scientists and engineers needed to create tomorrow's innovations.

Our goal is to double the number of science, technology, engineering and mathematics graduates with bachelor's degrees by 2015.[1]

The United States is in a fierce contest with other nations to remain the world's scientific leader. But other countries are demonstrating a greater commitment to building their brainpower. Consider these facts:

Increasing international competition:

- By 2010, if current trends continue, more than 90 percent of all scientists and engineers in the world will be living in Asia.[2]
- South Korea, with one-sixth of our population, graduates as many engineers as the United States.[3]

Increasing reliance on and reduced availability of foreign talent to work in the United States:

- More than 50 percent of all engineering doctoral degrees awarded by U.S. engineering colleges are to foreign nationals.[4]
- However, security concerns in the United States are reducing the number of foreign students, while competition for this talent from other countries and the opportunity to return to their home countries to work is increasing.

Alarming domestic trends:

- The number of engineering degrees awarded in the United States is down 20 percent from the peak year of 1985.[5]
- Although U.S. fourth graders score well against international competition, they fall near the bottom or dead last by 12th grade in mathematics and science, respectively.[6]

Our organizations feel strongly that the United States must respond to this challenge as energetically as we did to the Soviet Union's launching of Sputnik in the 1950s. To remain the technological leader in the 21st century, we must establish and achieve an ambitious goal: We must double today's science, technology, engineering and mathematics graduates with bachelor's degrees by 2015.

Current federal education reform programs, such as No Child Left Behind, and state efforts to redesign high schools provide a foundation that we can build on. However, to sustain American competitiveness in science and engineering, we need a focused, long-term, comprehensive initiative by the public and private sectors to:

1. Build public support for making improvement in science, technology, engineering and mathematics performance a national priority.

2. Motivate U.S. students and adults, using a variety of incentives, to study and enter science, technology, engineering and mathematics careers, with a special effort geared to those in currently underrepresented groups.

3. Upgrade K–12 mathematics and science teaching to foster higher student achievement, including differentiated pay scales for mathematics and science teachers.

4. Reform visa and immigration policies to enable the United States to attract and retain the best and brightest science, technology, math and engineering students from around the world to study for advanced degrees and stay to work in the United States.

5. Boost and sustain funding for basic research, especially in the physical sciences and engineering.

The recommendations above and the statement, "Tapping America's Potential: The Education for Innovation Initiative," that follows echo the alarm expressed by numerous prestigious public and private groups about the need to inspire, recruit and train a larger domestic pool of technical talent. This is so vital for the security and continued prosperity of our country that we can no longer delay action.

We are calling on business leaders to unite with government officials at all levels — national, state and local — to create the momentum needed to achieve this goal. We are committed to providing the leadership and sustained effort needed to help the American people realize the dimensions of the problem and the urgent need for solutions.

Sincerely,

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A Statement by ...

AeA, Business Roundtable, Business-Higher Education Forum, Computer Systems Policy Project, Council on Competitiveness, Information Technology Association of America, Information Technology Industry Council, Minority Business RoundTable, National Association of Manufacturers, National Defense Industrial Association, Semiconductor Industry Association, Software & Information Industry Association, TechNet, Telecommunications Industry Association, and the U.S. Chamber of Commerce

Almost 50 years ago, the Soviet Union shocked Americans by launching Sputnik, the first Earth orbit satellite. The U.S. response was immediate and dramatic. Less than a year later, President Eisenhower signed into law the National Defense Education Act, a major part of the effort to restore America's scientific pre-eminence.[7]

Today, our nation faces a more serious, if less visible, challenge. One of the pillars of American economic prosperity — our scientific and technological superiority — is beginning to atrophy even as other nations are developing their own human capital.

If we wait for a dramatic event — a 21st-century version of Sputnik — it will be too late. There may be no attack, no moment of epiphany, no catastrophe that will suddenly demonstrate the threat. Rather, there will be a slow withering, a gradual decline, a widening gap between a complacent America and countries with the drive, commitment and vision to take our place.

History is replete with examples of world economies that once were dominant but declined because of myopic, self-determined choices.

The United States is at such a critical point in our own history.

Virtually every major respected organization representing business, research and education, as well as government science and statistics agencies and commissions,[8] has extensively documented the critical situation in U.S. science, technology, engineering and mathematics. The indicators range from measurable declines in U.S. innovation, such as patents and scientific articles, to soaring numbers of students in Asia majoring in these fields, to U.S. students' lagging interest and measured performance in math and science.

Among the warning signs:

- **Foreign competition:** China not only graduates four times as many engineers as the United States,[9] but it also offers lucrative tax breaks to attract companies to conduct research and development (R&D) in the country.[10]
- **Interest in engineering:** Out of the 1.1 million high school seniors in the United States who took a college entrance exam in 2002, just under 6 percent indicated plans to pursue a degree in engineering — nearly a 33 percent decrease in interest from the previous decade.[11]
- **Student achievement:** On a recent international assessment of 15-year-olds' math problem-solving skills, the United States had the smallest percentage of top performers and the largest percentage of low performers compared to the other participating developed countries.[12] This is not surprising when nearly 70 percent of middle school students are assigned to teachers who have neither a major nor certification in mathematics.[13]
- **Investment in basic research:** In the United States, since 1970, funding for basic research in the physical sciences has declined by half (from 0.093 percent to 0.046 percent) as a percentage of the gross domestic product (GDP).[14]

For most of the 20th century, the American education system provided a substantial part of the talent and proficiency needed to sustain and improve our way of life. In addition, many foreign scientists were attracted to pursue research in the United States by the American scientific enterprise's top-notch facilities and financial support, and by their own desire to escape totalitarian regimes and live in a free society.

Today, however, as the U.S. economy becomes even more reliant on workers with greater knowledge and technological expertise, the domestic supply of qualified workers is not keeping up with the skill demands. Employers are increasingly interested in hiring people who not only can execute well but also can create the next wave of innovation. One economist estimates that "trailing other developed countries on education measures may reduce U.S. economic growth by as much as a half percentage point a year."[15] All projections suggest that the discrepancy between supply and demand of domestic talent will grow more pronounced. In the face of the declining interest and proficiency of Americans in science, math and engineering, American industry has become increasingly dependent — some would say overly dependent — on foreign nationals to fill the demand for talent in a variety of fields that require strong backgrounds in science, technology, engineering and mathematics.

A number of developments — including heightened security after September 11, growing competition from other countries for the same foreign talent and the technological capacity for foreign talent to work in their home countries — have underscored the need for greater scientific and technological self-sufficiency in our country. The United States has always welcomed the best and brightest from other countries to study and work here, and we should continue to do so. We cannot and should not, however, rely so heavily on foreign talent to fill critical positions in teaching, research and industry.

From Rhetoric to Action

A remarkable consensus emerges from the recommendations in recent reports and statements about what the United States must do to maintain its pre-eminence in science and engineering and to prepare its future workforce for the high-skilled jobs created by a growing U.S. economy. The CEOs, university presidents, members of Congress, Cabinet secretaries, governors, Nobel Laureates, scientists, mathematicians, researchers and educators on different prestigious commissions and panels all agree that the United States risks a declining standard of living if America postpones taking aggressive, strategic action.

The sense of urgency among those who see the problem at home and increased competition from abroad provides a catalyst for action. Those who have studied or experienced this challenge must provide leadership to build a broader understanding of what is at stake, as well as provide support to undertake a corrective course.

Although numerous policy initiatives and programs are under way, none matches the coordinated vision, concentrated energy, attention and investment that emerged from the shock Americans faced when the Soviet Union beat the United States into space with Sputnik in 1957. We need a 21st-century version of the post-Sputnik national commitment to strengthen science, technology, engineering and math education. We need a public/private partnership to promote, fund and execute a new National Education for Innovation Initiative. It must be broader than the 1958 National Defense Education Act because federal legislation is only one component of a larger, more comprehensive agenda.

The federal government must play a critical role in this endeavor. We understand that states and local communities determine most of the funding and governance of our public education system. We know that the private sector can and must do more. Nevertheless, this is a national problem that demands national leadership and a sense of national purpose to create the impetus for crucial state, local, private and individual action.

We firmly believe that the federal government can maintain fiscal discipline and restrain discretionary spending while also making "smart investments" to secure our nation's future. It will require making hard choices, but the resources can be found if the national interest drives decisions. We recognize that we will have to make our case to the American people to build the political support for moving this issue to the top of the national agenda.

Why Education Reform Is Necessary but Insufficient

The United States spends more than $455 billion annually for elementary and secondary education.[16] There is disagreement over whether the amount is enough and whether it is well-spent, but there is no argument that resources and reform must work in tandem to produce acceptable results.

Past national and state efforts to improve U.S. math and science achievement clearly demonstrate that they cannot be isolated from the need to improve the overall quality and results of the entire U.S. education system, pre-K through 16. That is why the business community supports high-quality early childhood education; implementation of the No Child Left Behind Act; the Action Agenda for Improving America's High Schools, adopted at the 2005 National Education Summit on High Schools;[17] the moral and economic imperative to address the reality that close to a third of teenagers drop out before they graduate from high school;[18] expansion of charter schools; and greater access to and completion of higher education. The current local, state and national focus that No Child Left Behind has brought to closing the achievement gap between majority and minority students was long overdue and is beginning to pay off.[19] These education reform initiatives represent significant progress. However, they must be supplemented by the recommendations in this paper because of four unique challenges that science, technology, engineering and math improvement must address:

1. Depletion of the teacher talent pool by the private sector: College graduates who major in math and science can earn far more as private sector employees than as teachers.[20] Higher-aptitude students also find performance-based compensation in the private sector more appealing than the traditional teacher salary schedule based on years of experience and degrees.[21]

2. Cyclical employment trends: Labor supply in these fields is particularly sensitive to changes in the economy. Growth and decline in the number of annual majors in science and engineering closely track with hiring and layoff cycles; the supply of graduates typically lags behind the pace of economic recovery. To counter the impact of these trends on students' choices of majors, high school and college students need better information about the wide range of opportunities that science, technology, engineering and math degrees open up to them.[22]

3. Government security needs: U.S. government agencies and firms that handle sensitive national security research and development must hire qualified American citizens, a requirement that presents a further demand for domestic talent.

4. Baby boom retirement: More than 50 percent of the current science and engineering workforce is approaching retirement. It must be replaced by a larger pool of new talent from a more diverse population.

Recommendations

From the U.S. Commission on National Security/21st Century's report in 2001 to the Business' Higher Education Forum's report in 2005, we identified a core set of recommendations in a dozen recent reports that we can begin to initiate, even in this tight budget year. The recommendations may need to begin incrementally. However, to reach our goal of doubling the number of science, technology, engineering and math graduates by 2015, we must focus as quickly as possible in the years ahead on five critical areas that affect the choices made by students now in the pipeline. (For each action proposed within the five areas, we identify in parentheses who has primary responsibility.)

1. Build public support for making science, technology, engineering and math improvement a national priority.

- Launch a campaign to help parents, students, employees and community leaders understand why math and science are so important to individual success and national prosperity. *(Business)*
- Expand the State Scholars Initiative to encourage students to take rigorous core academic courses in high school and provide role models and other real world examples of the work that engineers and scientists do.[23] *(Business)*

2. Motivate U.S. students and adults to study and enter science, technology, engineering and mathematics careers, with a special effort geared to those in currently underrepresented groups.

- Create more scholarships and loan-forgiveness programs for students who pursue two-year, four-year and graduate degrees in science, technology, math and engineering (including students who plan to teach math and science, particularly in high-poverty schools). Build on existing programs such as Science, Mathematics and Research for Transformation (SMART) at the Department of Defense;[24] the Science and Technology Scholarship Program (STSP) at NASA;[25] Robert Noyce Scholarships at the National Science Foundation (NSF);[26] and federal loan forgiveness programs that provide up to $17,500 for secondary math and science teachers. Supplement Pell Grants for eligible students who successfully complete core academic courses in high school.[27] *(Federal, State, Business)*

- Increase the retention rate of undergraduates in science, technology, engineering and math majors by expanding programs such as NSF's Science, Technology, Engineering and Mathematics Talent Expansion Program (STEP Tech Talent)[28] and by offering programs such as the Professional Science Masters that encourage college graduates to pursue fields outside of academia that combine science and/or math with industry needs.[29] Encourage private sector involvement in consortia of industries and universities that establish clear metrics to increase the number of graduates. *(Higher Education, Business, Federal, State)*
- Eliminate the security clearance backlog that discourages many talented U.S. citizens — graduating students and adults — from entering key national security science, technology, engineering and math careers by providing an expedited clearance process. *(Federal)*
- Establish prestigious fellowships for exceptional recent college graduates or those at mid-career that lead to certification and a five-year commitment to teach math or science in schools with high-poverty populations.[30] *(Federal, State, Business)*
- Create opportunities for high-achieving math and science students, such as advanced courses, math or science immersion experiences, corporate internships, charter schools, local magnet programs and regional/state magnet schools. *(State, Business)*
- Adopt curricula that include rigorous content as well as real world engineering and science experiences so that students learn what it means to do this work, what it takes to get there, and how exciting these fields are. *(District, Business)*

3. Upgrade K–12 math and science teaching to foster higher student achievement.

- Promote market- and performance-based compensation and incentive packages to attract and retain effective math and science teachers. Provide the flexibility for high school teachers, retirees and other qualified professionals to teach these subjects part time.[31] Resources in No Child Left Behind that can be used to develop alternative teacher compensation systems and the proposed federal teacher incentive program are particularly crucial for helping to address shortages of math and science teachers. *(Business, District, State, Federal)*

- Support cost-effective professional development and other technical assistance to fill gaps in teachers' content knowledge and prepare them to teach the content effectively. Promote and strengthen use of existing resources in federal education laboratories, regional technical assistance centers, No Child Left Behind, and focused Math and Science Partnerships (MSP) to support best practices, with a priority on those who teach math in schools that are not making "adequate yearly progress" (AYP). *(State, District, Higher Education, Federal, Business)*
- Include incentives in the Higher Education Act and in state policies for colleges and universities to produce more math, science and engineering majors and to strengthen preparation programs for prospective math and science teachers. *(Federal, State, Higher Education)*
- Strengthen and enforce the highly qualified teacher provisions in No Child Left Behind for math and science teachers to ensure that they have the requisite knowledge in the subjects they are assigned to teach. *(Federal, State)*
- Launch a "Math Next" initiative as a logical next step to the U.S. Department of Education's focus on Reading First. *(Federal, State)*
- Provide high-quality online alternatives and postsecondary options for students in any middle school or high school that does not offer advanced math and science courses. *(State)*

4. Reform visa and immigration policies to enable the United States to attract and retain the best and brightest science, technology, math and engineering students from around the world to study for advanced degrees and stay to work in the United States.

- Provide an expedited process to obtain permanent residence for foreign students who receive advanced degrees in these fields at U.S. universities. *(Federal)*
- Ensure a timely process for foreign students who want to study science, technology, engineering and math fields at U.S. universities to obtain the necessary visas by clearing Department of Homeland Security requirements. *(Federal)*

5. Boost and sustain funding for basic research, especially in the physical sciences and engineering.

- Reverse declines in the federal share of total R&D spending, particularly for basic research in the physical sciences and engineering at the NSF, National Institute of Standards and Technology (NIST), U.S. Department of Defense basic research programs,[32] and U.S. Department of Energy Office of Science, by adding a minimum of 7 percent per year to enable research to keep up with growth and inflation.[33] *(Federal)*

As a first step, all of the federal Cabinet secretaries with a stake in this issue — Defense, Education, Homeland Security, Commerce, Labor and Energy — should convene to map out how they can best mobilize to address the problem. To succeed, a strategic approach to the reauthorizations of relevant federal programs, a governmentwide focus across federal and state agencies, dynamic public-private partnerships, the frequent use of the bully pulpit, and vigorous private sector leadership and investment will be required. All of these efforts should be driven by a commitment to inspire and educate a new generation of mathematically and scientifically adept Americans.

Conclusion

This statement focuses on actions that can be initiated this year. Is this enough to solve the problem? Absolutely not. Clearly, a successful national Education for Innovation Initiative will need a comprehensive, long-term plan developed in partnership with the states. However, we must begin moving forward now.

Business leaders are united around this agenda. We will work with the administration, members of Congress, governors, educators, colleges and universities, and member companies to identify specific legislative, regulatory, programmatic and corporate philanthropic vehicles to adopt these recommendations. We will provide the leadership needed to help the American public realize the dimensions of the problem and the urgent need to implement solutions.

We must not disregard our history nor forget who we are. We are the people who pioneered in the air, built the first mass production assembly line, discovered vaccines for polio, harnessed the power of the atom, first set foot on the moon, and developed the best private and public biomedical research enterprise in the world. We are still that same people, still equal to the challenge if only we resolve to meet it.

As World War II was drawing to a close, Congress approved the GI Bill, which provided billions of dollars in education and training benefits to nearly 10 million veterans between 1944 and 1956. Perhaps no greater investment in human capital has been made in American history. The return to American taxpayers on that investment has been incalculable.

This generation now faces an entirely new challenge, both at home and abroad. Any number of countries in Asia and Europe are educating and training their citizens and competing with — and, in several cases, beginning to surpass — the United States for talent to develop new technologies, new cures, new frontiers.

If we take our scientific and technological supremacy for granted, we risk losing it. What we are lacking at the moment is not so much the wherewithal to meet the challenge, but the will. Together, we must ensure that U.S. students and workers have the grounding in math and science that they need to succeed and that mathematicians, scientists and engineers do not become an endangered species in the United States.

Endnotes

[1] The baseline for the goal is taken from the most recent data (2001) in National Science Board's *Science and Engineering Indicators, 2004*:

2001 bachelor's degrees earned by U.S. citizens/ permanent residents:

- 14,048 in physical sciences
- 4,001 in earth, atmospheric and ocean sciences
- 63,528 in biological sciences
- 11,256 in math
- 34,502 in computer sciences
- 17,986 in agricultural sciences
- 55,003 in engineering

TOTAL: 200,324

Therefore, the goal is 400,000 bachelor's degrees earned by U.S. citizens/permanent residents by 2015.

[2] Prediction by Richard E. Smalley, Gene and Norman Hackerman Professor of Chemistry and Professor of Physics & Astronomy, Rice University, in a PowerPoint presentation, "Nanotechnology, the S&T Workforce, Energy, and Prosperity," to the President's Council of Advisors on Science and Technology (PCAST), March 3, 2003. Available at http://cohesion.rice.edu/NaturalSciences/Smalley/emplibrary/PCAST%20March%203,%202003.ppt#432,8,Slide8.

[3] National Science Board, *Science and Engineering Indicators, 2004*. Volume 2, Appendix Table 2–34.

[4] *Ibid.* Appendix Table 2–28.

[5] *Ibid.* Appendix Table 2–22.

[6] U.S. Department of Education, National Center for Education Statistics, *Trends in International Mathematics and Science Study*. Fourth- and eighth-grade results are available at http://nces.ed.gov/pubs2005/2005005.pdf. Twelfth-grade results are available at http://nces.ed.gov/pubs98/98049.pdf.

[7] Enacted in 1958 and funded initially for $115,300,000, the National Defense Education Act (NDEA) provided support to all levels of education, public and private, in the United States. Its primary focus was on the advancement of student knowledge in mathematics, science and modern foreign languages. Institutions of higher education were provided with 90 percent of capital funds to use for low-interest loans to students. K–12 teachers educated with NDEA support were later able to get part of their loan forgiven for each year of teaching (5–7 years, forgiveness for amounts of 50–100 percent). NDEA also gave general support for improvements to elementary and secondary education, with statutory prohibitions against federal control or influence over curriculum, pedagogy, administration or personnel at any educational institution. Many individuals in the STEM workforce — those in their 50s and 60s today — cite NDEA as a major source of support for their postsecondary degrees.

[8] A partial listing includes: Business-Higher Education Forum, *A Commitment to America's Future: Responding to the Crisis in Mathematics and Science Education*, February 2005; AEA, *Losing the Competitive Advantage? The Challenge for Science and Technology in the United States*, February 2005; Task Force on the Future of American Innovation, *The Knowledge Economy: Is the United States Losing Its Competitive Edge?* February 16, 2005; Council on Competitiveness, *Innovate America, National Innovation Initiative Report: Thriving in a World of Challenge and Change*, December 2004; *Learning for the Future: Changing the Culture of Math and Science Education to Ensure a Competitive Workforce*, Statement by the Research and Policy Committee of the Committee for Economic Development, 2003; President's Council of Advisors on Science and Technology (PCAST), *Assessing the U.S. R&D Investment*, 2002; Building Engineering & Science

Talent, *The Quiet Crisis: Falling Short in Producing American Scientific and Technical Talent,* September 2002; Phase III Report of the U.S. Commission National Security/21st Century (The Hart-Rudman Commission), *Road Map for National Security: Imperative for Change*, March 15, 2001; National Commission on Mathematics and Science Teaching for the 21st Century (Glenn Commission), *Before It's Too Late: A Report to the Nation from the The National Commission on Mathematics and Science Teaching for the 21st Century* (Glenn Commission), September 27, 2000.

9. National Science Board, *Science and Engineering Indicators, 2004*. Appendix Table 2-34.

10. Matthew Kazmierczak, *Losing the Competitive Advantage? The Challenge for Science and Technology in the United States* (Washington, DC: AEA, 2005).

11. Richard J. Noeth et al., *Maintaining a Strong Engineering Workforce: ACT Policy Report* (Iowa City: ACT, Inc., 2003). Available at http://www.act.org/path/policy/pdf/engineer.pdf.

12. U.S. Department of Education, National Center for Education Statistics, *International Outcomes of Learning in Mathematics Literacy and Problem Solving: 2003 PISA Results from the U.S. Perspective* (Washington, DC: U.S. Department of Education, 2004).

13. *Ibid, Qualifications of the Public School Teacher Workforce: Prevalence of Out-of-Field Teaching 1987–88 to 1999–2000 — Statistical Analysis Report*. Table 1.

14. American Association for the Advancement of Science, *Report XXX: Research and Development FY 06*, Chapter Two, "Historical Trends in Federal R&D." Available at http://www.aaas.org/spp/rd/06pch2.htm.

15. June Kronholz, "Economic Time Bomb: U.S. Teens Are Among the Worst at Math," *The Wall Street Journal*, December 7, 2004.

16. U.S. Department of Education, National Center for Education Statistics, *Revenues and Expenditures for Public Elementary and Secondary Education: School Year 2002–03* (Washington, DC: U.S. Department of Education, May 2005). Available at http://nces.ed.gov/pubs2005/2005353.pdf.

17. The Agenda for Action released at the 2005 National Education Summit on High Schools calls on governors and business and education leaders to develop a comprehensive plan for their states to restore value to the high school diploma to ensure graduates are college- and work-ready, redesign the American high school, give high school students the excellent teachers and principals they need, hold high schools and colleges accountable for student success, and streamline educational governance. Available at http://www.achieve.org/achieve.nsf/2005Summit?OpenForm and http://www.nga.org.

18. Jay P. Greene and Marcus A. Winters, *Public High School Graduation and College Readiness Rates: 1991–2002* (New York: Manhattan Institute for Policy Research, February 2005); Christopher B. Swanson, *Who Graduates? Who Doesn't? A Statistical Portrait of Public High School Graduation, Class of 2001* (Washington, DC: Urban Institute, 2004); Andrew Sum, Paul Harrington et al., *The Hidden Crisis in the High School Dropout Problems of Young Adults in the U.S.: Recent Trends in Overall School Dropout Rates and Gender Differences in Dropout Behavior* (Washington, DC: Business Roundtable, February 2003). Available at http://www.businessroundtable.org.

19. The National Assessment of Educational Progress (NAEP) long-term trend assessment scores released on July 14,

2005, show gains among 9-year-olds in reading, as well as a closing of the achievement gap in reading for African American and Hispanic students. The NAEP data also show significant improvement and a closing of the achievement gap in mathematics among 9- and 13-year-olds.

[20.] National Council on Teacher Quality (NCTQ), *Higher Pay for Math, Science and Other Shortage Subjects* (Washington, DC: NCTQ).

[21.] Carolyn Hoxby, "Changing the Profession," *Education Next*, Hoover Institution, 2001. Available at http://www.educationnext.org/2001sp/57.html.

[22.] For example, there is a high economic return for an engineering degree even if a graduate works in a non-engineering field. From Neeta P. Fogg, Paul E. Harrington and Thomas F. Harrington, *College Majors Handbook with Real Career Paths and Payoffs: The Actual Jobs, Earnings, and Trends for Graduates of Sixty College Majors*, 2nd ed. (Indianapolis: JIST Publishing, 2004).

[23.] The State Scholars Initiative is a business-led effort that focuses on preparing high school students for college and careers through rigorous coursework. The Initiative is currently offered in 14 states. Available at http://www.centerforstatescholars.org.

[24.] The Department of Defense Science, Mathematics and Research for Transformation (SMART) Scholarship provides financial assistance to students pursuing degrees in science, math and engineering fields in return for a commitment to work for the Defense Department. Available at http://www.asee.org/resources/fellowships/smart/.

[25.] The Science and Technology Scholarship Program (STSP) is currently being developed by NASA. The scholarship-for-service program will provide scholarship and internship opportunities to undergraduate students pursuing degrees in engineering, mathematics, computer science and physical/life sciences. Students will compete for scholarship awards of up to $20,000 per year in exchange for a commitment to work full time at a NASA Center or one of its affiliates upon graduation. Available at http://education.nasa.gov/divisions/higher/overview/F_pathfinder_scholarship.html.

[26.] The Robert Noyce Scholarship Program at NSF provides funds to institutions of higher education to support scholarships, stipends and programs for talented science, technology, engineering and mathematics majors and professionals to become K–12 math and science teachers in high-need K–12 schools. Available at http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5733&org=NSF.

[27.] Signed into law on October 30, 2004, by President Bush, the Taxpayer-Teacher Protection Act (P.L. 108-409) authorizes up to $17,500 in loan forgiveness to eligible, highly qualified teachers in special education, secondary math or secondary science. Available at http://www.ifap.ed.gov/dpcletters/GEN0414.html.

[28.] The goal of the Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP), created by the Tech Talent legislation, is to increase the number of students — U.S. citizens or permanent residents — receiving associate's or bachelor's degrees in science, technology, engineering and mathematics. Available at http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5488.

[29.] The Professional Science Master's is a degree in science or mathematics for students interested in a wider variety of career options than provided by current graduate programs in the two subjects. Available at http://www.sciencemasters.com/.

[30] The National Commission on Mathematics and Science report, *Before It's Too Late: A Report to the Nation from The National Commission on Mathematics and Science Teaching for the 21st Century,* identifies goals for improving mathematics and science teaching. Available at http://www.ed.gov/inits/Math/glenn/report.pdf.

[31] The Teaching Commission's report, *Teaching at Risk: A Call to Action,* identifies the need to differentiate compensation and develop incentives to recruit and retain teachers in shortage fields. Available at http://www.theteachingcommission.org/publications/FINAL_Report.pdf.

[32] The specific Department of Defense programs are 6.1 and 6.2.

[33] The federal effort in research must keep pace with the overall growth of the economy, not fall, as it has outside of biomedical research. The 7 percent is based on 3 percent (real GDP growth) plus 4 percent (NIH and higher education price index), which equals 7 percent.

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