

**Preparing the Next Generation
of STEM Innovators:
Identifying and Developing
Our Nation's Human Capital**

May 5, 2010

NATIONAL SCIENCE BOARD



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EXECUTIVE SUMMARY

On November 17, 1944, in the midst of World War II, President Franklin Delano Roosevelt wrote a letter to Vannevar Bush, head of the U.S. Office for Scientific Research and Development. In that letter, President Roosevelt posed the question:

*Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?*¹

In *Science—The Endless Frontier*, Vannevar Bush offered his answer to this question. In his response, Bush called for the renewal of our scientific talent through the U.S. education system. He wrote:

*The responsibility for the creation of new scientific knowledge rests on that small body of men and women who understand the fundamental laws of nature and are skilled in the techniques of scientific research. While there will always be the rare individual who will rise to the top without benefit of formal education and training, he is the exception and even he might make a more notable contribution if he had the benefit of the best education we have to offer.*²

A little more than a decade later, mobilized by the Soviet's successful launch of Sputnik, the United States embarked on a collective, coordinated, and sustained effort to recruit and educate the "best and brightest" who subsequently would form a new generation of leaders and innovators in science and engineering. This effort resulted in unprecedented scientific and technological progress, leading to the creation of new enterprises, new jobs, and the betterment of the national standard of living. At the root of this progress was a substantial investment in research and development, along with a nationwide focus on excellence in science, technology, engineering, and mathematics (STEM) education and talent development. Regrettably, by the 1970s, this national sense of urgency had diminished, and complacency soon supplanted the ideal of excellence in education. Today, faced with growing international competition, the cost of inaction continues to grow at an intensifying pace.

The National Science Board (Board) firmly believes that to ensure the long-term prosperity of our Nation, we must renew our collective commitment to excellence in education and the development of scientific talent. Currently, far too many of America's best and brightest young men and women go unrecognized and underdeveloped, and, thus, fail to reach their full potential. This represents a loss for both the individual *and* society. The Nation needs "STEM innovators"—those individuals who have developed the expertise to become leading STEM professionals and perhaps the creators of significant breakthroughs or advances in scientific and technological understanding. A key component of innovation is the development of new products, services, and processes essential to the Nation's international leadership. Just as in generations past, there are talented students from every demographic and from every part of our Country who with hard work and with the proper opportunities will form the next generation of STEM innovators. The vital importance of innovation to the U.S. economy led the Board to embark on a 2-year exploration of this issue.

Our analyses of research and demographic data, as well as our consultation with a wide range of experts, practitioners, policy-makers, and STEM innovators, led us to identify three major areas where focused attention is essential. First, while there are some examples of high-impact educational policies and practices that are effective in enabling tomorrow's potential STEM innovators to thrive, many more are needed. Second, a commitment to equity and diversity, and analyses of demographic trends, lead to the conclusion that new, ambitious efforts to cast a wide net in seeking and inspiring tomorrow's STEM leaders are critical. Finally, it is clear that when the learning environment is infused with high expectations and a commitment to excellence, the potential for future innovators to flourish is great.

To identify and develop the next generation of STEM innovators, the Board makes three keystone recommendations. Each recommendation contains several *policy actions* for the National Science Foundation (NSF), other Federal entities, and the Nation. Additionally, for each keystone recommendation, the Board proposes a *research agenda* for NSF that will ensure the policy actions are supported by the best available research. The keystone recommendations and a summary of the policy actions are listed below. The findings and research agenda can be found in the main body of the report (pp. 15-25).

Keystone Recommendations:

I. *Provide opportunities for excellence.* We cannot assume that our Nation's most talented students will succeed on their own. Instead, we must offer coordinated, proactive, sustained formal and informal interventions to develop their abilities. Students should learn at a pace, depth, and breadth commensurate with their talents and interests and in a fashion that elicits engagement, intellectual curiosity, and creative problem solving—essential skills for future innovation.

To achieve this goal, the Board proposes the following policy actions:

- A. Encourage states and/or local education agencies to adopt consistent and appropriate policies on differentiated instruction, curriculum acceleration, and enrichment, and to recognize the achievement levels of students moving or transitioning to different schools.
- B. Increase access to and quality of college-level, dual enrollment, and other accelerated coursework, as well as high-quality enrichment programs.
- C. Support rigorous, research-based STEM preparation for teachers, particularly general education teachers, who have the most contact with potential STEM innovators at young ages.
- D. Provide Federal support to formal and informal programs that have a proven record of accomplishment in stimulating potential STEM innovators.
- E. Leverage NSF's *Broader Impacts Criterion* to encourage large-scale, sustained partnerships among higher education institutions, museums, industry, content developers and providers, research laboratories and centers, and elementary, middle, and high schools to deploy the Nation's science assets in ways that engage tomorrow's STEM innovators.

- F. Create NSF programs that offer portable, merit-based scholarships for talented middle and high school students to participate in challenging enrichment activities.
- G. Increase the technological capabilities and network infrastructure in rural and low-income areas, and expand cyber-learning opportunities.
- H. Create a national database of formal and informal education opportunities for highly talented students, and publicize and promote such opportunities nationally to parents, education professionals, and content and resource providers.

II. *Cast a wide net* to identify *all* types of talents and to nurture potential in *all* demographics of students. To this end, we must develop and implement appropriate talent assessments at multiple grade levels and prepare educators to recognize potential, particularly among those individuals who have not been given adequate opportunities to transform their potential into academic achievement.

To achieve this goal, the Board proposes the following policy actions:

- A. Improve pervasiveness and vertical coherence of existing talent assessment systems.
- B. Expand existing talent assessment tests and identification strategies to the three primary abilities (quantitative/mathematical, verbal, and spatial) so that spatial talent is not neglected.
- C. Increase access to appropriate above-level tests and student identification mechanisms, especially in economically disadvantaged urban and rural areas.
- D. Encourage pre-service education and professional development for education professionals (including teachers, principals, and counselors) in the area of talent identification and development.
- E. Encourage pediatricians and early childhood educators, especially *Head Start* teachers, to become knowledgeable about early signs of talent and the need for its nurturance.

III. *Foster a supportive ecosystem* that nurtures and celebrates excellence and innovative thinking. Parents/guardians, education professionals, peers, and students themselves must work together to create a culture that expects excellence, encourages creativity, and rewards the successes of all students regardless of their race/ethnicity, gender, socioeconomic status, or geographical locale.

To achieve this goal, the Board proposes the following policy actions:

- A. Create a national campaign aimed at increasing the appreciation of academic excellence and transforming stereotypes towards potential STEM innovators.
- B. Encourage the creation of positive school environments that foster excellence by providing professional development opportunities for teachers, principals, counselors, and other key school staff.

- C. Support the expansion of computing and communications infrastructure in elementary, middle, and high schools to foster peer-to-peer connections and collaborations, and direct connections with the scientific research community.
- D. Hold schools, and perhaps districts and states, accountable for the performance of the very top students at each grade.
- E. Have NSF, in partnership with the Institute of Education Sciences, hold a high-level conference to bring together researchers in the learning sciences, other scientists, education school administrators, current teachers and principals, and teacher professional associations to discuss teacher preparation and pedagogical best practices aimed at fostering innovative thinking in children and in young adults.

The United States is faced with a clear and profound choice between action and complacency. The Board firmly believes that a coherent, proactive, and sustained effort to identify and develop our Nation's STEM innovators will help drive future economic prosperity and improve the quality of life for all. Likewise, providing opportunities for all young men and women to reach their potential will serve the dual American ideals of equity *and* excellence in education. The decisive action taken years ago in the wake of Sputnik created a legacy guaranteeing that today's generation would live in a more prosperous and secure society than that of their predecessors. It is our collective responsibility today to do the same, and ensure that future generations reap the benefits of our choice to act. We believe that the recommendations set forth in this report represent one step of many towards continuing this legacy.