

**DRAFT Written Testimony
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Committee on Science and Technology
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Chairman Baird, Ranking Member Ehlers, Members of the Subcommittee, it is a pleasure to speak to you today about the National Science Board's recently released *National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System* (NSB-07-114). I am Steven C. Beering, Chairman of the National Science Board and President Emeritus of Purdue University. The Board appreciates the strong support and contributions to this plan by several Members of this Committee.

The Board feels that science, technology, engineering, and mathematics (STEM) education is of critical importance to the Nation and is delighted that this Committee has chosen to gain additional comments and insights on the Action Plan from the important stakeholders and learned experts you have invited to also provide testimony today. In this written testimony I will first describe the process for developing the Board's Action Plan, summarize the main points of the Action Plan, and then describe the public comments received by the Board on a draft version of the Action Plan. I have also attached as supplemental information a brief biography, excerpted statements from select governors, and a pre-publication copy of the Action Plan.

Process for Developing the Action Plan

The development of this action plan has been a long and systematic process for the Board, beginning in December 2005 when the Board held the first of three hearings on what actions could be taken to improve K-12 science, technology, engineering, and mathematics (STEM) education in the Nation on Capitol Hill. The Board held two more hearings in February and March 2006 in Boulder, Colorado and Los Angeles, California. A list of those who testified at the Board hearings may be found in Appendix C of the Action Plan.

In March 2006 the Board established a Federal advisory committee to the Board, the Commission on 21st Century Education in Science, Technology, Engineering, and Mathematics. The Charge to the Commission and its membership are listed in Appendices D and E, respectively, of the Action Plan. The Commission presented a draft report to the Board in March 2007, which is included as Appendix F of the Action Plan, including a list of those who testified before the Commission or were on one of its working groups.

The Board developed its National Action Plan based on all this input. I personally chaired the hearings the Board held and attended nearly all of the meetings of the Commission. All together, more than 90 experts provided input to the Action Plan either by serving on the Commission or one of its working groups or testifying before either the Board or the Commission. In addition, Dr. Michael Crosby, National Science Board Executive Director, and Dr. Elizabeth Strickland, from our Board Office staff held more than two dozen meetings with various stakeholders to gather input to the action plan.

In August 2007 the Board released a draft version of its action plan for public comment and received nearly one hundred valuable and overwhelmingly positive that I will summarize later in this testimony. A list of those who provided public comments is included in Appendix G of the Action Plan.

Summary of Action Plan

Addressing the shortcomings of the Nation's STEM education system is absolutely essential to the continued economic success of the Nation and to its national security. It is essential that *all* American citizens have the necessary scientific, technological, and mathematical knowledge and skills to make informed personal choices and voting decisions and to thrive in the current technologically rich, global marketplace. In 2003, 18 countries out of 29 countries outperformed the United States in the science literacy of 15 year olds on the OECD's PISA test. American students must achieve to higher standards and perform better relative to their international peers. Unless there is a broad pool of K-12 students with a solid foundation in STEM disciplines, it will be very difficult for the U.S. to develop the future mathematicians, scientists, and engineers needed for the Nation to continue to lead the world in innovation – an issue that the Board plans to address in the upcoming year.

Many respected reports on STEM education have been published by well-qualified experts over the past two and a half decades. What is immediately apparent when one reviews these reports is that, tragically, many of these reports had excellent recommendations for actions that were never implemented.

In developing this action plan, the Board has attempted to prioritize the most important actions that can be taken by Congress and others in order to make a significant impact on STEM education in the Nation. These actions are not, of course, the only actions that could – or even should – be taken to improve STEM education. Rather, the intent of the Board in this action plan is to call out a few critical actions that are absolutely essential for significant gains in STEM education in the Nation.

In order to move STEM education forward in the Nation, the Board believes that two major issues must be addressed – ensuring coherence in the Nation's STEM education system and ensuring an adequate supply of well-prepared and highly effective STEM teachers.

The Nation requires a coordinated system of STEM education. There is a need for both horizontal coordination of STEM education among states and vertical alignment among components of the system, from pre-kindergarten through college. A coordinated system of STEM education means that a student who starts kindergarten in Kansas, attends middle school in California, and enters high school in Illinois will have the opportunity to master the foundational skills needed for future success in the workforce and higher education.

Second, the Nation requires a supply of well-qualified, highly effective, and well-supported teachers. Teachers, as you are well aware, are critically important to student learning in the classroom, and we must make serious efforts to attract top-quality teachers into the classroom in STEM disciplines, ensure their preparation for teaching STEM content is thorough, and effectively support them while they are in the classroom.

First, the Board strongly feels that increased coordination of STEM is essential for significant improvements to be made. Coordination should occur both across the Federal Government and among the Federal Government and all stakeholders including, in particular, local and state education agencies and institutions of higher education. The Board is well aware that local and state governments bear the ultimate responsibility in the Nation's public education system and does not challenge this role. The actions being proposed by the Board are intended to provide mechanisms for the Federal government to better support local and state efforts and for local and state education agencies to interact effectively with each other and other stakeholders in addition to the Federal government.

I will not describe in detail all the recommendations in the Action Plan for this coordination, but rather highlight, briefly, the four places where the Board feels coordination should occur.

First, without question, the Federal government must do a better job of coordinating its own STEM education activities. The Academic Competitiveness Council report that inventoried Federal STEM education programs for fiscal year 2006 put the spending total for all agencies at more than 3 billion dollars scattered across 100-some programs – approximately 575 million of which was for K-12 programs. To maximize the effectiveness of this spending and these programs, the Board's recommendation is that all Federal agencies coordinate their STEM education efforts through the National Science and Technology Council (NSTC) within the Office of Science and Technology Policy in the Executive Office of the President. The Board recommends that given the importance of this issue a full committee on STEM Education be created within the NSTC.

Second, given the clear, important role that the Department of Education plays in STEM education, the Board recommends that a new Assistant Secretary position be created within the Department of Education to coordinate STEM programs within the Department and to serve as the focal point for those outside the Department to interact with the Department on STEM education issues.

Third, much direction is given in the action plan to the specific responsibilities of the National Science Foundation toward STEM education in the Nation and how it should be prioritizing and focusing its own activities and partnering with other Federal agencies.

Finally, and perhaps most importantly, the Board recommends the creation of something that does not currently exist and is without precedent – a National Council for STEM Education. The Board recommends that Congress charter a new, non-Federal National Council for STEM Education that would coordinate among all those involved in STEM education, not just those at the Federal level. Potential members of the Council are shown here. The Council would be made up of representatives from local and state governments and organizations, professional STEM educators, the business community, higher education, private foundations, STEM disciplinary societies, informal STEM education, and other stakeholders. The Federal government would be represented on the Council through representatives from the NSTC Committee on STEM Education that I described earlier. The role of the Council would be to coordinate among all its members to ensure that STEM education in the Nation moves forward. A detailed list of proposed responsibilities may be found in the action plan text.

Now that I have described the “who” of the recommendations for increased coordination, I briefly describe the Board’s vision for a coherent national STEM education system.

The Board’s action plan recommends that all stakeholders work together through the National Council for STEM Education to ensure horizontal coordination among states and vertical alignment across grade levels. This is particularly important in our highly geographically mobile society. A 2004 Census Bureau report estimates that 15 to 20 percent of school-aged children moved in the previous year, and a 1994 GAO study reported that one out of six students had attended three or more schools by the end of third grade. In this context, coordination of STEM learning, which requires the systematic building of a knowledge base, is critical. Details of each of these aspects may be found in the text of the action plan. Briefly, however,

The Board recommends that all stakeholders work together, using the National Council for STEM education to provide horizontal coordination of STEM education among states by:

- Facilitating a strategy to define national STEM content guidelines that would outline the essential knowledge and skills needed at each grade level;
- Developing metrics to assess student performance that are aligned with national content guidelines;
- Ensuring that assessments under No Child Left Behind promote STEM learning; and
- Providing a forum to share and disseminate information on best practices in STEM teaching and learning.

Additionally, the Board recommends that all stakeholders promote vertical alignment of STEM education across grade levels – from pre-Kindergarten through the first years of college by:

- Improving the linkage between high school and higher education and/or the workforce; and
- Creating or strengthening STEM education-focused P-16 or P-20 councils in each state.

Finally, the Board feels strongly that serious national attention must be focused on attracting, preparing, and retaining qualified and committed teaching candidates. The Board recognizes that much was done in the America COMPETES Act to support STEM teacher preparation and we are supportive of that. STEM educators should be viewed as a valuable national resource, and the best and the brightest should be encouraged to consider pre-college STEM teaching as a profession. Accordingly, the Board recommends:

- Developing strategies for compensating STEM teachers at market rates;
- Providing resources for the preparation of future STEM teachers;
- Increasing STEM teacher mobility between districts by creating national STEM teacher certification standards; and
- Preparing STEM teachers to teach STEM content effectively.

Although all stakeholders must work to address shortages in the STEM teacher supply, this is an area where institutions of higher education must play a large role and communication must increase among community colleges and four year institutions and among schools of education and colleges of arts and science and schools of engineering.

To summarize, this action plan lays out a structure that will allow stakeholders from local, state, and Federal governments, as well as non-governmental STEM education stakeholder groups, to work together to coordinate and enhance the Nation's ability to produce a numerate and scientifically and technologically literate society and to increase and improve the current STEM education workforce.

Summary of Public Comments

The Board received more than 100 public comments on the Action Plan. The comments came from a broad range of stakeholders – states, K-12 teachers, disciplinary societies, university faculty and administrators, mathematicians, scientists and engineers, various organizations, and parents.

Overall the comments were positive with a number noting their gratitude for the Board's willingness to address this topic.

The dominant themes that emerged from the comments were:

- (1) General support for the National Council for STEM Education, but suggestions for ways that the Council could be structured slightly differently. These included increasing the level of staff support to accomplish the Council's mandate, including additional specific groups, and suggesting alternate ways the initial

- members of the Council could be appointed. A few raised the concern that the Council could become ineffective bureaucracy.
- (2) Concern that disciplinary societies (and national labs) were given an inadequate role in the draft Action Plan.
 - (3) General support for the draft Action Plan statements on increasing STEM teacher compensation
 - (4) Many comments related to a need for a sea-change in public perception of STEM fields and student interest in these. There were many recommendations for increased emphasis for this in the draft Action Plan and for the need for a public campaign to raise the profile of STEM fields
 - (5) Concern that technology, engineering, and mathematics are not adequately emphasized and that the draft Action Plan was really more about science than the other disciplines. A repeated concern raised was that technology and engineering skills are in particular demand in the 21st century.
 - (6) Regarding national content guidelines there was a mix of opinions about the merit of this and concerns about unintended consequences of the implementation.
 - (7) Concern that not enough responsibility was assigned to the colleges of arts and sciences and engineering to be collaborating with colleges of education to prepare STEM teachers.

The revisions made to the draft Action Plan in response to the public comments were adjustments to the language and emphasis of sections of the action plan rather than a significant restructuring of the Action Plan recommendations.

Concluding Statements

In releasing this National Action Plan, the Board is making a statement that it feels action must be taken on STEM education now. To be frank, the United States cannot afford to let the status quo of STEM education in the Nation continue. If this critically important, yet often disregarded, issue is not addressed, my grandchildren and the generations that follow will not have the same opportunities for world leadership in STEM and standard of living as those of us serving on the Board today have enjoyed.

Many of the recommendations in the Board's action plan – particularly related to STEM teacher preparation – are consistent with items in the America COMPETES act that Congress passed and the President signed into law in August. Congress is to be congratulated for the bold steps taken there.

The Board is in agreement that although many of the steps already taken by Congress and underway in many states through the leadership of Governors are extraordinarily valuable

and important, without a focal point for coordination, these scattered programs likely will not be able to effect a large change in the Nation's overall STEM education system. The Board is convinced that the recommendations made in the Action Plan for increased coordination of STEM education and, in particular, the creation of an independent and non-Federal National Council for STEM Education to bring together *all* stakeholders must be given serious consideration by Congress.

Attachments:

- (1) Beering Biosketch
- (2) Excerpted Statements from Governors
- (3) Bound pre-publication copy of action plan