Assessment of the National Science Board's Action Plan for STEM Education

A Hearing by the Subcommittee on Research and Science Education,
House Committee on Science and Technology

October 10th, 10:00am

Testimony presented by

Dr. Robert J. Semper
Executive Associate Director
Exploratorium
San Francisco, CA

Chairman Baird, Vice Chairman McNerney, Ranking Member Ehlers, and distinguished members of the Subcommittee, thank you for the opportunity to discuss the findings and recommendations contained in the National Science Board's Action Plan for STEM Education. My name is Rob Semper and I am Executive Associate Director of the Exploratorium, a Museum of Science, Art and Human Perception in San Francisco. The Exploratorium is one of over 348 science centers and museums in the United States that are members of the Association of Science Technology Centers (ASTC). These institutions offer critical science, technology, engineering and mathematics education in informal settings to over 58 million children and adults every year including specific programs for students and teachers. I have been asked to represent the views of the field of these informal science education institutions to the NSB's Action Plan.

It is fitting that this hearing is occurring 50 years to the week that this nation was shocked by the launch of Sputnik into addressing the issue of STEM education in a comprehensive way. As a result of that experience an investment was made that made a difference and that difference has been demonstrated by the significant advancement in STEM leadership that this country has enjoyed since that time. Building on the existing science education reform work already underway, the national resolve to invest in STEM education resulted in new curriculum being developed and disseminated, enhanced professional development of teachers being provided, and the launching of significant efforts to promote public engagement in science. New science education research and development organizations were created to support this work. A STEM education improvement infrastructure was created. We called on our universities, our scientists and our schools to work together to improve the situation and they did. In short the country was galvanized to do something about the problem.

I am a product of the tremendous effort and investment that was made at that time to improve science education in this country. Upon returning to school to start my sixth grade class, I was met with the scene of crates of lab equipment being unpacked in the hall, newly minted science textbooks and, most importantly, a sixth grade teacher who had been trained in an NSF sponsored summer science teacher institute who took me under her wing as a budding scientist. Later in high school I was taught physics by an Ex Navy nuclear submarine engineer who

entered teaching through a Department of Defense career transfer program and in college I attended a summer NASA undergraduate research program where I learned what it meant to be a scientist instead of a science student. In graduate school I participated as an instructor in an NSF sponsored program to introduce a new self paced science curriculum at the undergraduate level and I spend a summer at Los Alamos National Laboratory in their graduate student program doing exciting physics research.

I am mentioning all of this not to impress you with my resume but to point out that each and every one of these experiences was supported by the Federal government and would just not have happened if there had not been strong Federal support for STEM education. And in particular I want to point out the vital and unique role that NSF played in leading and supporting this effort over the years. It was their support of quality programs through their rigorous peer review process of proposals from universities, schools, museums and education research labs that provided the research, development and implementation of much of this work.

Today we are eerily confronting the same concerns as our previous generation did in 1957. We perceive a threat to our future, we realize that we need to make an investment in STEM education to mitigate this threat, and we are asking the Federal government to help. In many respects we might think that we are in the same place as 1957 and indeed many of the proposed solutions today might be similar to those proposed 50 years ago. But at least in one major respect things are quite different. The field that I represent here today simply did not exist.

One of the legacies of the post Sputnik investment in STEM education was the creation and widespread dissemination of a new kind of educational institution, the science center. These new places were born out of the confluence of the investigation-focused science education reform movement of the late 1950s and the learner-centered educational movement of the mid to late 60s. They borrowed interactive exhibits from the science-and-industry museums, the informational displays of the Worlds Fair science exhibitions, and the science demonstrations common to schools and universities to create new institutions that contained collections of ideas rather than things. These institutions rode the wave of the deauthoritization of formal education—the dramatic shift toward the empowerment of students and individuals to be in control of their own learning—that swept through the country and the world at that time. The oft-repeated statement by Frank Oppenheimer, the Exploratorium's founder, that "No one flunks a museum" became emblematic of a public education movement that has spawned hundreds of science centers and has advanced exhibition development in science museums, natural history museums, zoos, aquariums, and planetariums worldwide.

These science centers now form a powerful new community-based resource that can play a significant role in advancing STEM education nationwide. They serve a significant part of the US population. They offer experiences that are rich in science, and as importantly, engaging to visitors of all ages. They are repositories of science-trained staff that help students gain a deeper understanding of science, nature and the world around us. They support teacher professional development activities for grades K-12 and they develop curriculum. They partner with schools, universities, industry and community groups to provide STEM education for all citizens. And they provide a focus of commitment to science in their community that is both respected and accessible.

For example every year, my organization, the Exploratorium, welcomes over 500,000 children and adults to a lively exhibit space in San Francisco that is filled with 500 exhibits on topics as diverse as light and color, genetics and the brain. We provide the public access to the latest images from the Mars rover, an opportunity to talk to scientists working in Antarctica and the science of skateboard wheels. Our audience includes 100,000 field trip students who come from the diverse school population of the Bay Area, many of whom are underserved in STEM. Through the use of the Internet we reach an additional 18 million kids and adults nationwide with online exhibits and teaching tools developed at our institution. Using the exhibits, our professional development staff works intensively with over 500 teachers a year to develop their science teaching skills and actively support an alumni community of over 2500 Bay Area teachers who use the museum as their science home away from home.

The development over the years of this robust group of science centers and museums, along with the expansion of other out of school resources such as after-school programs and clubs and science related media, is an important part of the solution to advancing STEM education. To successfully make the improvement in STEM education that we all desire, we will need to make use of all of these opportunities due to one sobering fact. The average amount of time that a student will spend in school on science throughout their K-12 career is only 1000 hours. That is one half of an adult working year. Given the fact that there is no realistic prospect of increasing this time due to the competing demands on school time, we simply must take advantage of the out of school time if we are going to make headway on STEM education.

Response to Specific Questions

It is with this background as a member of the science center and museum community represented by ASTC that I am responding to the recommendations of the NSB report and addressing the questions posed to me by Chairman Baird.

Does the NSB action plan address what you see as the key issues for improving STEM education? Are there specific actions or policies that you believe are important to improvement of STEM education that are not included? What are the principal barriers to achieving the recommended changes to STEM education system?

We support both of the Board's priority recommendations: (1) the need to ensure coherence in the Nation's STEM education system; and (2) the need to ensure that students are taught by well-qualified and highly effective teachers. Our field is pleased that the report recognizes the importance of informal science education institutions. They are the catalyst for sparking interest in STEM issues at all ages. Clearly this interest has overwhelmingly positive future implications for workforce development, teacher preparation, science interest and literacy and quality of life. However, we are concerned that our field is not always considered as part of the solution when the talk turns to STEM education.

Priority Recommendation A: Ensure Coherence in the Nation's STEM Education System

This is a key issue for improving STEM education because it addresses the key barrier to achieving the recommended changes to STEM education – recognizing the fact that STEM education is not just the province of the schools and therefore bringing all the stakeholders to the same table. There are many different things to be gained by this coherence but let me give you an example from my own field.

While our children (and our teachers) experience science in and out of school, the systems of formal schooling and out of school learning opportunities currently do not have a place to talk with each other to develop a coordinated approach. They are funded by different processes at the federal, state and local level, they have different (albeit complementary) goals and they have different strengths and weaknesses. By stepping back and looking at the STEM learning environment as a whole with the permanent representation of the informal education community on both the proposed National Council and the state P-16 Councils, we would have the opportunity to develop the needed coherency and synergy between these two worlds.

A.1 Actions for Coordination of Key Stakeholders

This action item is an exceedingly important part of this plan from our perspective. Traditionally as private, non profit organizations, science centers get national support for their own educational activities from peer reviewed grant opportunities primarily at the NSF, NASA, NIH and the Department of Education. They also provide a venue for public engagement for the science outreach activities of NSF, NASA, NIH, NOAA, the Department of Energy and the associated universities and labs receiving these research dollars. They receive most of their funding to support their educational work from local philanthropic giving, local government funding and institutionally earned income. As independent entities they develop their own agenda. Formal education on the other had is supported primarily through federal and state funds and local taxes that is given to the local education agencies and the school agenda is driven by various policy initiatives supported by the funders and determined by local school boards and the state. Coordination of key stakeholders at the national and state level in a system like this is required if one is to develop a synergistic approach.

We support the leadership role outlined for NSF in the report and the development of a coherent internal framework for its own work in education. Our new century needs leadership in the innovation of STEM education for the 21st century with a focus on new ideas for instruction, staff development and the use of new technology. Science centers are active players in all three domains of identified NSF leadership – research on learning and educational practice and the development of instructional materials; development of human capital in STEM fields, including STEM teachers; and the improvement of public appreciation for and understanding of STEM. NSf is a key supporter of our field and it is important that informal science education institutions maintain an eligibility to apply for funds in each of the areas in NSF to continue this work in the future.

The report's support for the continued development and funding of programs that increase public appreciation for and understanding of STEM is most appreciated by ASTC and our members, as is the specific mention of museums and informal science education learning environments in this context. While ASTC agrees that collaboration between all NSF directorates and offices should be encouraged in this effort, we strongly believe that any such collaboration should not come at the expense of the NSF EHR's Informal Science Education program, be it is scope or mission This vital, peer-reviewed program, designed to increased interest, engagement, and understanding of STEM by individuals of all ages and backgrounds, must remain robust.

A.2 Actions for Horizontal Coordination and Coherence and A.3 Actions for Vertical Alignment and Coherence

Beyond the national coordination of key stakeholders, science centers are key participants in local and statewide STEM educational efforts. We appreciate the report's support for including informal science education institutions in the newly-created and existing statewide P-16 councils. It is important that these councils also develop a broader view of the STEM education landscape if they are to create coherency in a students' educational life. As institutions we interact with students all along the educational continuum from field trips through summer classes to an employer of STEM educated staff. In some cases our institutions provide facilities and hands on engagement that schools just cannot provide. Active participation in the statewide dialog about STEM education will insure a more coordinated approach to our offerings and also our ability to provide the many parents who visit our places information about high quality STEM education.

Priority Recommendation B: Ensure That Students are Taught by Well–Qualified and Highly Effective STEM Teachers

The focus on the STEM teacher workforce as a high priority is absolutely important. But in addition to the recommendations presented in the report I would propose to add one more based on my past experience in the informal education field and teacher education. We need a program to develop innovative new models for teacher professional development, ones that address the issues as dramatically as the invention of the teaching hospitals and medical schools did for medical professional education at the turn of the last century.

For example. science centers have historically participated in teacher professional development activities primarily through peer reviewed proposals to the NSF and the US Department of Education. They have made use of their unique environments and scientific staff to provide in-depth and ongoing professional development to teachers in their region and in some cases they have become a professional home for science teachers in their community. The Exploratorium works with teachers from 140 school districts that exist in the Bay Area providing a consolidated approach to intensive teacher professional development for the region. Other science centers such as the Pacific Science Center in Seattle operate statewide initiatives.

But because teacher professional development is currently only considered the province of the LEAs and IHEs in current federal and state legislation, there is little opportunity for science

centers to play the lead role in creating new community based teacher professional development models. Opening up eligibility for funding as the prime award winner to non-profits with the experience and capability to do good work is critical if we are to develop alternative approaches. A program to actively create new models of professional development will lead to the dramatic change in STEM education that we are all seeking.

Is the proposed national STEM education council needed in order to implement the NSB's recommendations; can it be made to work as envisioned; and can it become self-sustaining? Do you support establishing this council? Do you have recommendations for changing the proposed structure or function of this council? Furthermore, what role do you envision for the council in defining the recommended "national content guidelines"?

It is clear that a coordinating function at the national level with membership of all of the stakeholders is critically needed if we are to maximize our investment of resource. Currently there does not exist a venue for this discussion that is both specific to STEM and inclusive of all of the potential players. This is in addition to the need for coordination of federal government's response to the issue. Therefore ASTC is intrigued by the idea of a National Council for STEM Education, and appreciates the Board's recommendation that informal science educator should be represented in its membership. We would recommend that an informal science educator should hold a permanent seat rather that a rotated one, however, especially given the role that informal science institutions play in student and teacher education.

What is the appropriate federal role in carrying out the recommendations of the NSB action plan?

While many of the reports recommendations concern initiatives that are clearly at the state and local level, the fact that much of the current funding for the improvement of STEM education comes from the federal coffers means that it is an important federal role to establish mechanisms to provide coordination amongst the involved parties and to develop a STEM education improvement roadmap for the country.

It is also the federal role to provide the investment in innovation for STEM education and the national support for STEM education improvement. To this end we would strongly endorse the reports recommendation that the National Science Foundation (NSF) exercise a significant leadership role in research and development, STEM workforce development and public STEM engagement and the board's recommendation that NSF develop an internal agency roadmap toward this end.

In closing I would like to thank you for offering me the chance to testify on this very important issue. I look forward to answering any questions that you may have.