U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE AND TECHNOLOGY

SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION

HEARING CHARTER

A Systems Approach to Improving K-12 STEM Education

Thursday, July 30, 2009
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

1. Purpose

On July 30, 2009 the Subcommittee on Research and Science Education of the House Committee on Science and Technology will hold a hearing to examine how the many public and private stakeholders in an urban K-12 system can work together to improve science, technology, engineering and mathematics (STEM) education inside and outside of the classroom.

2. Witnesses

- **Dr. Wanda Ward,** Acting Assistant Director, Directorate for Education and Human Resources, National Science Foundation (NSF)
- **Ms. Maggie Daley,** Chair, After School Matters
- **Mr. Michael Lach**, Officer of Teaching and Learning, Chicago Public Schools
- **Dr. Donald Wink**, Director of Undergraduate Studies, Department of Chemistry, and Director of Graduate Studies, Learning Sciences Research Institute, University of Illinois at Chicago
- **Ms. Katherine Pickus**, Divisional Vice President, Global Citizenship and Policy, Abbott

3. Overarching Questions

- Who are the many public and private stakeholders in the K-12 STEM education system? What are, or should be, their respective roles and responsibilities? What kinds of partnerships across the system are most effective at leveraging resources and intellectual capital? How do these partnerships ensure continuity in teaching and learning between the classroom and informal environments such as after-school programs?

- What are the major barriers to improving the interest and performance of K-12 students and teachers in STEM? Are there model programs or approaches to curriculum and instruction that have demonstrated how to increase student achievement and/or teacher performance? What are the most important and effective components of these programs? How are these programs evaluated for effectiveness? How can partnerships between various stakeholders in the STEM education system facilitate the identification and implementation of successful models?
- How do NSF programs support the improvement of the teaching and learning of STEM disciplines in the pre-K through 12 years? What instructional tools, resources, materials, and technologies has NSF supported to enable STEM learning? Under what conditions, and for whom, are such resources for learning most effective? How can NSF help to disseminate successful tools and resources and facilitate effective partnerships between other stakeholder groups in the STEM education system?

4. Background

A Systems Approach

A consensus now exists that improving STEM education throughout the nation is a necessary, if not sufficient, condition for preserving our capacity for innovation and discovery and for ensuring U.S. economic strength and competitiveness in the international marketplace of the 21st century. The National Academies *Rising Above the Gathering Storm* report placed a major emphasis on the need to improve STEM education and made its top priority increasing the number of highly qualified STEM teachers. This recommendation was embraced by the 2007 *America COMPETES Act*.

Two more recent STEM education reports that have generated a lot of attention have emphasized, as part of their priority recommendations, the need for greater coordination between the many public and private stakeholders in the nation's K-12 STEM education system. The reports are: "A National Action Plan for Addressing the Critical Needs of the U.S. STEM Education System," from the National Science Board (NSB),[1] and "The Opportunity Equation," from the Carnegie Corporation's Institute for Advanced Study.[2] The stakeholders cited in these reports include the federal and state governments, colleges and universities, businesses, a variety of nonprofit organizations, philanthropic organizations, and of course, school districts themselves.

In a related effort, the Business Higher Education Forum just launched a new education system predictive modeling tool to "provide an organized and comprehensive approach to viewing and understanding the complex, multi-level nature of the U.S. and STEM education system." The STEM Research and Modeling Network (SRMN),[3] which provided input to the development of and now oversees the model, is composed of representatives from all of the aforementioned stakeholder groups.

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[1] http://www.nsf.gov/nsb/documents/2007/stem_action.pdf
[2] http://www.opportunityequation.org/
[3] http://www.bhef.com/solutions/stem/srmn.asp

The Science and Technology Committee held a hearing on the NSB report in October 2007 to review the recommendations in the report, which addressed both federal interagency coordination and coordination across all of the stakeholder groups. In response to the recommendation for greater interagency coordination, the Committee introduced H.R. 1709, the *STEM Education Coordination bill of 2009*, which passed the House last month and has a companion bill in the Senate, S. 1210. The Committee is continuing to explore possible roles for the federal government in facilitating greater coordination among the full range of stakeholder groups.

K-12 STEM Education at the National Science Foundation

Science and math education is a cornerstone of the historic mission of the National Science Foundation. *The National Science Foundation Act of 1950*, which established NSF, directed NSF to support and strengthen science and math education programs at all levels. NSF carries out its K-12 mission by supporting a variety of STEM education activities, including teacher training (both in-service and pre-service), curriculum development, education research, and informal education at museums, science centers and other after school settings.

Examples of NSF programs designed to improve K-12 teacher performance include the Math and Science Partnership (MSP) Program and the Robert Noyce Scholarship (Noyce) Program, both reauthorized in 2007 as part of *The America COMPETES Act*. The MSP Program funds partnerships between universities and local school districts to strengthen the science and math content knowledge of K-12 school teachers. The grants are awarded to support the creation of innovative reform programs that could be expanded to the state level if successful. The Robert Noyce Scholarship Program is designed to help recruit highly-qualified science and math teachers through grants to college and universities to give scholarships to science and math majors in return for their commitment to teach at the elementary or secondary school level.

Additional NSF programs targeted to K-12 education include Discovery Research K-12, which funds everything from basic research on learning and teaching to the development and implementation of tools, resources, curricula, models and technologies based on the research findings; Informal Science Education, which funds projects that advance informal STEM education; and Research and Evaluation on Education in Science and Engineering, which seeks to improve the methodology of education research and evaluation of education tools and models to ensure high-quality research results and effective program development. The Graduate STEM Fellows in K-12 Education (GK-12) Program puts science and engineering graduate students into K-12 classrooms on a part-time basis during their graduate studies. Primarily this is considered a professional development program for graduate students – in particular to strengthen their communication skills and instill a deeper appreciation for the societal context for their research; however, when effectively integrated with broader university partnerships with local schools and school districts, GK-12 fellows can also contribute in a meaningful and lasting way to student and teacher performance in the classroom.

Chicago: A Large Urban School District

Last year the Committee held a hearing to learn about STEM education in Texarkana, Texas, a small town of 35,000 in northeast Texas.[4] Similarly, in today's hearing, the Committee is examining a systems approach to STEM education using Chicago as a case study for a large urban school district. Chicago Public Schools (CPS), the third largest school district in the nation, currently operates 666 schools, including 483 elementary and middle schools, 116 high schools and 67 charter schools. Total student enrollment is nearly 408,000 – nearly 20 percent of all Illinois public school students. The CPS student population is 46.2 percent African American, 41.2 percent Latino, 8.9 percent White and 3.5 percent Asian/Pacific Islander. CPS students have made some notable gains in achievement in recent years. The composite percentage of students meeting or exceeding state standards on the Illinois Student Achievement Test has risen from 47 percent in 2004 to 69.8 percent in preliminary 2009 data. The number of high school students taking at least one Advanced Placement course has doubled from less than 6,000 in 2004 to 12,464 a year ago. The district's drop-out rate has decreased by about 7 percentage points since 2003 and the graduation rate has risen by almost the same amount during the same period. However, the most recent Prairie State Achievement Examination showed that more than 70 percent of high school juniors failed to meet state standards in math and science. Average math and science scores on the national ACT exam also indicate a lack of college readiness among a high percentage of CPS high school students. Improving the achievement of CPS students in math and science will require an all hands on deck, coordinated effort by local universities, businesses, and nonprofit organizations in partnership with CPS. Witnesses today will discuss several of those partnerships and the gains already demonstrated.

5. Questions for Witnesses

Wanda Ward

1. What evidence is available from NSF-funded projects to help us better understand how students develop interests in STEM fields in the pre-K through 12 years, and how can those interests be sustained across the high school to postsecondary education transition? Are there model programs or approaches to curriculum and instruction that have demonstrated how to engage students successfully in STEM areas and that lead to choice of STEM degrees and careers? What is the role of out-of-school learning in encouraging STEM interest and achievement?
2. How do NSF programs support the improvement of the teaching and learning of the STEM disciplines in the pre-K through 12 years? What programs are available to improve teachers' knowledge and abilities, and what does research tell us about the best ways to enable teachers' effectiveness in promoting learning? What types of programs and models for STEM teacher preparation, induction, and professional development show the most promise for supporting STEM teachers' learning, and what can be learned from the implementation of such programs and models?

[4] http://science.house.gov/publications/hearings_markups_details.aspx?NewsID=2181

3. What instructional tools, resources, materials, and technologies has NSF supported to enable STEM learning? Under what conditions, and for whom, are such resources for learning most effective? Does research provide insight into what kinds of instructional materials and tools are most useful in supporting learning at various levels, and for various groups of learners? How much do regional differences across the United States account for the efficacy of any given set of tools or materials?

Maggie Daley

1. What is After School Matters (ASM)? What kind of science, technology, engineering and mathematics (STEM) programming does ASM offer? What partnerships have you built in support of your programming – in terms of both financial support and intellectual resources?
2. How does ASM's informal learning complement the formal education students receive in the classroom? How do you work with the local school districts to develop your STEM programming and to ensure a seamless transition from the formal education of the classroom, including adherence to state or local standards, and the informal education provided by ASM? How do you assess the impact of your programs on student interest and/or achievement in STEM?
3. What are the major challenges that inhibit the interest or performance of youth in your after school STEM programs? What steps has ASM taken to address these challenges? Do you have any recommendations to the private sector or to state and federal stakeholders on how they can take better advantage of not-for-profit organizations such as ASM in their own efforts to improve STEM education?

Michael Lach

1. What is the overall state of science, technology, engineering and mathematics (STEM) education in Chicago Public Schools (CPS)? Why is it important for all students to achieve proficiency in these subjects?
2. How do you work with the local private sector, not-for-profit organizations, and colleges and universities to improve STEM education in CPS? Please describe these partnerships and activities. How do you develop such partnerships and activities, and how do you assess them in terms of impact on student achievement?
3. What are the major problems that limit the performance of students and teachers, and what do you feel is the single, most important step that the federal government should take to improve K-12 STEM education? What involvement have you had with math and science education programs at the National Science Foundation or other federal agencies as well as those in the state of Illinois? What are the most important and effective components of these programs?
4. What role should parents play in improving K-12 STEM education? Do you have outreach programs intended to engage parents in their children's K-12 STEM education?

Donald Wink

1. Please describe briefly the University of Illinois at Chicago's (UIC) K-12 science, technology, engineering and mathematics (STEM) education programs and initiatives, including those that involve education and professional development for math and science teachers. How have you and your colleagues worked with Chicago Public Schools in developing or revising these programs over time? What other partners – public or private – have provided funding or have otherwise been involved in the development or implementation of these programs? How do you evaluate the effectiveness of these programs and partnerships?
2. What are the major problems that limit the performance of students and teachers in STEM? What are the most important and effective components of the National Science Foundation (NSF) funded programs (including the Math and Science Partnership Program, the Robert Noyce Teacher Scholarship Program, and the Graduate STEM Fellows in K-12 Education Program) that UIC has implemented in partnership with Chicago Public Schools? Are there common lessons learned or replicable elements across UIC's various science and math programs, including those funded by NSF? How do you or can you help to disseminate these findings to other cities and regions of the country?
3. What is the most important role a university such as your own can play in improving K-12 STEM education in your own community and/or nationally? How can universities help facilitate and build partnerships with other stakeholders, including the private sector and informal education providers? What is the single, most important step that the federal government should take to improve K-12 STEM education?

Katherine Pickus

1. Please describe what Abbott does. What percentage of your U.S. workforce has a science, technology, engineering and/or mathematics (STEM) background? Are you able to recruit locally for these positions and if not, why not? How does investing in K-12 STEM education in the U.S. communities in which you are located benefit your own future workforce needs? Why else is it important for Abbott to be interested in K-12 STEM education?
2. How do you work with the local school districts and with colleges and universities to help build a talented STEM talent pool from which to recruit? How do you work with other companies and organizations in the private and not-for-profit sectors to improve STEM education both nationally and within your community? Please describe these activities, the kind of partnerships involved, the level of investment in such activities, and how you go about developing and assessing such activities. How do you prepare your own scientists to work with youth in or out of the schools?
3. What do you see as the biggest challenges to improving STEM education in this country? Can you provide specific examples of barriers that you have faced in your own efforts to build partnerships and invest in STEM education in your own communities? Do you have any recommendations to state or federal stakeholders on how they can take better advantage of the private sector in their own efforts to improve STEM education?