U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE AND TECHNOLOGY

SUBCOMMITTEE ON RESEARCH AND SCIENCE EDUCATION

HEARING CHARTER

Encouraging the Participation of Female Students in STEM Fields

Tuesday, July 21, 2009

10:00 a.m. – 12:00 p.m.

2318 Rayburn House Office Building

1. Purpose

On July 21, 2009 the Subcommittee on Research and Science Education of the House Committee on Science and Technology will hold a hearing to examine current research findings, best practices, and the role of the federal agencies in increasing the interest of girls in science, technology, engineering, and mathematics (STEM) in primary and secondary school, and addressing the challenges that deter young women from pursuing post-secondary STEM degrees.

2. Witnesses

- **Dr. Alan I. Leshner,** Chief Executive Officer, American Association for the Advancement of Science (AAAS).
- **Dr. Marcia Brumit Kropf,** Chief Operating Officer, Girls Incorporated.
- **Dr. Sandra Hanson,** Professor of Sociology, Catholic University.
- **Ms. Barbara Bogue,** Associate Professor of Engineering Science and Mechanics and Women in Engineering, Penn State College of Engineering.
- **Ms. Cherryl Thomas,** President, Ardmore Associates LLC.

3. Overarching Questions

- What is the current status of the participation of girls in STEM in primary, secondary, and post-secondary school? How does participation vary by field? How does it vary by other demographic categories, including race, ethnicity, and socio-economic status?
- What are the biggest challenges to increasing girls' interest and participation in STEM learning at the K-12 level, and to recruiting and retaining female undergraduates in STEM fields? Are there policies, programs or activities with demonstrated effectiveness in increasing the interest and participation of girls and young women in STEM? What roles can scientific organizations, formal and informal educators, non-profits, and businesses play in addressing these challenges and providing opportunities for girls to become engaged in STEM? What role can the federal government play in addressing these challenges? Are there particular federal programs or resources that can be most helpful?
- What assessment tools exist for evaluating the effectiveness of such programs? What are the barriers to improving assessment?
- What is the current states of research on the involvement of girls in STEM? What do we know about how teaching strategies, cultural norms, educational environments, and other outside factors shape girls' interest and participation in STEM? What are the biggest unanswered research questions?

4. Brief Overview

- A highly-skilled, STEM educated workforce is essential to ensuring U.S. competitiveness and leadership in the global economy of the 21st century. However, according to many reports, our country is facing a shortage of workers skilled in STEM. By broadening the STEM pipeline to include those who have been historically under-represented in STEM fields, we create a larger, more diverse STEM talent pool.
- In recent years, increased attention has been paid to the issue of gender inequity in STEM. Numerous reports have highlighted the continued lack of participation of girls and young women in certain STEM fields, most notably in the fields of engineering, physics, and computer science.
- Research findings suggest that women and other under-represented groups face unique challenges at multiple stages of the STEM pipeline, beginning at an early age.
- Both federal programs as well as non-governmental organizations and programs have been created to address these challenges.

5. Current Status of Participation of Female Students in STEM fields

Enrollment

According to data compiled by the National Science Foundation (NSF), in 2006 women earned more than half of all bachelor's degrees (58 percent.) Women also hold more than half of all science and engineering degrees (51 percent), but with notable variation among fields. Women earned more than half of the bachelor's degrees in psychology (77 percent), biological sciences (62 percent), and social sciences (54 percent), and almost half (45 percent) in math. However, in certain STEM fields, women remain largely under-represented. Women received only 20 percent of computer science degrees, 21 percent of physics degrees, and 20 percent of engineering degrees. Due to continued attrition throughout graduate school as well as other factors that deter women from entering STEM careers, women make up almost half (49 percent) of the Nation's workforce, but only 25 percent of the STEM workforce.

Achievement

The most recent National Association of Educational Progress (NAEP) assessment reports a small but persistent gap in performance between boys and girls in grades 4, 8, and 12 -- less than 1 percent for math and less than 3 percent for science. Many researchers suggest that issues such as self-confidence and perceived expectations negatively affect the achievement of girls on standardized tests.

6. Barriers to Increased Participation

A report of the Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology suggests that there are four key time periods in which women seem to lose interest in STEM: at the beginning of middle school, towards the end of high school, throughout college and graduate school, and in their professional lives.[1]

Research suggests that in elementary school, as many girls as boys have positive attitudes about science. A recent NSF funded study of fourth graders showed that 66 percent of girls and 68 percent of boys reported liking science. By the eighth grade, however, boys report twice as much interest in STEM careers as girls. Issues such as stereotypes, cultural expectations, self-efficacy and the behavior of teachers and parents are all potential contributors to girls' attitudes about STEM at an early age. Barriers persist as young women leave high school to enter post-secondary school. Although women now make up the majority of undergraduate students, participation of women in STEM degree programs remains markedly low. Issues such as a lack of female role models or a female peer group, and unsupportive classroom environments have been shown to deter women from pursuing or remaining in STEM degree programs in post-secondary school.[2]

The National Science Foundation (NSF), a major funding source for research on gender and STEM learning, compiled the following list, based on NSF research findings, of five common myths about girls and science[3]:

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[1] Congressional Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development. (2000). *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering and Technology.*

[2] Fancsali, Cheri. *What We Know About Girls, STEM and Afterschool Programs.*

[3] http://www.nsf.gov/news/news_summ.jsp?cntn_id=109939

1. Myth: From the time they start school, most girls are less interested in science than boys are.

Reality: In elementary school about as many girls as boys have positive attitudes toward science. A recent study of fourth graders showed that 66 percent of girls and 68 percent of boys reported liking science. But something else starts happening in elementary school. By second grade, when students (both boys and girls) are asked to draw a scientist, most portray a white male in a lab coat. The drawings generally show an isolated person with a beaker or test tube. Any woman scientist they draw looks severe and not very happy. The persistence of the stereotypes start to turn girls off, and by eighth grade, boys are twice as interested in STEM careers as girls are. The female attrition continues throughout high school, college, and even the work force. Women with STEM higher education degrees are twice as likely to leave a scientific or engineering job as men with comparable STEM degrees.

2. Myth: Classroom interventions that work to increase girls' interest in STEM run the risk of turning off the boys.

Reality: Actually, educators have found that interventions that work to increase girls' interest in STEM also increase such interest among the boys in the classroom. When girls are shown images of women scientists and given a greater sense of possibility about the person they could become, the boys get the message too--"I can do this!"

3. Myth: Science and math teachers are no longer biased toward their male students.

Reality: In fact, biases are persistent, and teachers often interact more with boys than with girls in science and math. A teacher will often help a boy do an experiment by explaining how to do it, while when a girl asks for assistance the teacher will often simply do the experiment, leaving the girl to watch rather than do. Research shows that when teachers are deliberate about taking steps to involve the female students, everyone winds up benefiting.

4. Myth: When girls just aren't interested in science, parents can't do much to motivate them.

Reality: Parents' support (as well as that of teachers) has been shown to be crucial to a girl's interest in science, technology, engineering and math. Making girls aware of the range of science and engineering careers available and their relevance to society works to attract more women (as well as men) to STEM careers. Parents and teachers are also in a position to tell young people what they need to do (in terms of coursework and grades) to put themselves on a path to a STEM career.

5. Myth: At the college level, changing the STEM curriculum runs the risk of watering down important "sink or swim" coursework.

Reality: The mentality of needing to "weed out" weaker students in college majors--especially in the more quantitative disciplines--disproportionately weeds out women. This is not necessarily because women are failing. Rather, women

often perceive "Bs" as inadequate grades and drop out, while men with "Cs" will persist with the class. "Bridge programs" that prepare students for challenging coursework can counteract this. One of the most effective interventions to help young women choose and sustain a STEM educational path and subsequent STEM career is mentoring. In addition, changing the curriculum often leads to better recruitment and retention of both women and men in STEM classrooms and majors. For example, having students work in pairs on programming in entry-level computer science and engineering (CSE) courses leads to greater retention of both men and women in CSE majors.

Title IX of the Education Amendments of 1972, the federal law that outlaws sex discrimination at schools receiving federal funds, has had a notable impact on womens' participation in athletics. In recent years, some advocates have called for applying Title IX to science and engineering departments, as a means to address barriers to women in these fields. However, the details of how Title IX might be applied to any academic department remains unclear.

7. Federal Support for Gender Equity in STEM Education

NSF Research on Gender and Science in Engineering Program

The National Science Foundation is the largest public funding source for research on the participation of girls and women in STEM. Beginning in 1993 with the establishment of the Program for Women and Girls, housed in the NSF's Division of Human Resource Development in the Directorate for Education and Human Resources, NSF began investing in research projects to improve the representation of girls and women in STEM. The Research on Gender in Science and Engineering Program (GSE), which grew out of the 1993 program, funds research designed to add to the body of knowledge on gender and STEM. GSE supports research on gender-related differences in learning, student and educator programs, as well as dissimination projects that aim to inform education practicioners about relevant research findings on how educational experiences, teaching styles, curriculum, institutional culture, and other factors affect female student interest, participation and performance in certain STEM fields.

In 2003 and 2006, the GSE program at NSF produced a series of publications with information and resources designed to help educators, employers, and parents promote gender diversity in STEM. *New Formulas for America's Workforce: Girls in Science and Engineering* is a two volume series presenting research and best practices on how to attract girls and women to the STEM disciplines. It also presents the results of various intervention programs that have succeeded in overcoming obstacles and enhancing the participation and achievement of girls in STEM. The agency then followed up with the *New Tools for America's Workforce*, a supplementary publication that catalogs the various resources available to educators through NSF.

The FY09 budget for the Research on Gender and Science in Engineering Program was approximately $11.5 million. Three of the witnesses on the panel today have received, or are currently receiving NSF funding through the GSE program.

Support at Other Agencies

There are a variety of education programs and activities across the federal agencies that seek to encourage the participation of girls in STEM. NASA, often in partnership with a number of girl-serving organizations, such as the Girl Scouts, provides opportunities for young girls to learn about NASA and interact with female astronauts. For example, the NASA Summer Institute in Science, Technology, Engineering, and Research (SISTER), is a five-day summer program for middle-school girls. In the SISTER program, 6-8th grade girls are given the opportunity to interact with NASA research scientists and explore STEM career fields. The Department of Energy supports programs for girls and young women as well. One such program, the Conference on Undergraduate Women in Physics, is designed to provide workshops, panel discussions, and other opportunities for female undergraduate physics students to interact with other women in the discipline.

The Department of Education has also been active in promoting gender equity in STEM. In 2007, the Department of Education, through the Institute for Education Sciences, released a Practice Guide entitled, "Encouraging Girls in Math and Science." The guide was developed by a panel of experts with the goal to compile the best available evidence-based recommendations to assist educators in encouraging girls in the fields of math and science. The guide offers a series of five recommendations for educators:

(1) teach students that academic abilities are expandable and improvable;

(2) provide prescriptive, informal feedback;

(3) expose girls to female role models who have succeeded in math and science;

(4) create a classroom environment that sparks initial curiosity and fosters long-term interest in math and science; and

(5) provide spatial skills training.

9. Questions for Witnesses

Dr. Alan I. Leshner

- What is the current status of the involvement of girls in STEM? What are the biggest challenges to attracting and retaining young women and girls in STEM fields, and what are the most promising solutions to these challenges?
- What role can scientific organizations such as AAAS play in helping to address these challenges? Please describe AAAS work targeted at increasing girls' interest and participation in STEM learning.
- What role can the federal government play in increasing the interest of girls in STEM at the primary and secondary education level, and in addressing the challenges that deter young women from pursuing post-secondary STEM degrees?

Dr. Marcia Brumit Kropf

- What is the current status of the involvement of girls in STEM? What are the biggest challenges to attracting and retaining young women and girls in STEM fields, and what are the most promising solutions to these challenges?

- What role can organizations such as Girls Inc. play in addressing these challenges and providing opportunities for girls to become engaged in STEM? Please describe the work of Girls Inc. and the evolution of your STEM programming. What programs or activities at Girls Inc. have been effective in increasing girls' interest and participation in STEM learning, and what were the key elements that led to their success? Are there common characteristics of programs that have demonstrated success in attracting girls to STEM?

- What role can the federal government play in increasing the interest of girls in STEM at the primary and secondary education level, and in addressing the challenges that deter young women from pursuing post-secondary STEM degrees? What is the nature of your interaction with federal agencies? Are there particular federal programs or resources that can be most helpful?

Dr. Sandra Hanson

- Please provide an overview of your research. What have you learned about what shapes girls' interest and participation in STEM?
- What is the current status of research on the involvement of girls in STEM? What do we know about how teaching strategies, educational environments, and other outside factors affect girls' interest or achievement in STEM in the elementary, middle, and high school years? What are the most important unanswered research questions?
- How can dissemination of these research findings be improved so that formal and informal educators and education policymakers implement best practices?

Dr. Barbara Bogue

- Please provide an overview of the Society of Women's Engineers' Assessing Women in Engineering Project. What metrics and methodologies exist for assessing and evaluating the effectiveness of programs designed to increase girls' participation in STEM? What are the barriers to improving assessment and developing better metrics? What kinds of programs or policies have been shown to be effective through rigorous evaluation?
- In your role as associate professor of Women in Engineering at Penn State, what do you see as the biggest barriers to recruiting and retaining female undergraduates in STEM fields? What programs or activities at your institution (or others you are familiar with) have been effective in addressing the barriers you identified above, and what were the key elements that led to their success?

Ms. Cherryl Thomas

- What influenced your decision to pursue a career in engineering, and what were some of the greatest barriers you faced as a woman in a STEM field?
- What are the biggest challenges to attracting and retaining young women and girls in STEM fields, and what are the most promising solutions to these challenges?