

Written Testimony  
Before the  
Committee on Science and Technology  
Subcommittee on Research and Science Education

by  
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Chairman Lipinski, Ranking Member Ehlers, members of the Subcommittee, thank you for the opportunity to testify today on the critically important topic of encouraging women and girls to pursue science, mathematics and engineering fields of study.

The American Association for the Advancement of Science (AAAS) is the largest multidisciplinary scientific society and publisher of the journal *Science*. The association encompasses all fields of science, engineering, mathematics, biomedicine and their applications. Our commitment to and involvement in education extends from pre-Kindergarten through post-graduate and into the workforce.

AAAS has a long history of efforts to increase the participation of girls and young women and to enhance the status of women in science, technology, engineering and mathematics (STEM). The association has communicated this commitment to equal opportunity in many ways: through its mission statement, its programs, and its governance. This work is consistent with the AAAS mission to "advance science, engineering, and innovation throughout the world for the benefit of all people." To fulfill this mission, the AAAS Board has set out broad goals that include strengthening and diversifying the science and technology (S&T) workforce and fostering education in science and technology for everyone.

The first woman president of AAAS was elected in 1970: Dr. Mina Rees, a mathematician. Since that time 35% of those in the presidential line have been women--all distinguished scientists, engineers, mathematicians and physician scientists. In 1971 the AAAS Council passed a resolution urging the establishment of a women's office. The goals of that resolution were realized in 1973 with the creation of the AAAS Office of and Committee on Opportunities in Science. The mandate of the office and committee was ultimately enlarged beyond the concerns of gender equity to include attention to issues of minorities and persons with disabilities.

Since those early days of advocacy and action related to women in STEM, the makeup of the larger science and engineering communities has changed. Fueled by societal changes regarding the participation of women in a range of career opportunities and improved access to science and engineering education for women, the levels of enrollment and degrees awarded increased dramatically.

At K-12 levels, young women greatly increased their course-taking in science and mathematics to the extent that participation gaps between males and females disappeared in courses such as chemistry, advanced algebra and pre-calculus mathematics. Women moved from 9% of those earning M.D. degrees in 1972-73 to earning nearly 50% of M.D. degrees in 2007. We saw similar success in women's participation in the life sciences. Between 1973 and 1977, women received 22% of doctoral degrees in the biological sciences; by 2006 women received almost half of such Ph.D.'s awarded.

Despite the progress achieved in the past there are many challenges that remain.

- In K-12 education, standards are unfortunately too low for **all** students and expectations lag, especially for students from groups without a clear history of participation in STEM fields.
- In high schools gaps persist for young women in pursuing study in courses such as physics, calculus and computer science. That gap continues to the undergraduate levels.
- In 2006, women represented only 20% of those receiving bachelor's degrees in engineering.
- The percentage of bachelor's degrees awarded to women in computer sciences was highest in 1984 at over 37% but has subsequently declined to today's level of 20.5%.
- There is a wide variation around women's participation within the broader fields of science and engineering. For example, women's 40+ % share within the physical sciences masks the fact that women received half of the bachelor's degrees in fields such as astronomy and chemistry but only 20% of bachelor's degrees in physics in 2006. In addition, women received 19.4% of all engineering bachelor's degrees in 2005-2006; this ranges from their 43.1% and 41.1% share of degrees in environmental and biomedical engineering degrees, respectively, to their 10.5% share of degrees in computer engineering on the other end of the spectrum.
- There is concern about the trajectory of doctoral production for women in many fields. For doctorates awarded to U.S. citizens and permanent residents there has been a plateauing or downward trending in women's share of degrees in mathematics, geosciences and computer science since about 2000.
- Even in fields such as psychology, where women have received more than 50% of Ph.D.'s since the mid 1980's (and where they have received over two-thirds of doctorates since 1996), in 2007-2008 they were less likely to be in the rank of full professor (26.4% of women vs. 46.3% of men) and more likely to be in non-tenure track or lecturer positions. In chemistry, despite receiving at least 30% of Ph.D.'s since the mid-1990's, women are not appearing in significant numbers among the ranks of the chemistry faculty in many of our major research institutions.
- Even where women may have reached the level of full professor at major research universities, climate studies of the academic environment at many of these institutions reveal that women continue to face ongoing micro-inequities and lack

diversity in the faculty hiring pools. And the hiring challenges are especially severe for women from underrepresented racial/ethnic minority groups.

Although the story of women in STEM fields is one of tremendous gains over the past 40 years, it is a bittersweet story that is coupled with uneven progress and sometimes loss of ground—a discipline-specific program here, a department there, but seldom an institution-wide effort.

And even where women are able to attain degrees, many leave the scientific workforce because of the lack of career opportunities that respect the balance between having a career and a life outside of the laboratory.

Fortunately, there have been some recent changes in culture in some institutions to legitimize the idea of making allowances for women **and** men in the workplace (especially in academe) to accommodate such needs. For example, the ADVANCE program of the National Science Foundation has been especially important in funding efforts on campuses of research universities to effect structural changes that lead to the creation of work environments where women and men are supported in blending the demands of their work and their lives.

We know that the challenges presented above need not be the norm since we see institutions that are able to do much better:

- Institutions that have high percentages of women in engineering--for example, Morgan State University, where women received over 42% of such bachelor's degrees in 2007.
- Institutions with high percentages of women in computer science--for example, Carnegie Mellon University, which was able to move from 7% to about 40% entering majors between 1995 and 2001.
- Curriculum arrangements that produce different outcomes--for example, programs of "Physics First" in Rhode Island, which are generating more excitement as well as parity in physics course taking.
- Departments with more than the token woman--for example, the chemistry faculty of Purdue University, which boasts 15 women.

The question is, "what do these institutions do differently?" How do we more broadly share these effective practices? How can individual champions, departments and whole institutions be rewarded and recognized for their effective efforts?

### **What Can AAAS Do?**

**Recognition.** Responding to the need to give recognition and visibility to individuals who have excelled in their efforts as mentors to students from underrepresented groups, AAAS established its mentoring award, conferred first in 1991. This award served as the inspiration for the Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring program administered by the National Science Foundation.

**Defining “Normative” Behavior.** An important role that a professional society plays is in helping to define what is an acceptable practice within the culture of the discipline. Through the years and on numerous occasions, the association has prescribed and clarified its position in support of equal opportunity in science and non-discrimination in the workplace and has urged its affiliates to adopt similar positions. Such a stance helps to shape the mores of the community, defining as unacceptable behaviors that “create an atmosphere that is not conducive to the advancement of science.”

**Career Development.** AAAS has a robust set of career-related activities coordinated across its programs and the journal *Science*, working cooperatively through a Center on Careers in Science and Technology. Through partnerships with organizations and corporations, AAAS produces materials that feature young and established women in STEM careers, telling their stories about their lives in science and beyond. These materials are among the resources that are distributed to organizations and institutions by AAAS and others as we reach into communities to help young women, along with their parents and teachers, explore the possibilities of careers in science. It is also important to tell these stories to higher education faculty.

In partnership with L’Oreal and its initiative “For Women in Science” we manage the postdoctoral awards program, giving a boost to the careers of young women scientists through grants to support their independent entry into research as well as through a program of professional development and skill building.

**Education and Career Guidance.** Through the support of a grant to promote STEM careers (especially those focused on energy and environment) to middle grades students, we are developing training materials and models for guidance counselors in secondary schools. By demystifying potential S&T jobs of the future and the education needed to pursue these career tracks, we are also directly addressing the stereotypes about “who can do science and engineering,” allowing the opportunity to develop the talent of students who may be female, members of minority groups and/or persons with disabilities.

**Capacity Building.** Recognizing the need to develop organizational capacity to assess program value and effectiveness, AAAS has established its Center on Advancing Science and Engineering Capacity. Working largely with universities, AAAS assists these institutions in developing internal structures to evaluate their programs and processes and to act on the information that it gains. The Capacity Center points to research-based interventions of demonstrated effectiveness to fully develop and utilize the talents of women and men among its undergraduate and graduate students as well as in support of diversifying its faculty.

Capacity building has not been confined to formal education; for decades AAAS has worked with community-based organizations and girl-serving groups to incorporate STEM programming into the suite of informal activities that such groups provide. In the past our partnerships have included Girls, Inc. (represented here at this hearing) and Delta Research and Education Foundation of Delta Sigma Theta Sorority (a service sorority of

college-educated African American women who used the AAAS-developed training models and materials to organize science-focused community activities for families). These types of informal science education opportunities have been found to be particularly effective for engaging underrepresented groups in the sciences. It is a theme that is echoed in the new NAS report, *Learning Science in Informal Environments: People, Places and Pursuits*.

**“The Double Bind.”** AAAS has played a leadership role in identifying barriers to education and careers in science, engineering and biomedicine for women who face multiple barriers including race/ethnicity and/or disability. In 1975 AAAS convened the first conference on minority women in science, the proceedings of which were published as *The Double Bind: The Price of Being a Minority Woman in Science*. The association catalyzed the development of a national network of minority women as well and urged the collection and reporting of data disaggregated by race/ethnicity and by sex. Such data are critical to identifying barriers still encountered by these women such as their lower levels of participation within university STEM faculties, even where their levels of doctoral attainment compare favorably with males of their particular group.

**Visibility.** Women are active and visible participants in every aspect of the leadership of AAAS: as speakers and organizers of meetings and conferences; as leaders in the governance of the organization; and among the ranks of its senior staff. It is critically important that young women who may be asking if there is a place for them in science see examples of individuals who have made this choice, who are being successful and making a difference.

### **What can the federal government do?**

Many researchers and program managers believe that STEM fields are not being “marketed” appropriately to girls and young women. While President Obama has articulated specific challenges where science and engineering must play a role, it is also important to provide materials (and opportunities for engagement) that demonstrate how STEM connects to addressing the real world problems we face as a nation and as a world. Consider, for example, the areas of engineering where the distribution of bachelor’s degrees in environmental and biomedical engineering awarded to women approaches that of men.

Many believe that a new call to serve for both young men and young women needs to link the critical role of education in STEM fields with the opportunity to address global concerns such as food security, clean water, climate change, clean sources of energy, and infectious diseases and other health issues. Students need examples of people who are doing this work today as well as access to opportunities for experiential learning. It is important in such efforts to prominently include women as well as men.

There is a range of laws and executive orders that pertain to colleges and universities as educational institutions as well as their role as recipients of federal funding that require fair treatment and equal opportunity. It is important that the federal government provide

guidance and assistance to higher education institutions in their voluntary reviews of their practices to ensure that there is full access to study and employment for women as well as men. It is important that we not tolerate discrimination in any form: in establishing environments supportive of women's education in STEM fields; in applications, hiring, salaries and so on.

In addition we need to explore the cost of pursuing STEM careers, both in terms of loans that must be repaid as well as the opportunity costs incurred through additional years of school. While access and the cost of education are problems for all, expecting a future of lower compensation is a major deterrent. With high rates of attrition and poor prospects for jobs, especially in universities, science is losing in the competition for talent. With debt and expectations of lower salaries women will vote with their feet.

**Statistics.** Critical to efforts to improve the recruitment and retention of women in STEM fields is identifying measures of success and “keeping score.” While this certainly means evaluating individual local programs for their effectiveness, it also means maintaining the statistical base in this country that will allow us to gauge “climate” and chart progress. We need to be able to look at enrollment data by specific field of study and by each degree level; disaggregated for men and women, most certainly, but also for women from different racial/ethnic groups and by citizenship status.

We need better information on women in the S&T workforce as well as their participation as members of the STEM faculties of different kinds of institutions.

**Better Practices.** It was noted above that institutions vary widely in their outcomes for women in STEM, as students as well as faculty. The federal government needs to support the research that helps us better understand the practices that are especially effective as well as provide greater support for dissemination of these. Federal laws and infrastructure are already in place to support much of this work. Several aspects that currently apply to the National Science Foundation might be viewed for wider adoption across agencies that support STEM education and careers. In particular, the NSF Equal Opportunity in Science and Engineering Act and the Committee on Equal Opportunities in Science and Engineering might help inform government-wide efforts to support equal access to education and careers. In addition, in select agencies aspects of NSF's “broader impacts” criterion in award of support might also be explored.

With regard to assembling the talent needed to address America's challenges, including our long-term competitiveness, it is “all hands on deck.” It is critical that the United States have access to the full talents of all of its citizens and that every effort be made to enable that. As we face pressing challenges whose solutions depend upon science and technology, we cannot afford to waste the minds and potential of women.

## APPENDIX A

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Alan I. Leshner is Chief Executive Officer of the American Association for the Advancement of Science (AAAS) and Executive Publisher of its journal, *Science*. From 1994 to 2001, Dr. Leshner was Director of the U.S. National Institute on Drug Abuse at the National Institutes of Health (NIH), and from 1988 to 1994 he was Deputy Director and Acting Director of the National Institute of Mental Health. Prior to that, he spent nine years at the National Science Foundation, where he held a variety of senior positions, focusing on basic research in the biological, behavioral and social sciences, on science policy and on science education. Dr. Leshner began his career at Bucknell University, where he was Professor of Psychology. His research has focused on the biological bases of behavior, particularly the role of hormones in the control of behavior. Dr. Leshner is an elected member of the Institute of Medicine of the National Academy of Sciences, and an elected fellow of the AAAS, the American Academy of Arts and Sciences, and the National Academy of Public Administration. He has received numerous awards from both professional and lay groups for his national leadership in science, mental illness and mental health, substance abuse and addiction, and public engagement with science. He received an A.B. degree in Psychology from Franklin and Marshall College and M.S. and Ph.D. degrees in Physiological Psychology from Rutgers University. He also has been awarded six Honorary Doctor of Science degrees.