Committee on Women in Science, Engineering, and Medicine
POLICY AND GLOBAL AFFAIRS

FROM DOCTORATE TO DEAN OR DIRECTOR: SUSTAINING WOMEN THROUGH CRITICAL TRANSITION POINTS IN SCIENCE, ENGINEERING, AND MEDICINE

STATEMENTS FROM PROFESSIONAL SOCIETIES ADDRESSING CRITICAL TRANSITION POINTS

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ASSOCIATION OF AMERICAN MEDICAL COLLEGES

With the establishment of a formal Women in Medicine (WIM) program in 1987, the Association of American Medical Colleges (AAMC) made a major commitment to supporting the growing numbers of women applying to medical schools in the 1980's and to first supporting and then later enhancing professional development for women faculty in medicine and the biomedical sciences. The current profile of support includes the following:

1) A national steering committee of women physician and science faculty from medical schools in the United States and Canada;
2) Two career development programs that enhance career planning, mentoring systems, and skill-building in management and leadership;
3) A network of Women Liaison Officers in nearly every medical school and teaching hospital in the U.S. and Canada, and a national meeting that addresses issues of equity and supportive work environments;
4) An annual survey of faculty and medical school leadership positions, including benchmarking data for academic rank and executive positions.

Thus, through the WIM programs, the Association offers a comprehensive portfolio of measures, programming, and communications that directly support women in the biomedical sciences.

In addition, the AAMC- Group on Faculty Affairs (GFA) supports the advancement of women faculty through initiatives to enhance medical school and teaching hospital policies for all faculty, paying special attention to areas of inequity. This occurs through formal professional development group activities and staff initiatives. The mission of the AAMC is comprehensive and addresses critical transition points for women faculty in the following ways:

Transition	**AAMC Activity**
Entry into academic research	GFA and WIM meeting presentations showcase Orientation programs, often drawing attention to generational differences in entering faculty. The July 2005 Analysis in Brief (AIB) shows approximately equal numbers of women and men entering academic medicine; other AIB's (March 2002, June 2008) suggest higher turnover and lower retention for women compared to men faculty.
Retention in the faculty workforce	A new initiative, Faculty Forward, will present a "dashboard" of faculty satisfaction data relative to the work environment; data are presented by gender (and pilot data suggest important differences in men's and women's perceptions). The initiative proposes to bring institutional leaders together to compare benchmarking information and make improvements. The impact of these actions can then be measured over time and compared within schools and across peer schools. AAMC faculty roster database, which has been maintained since

	1965, allows medical schools to identify retention rates and to benchmark against comparable schools. The June 2008 AIB reports rates of retention of assistant professors, with PhD's having a higher retention rate than MD's. A variety of resources are offered to support faculty—programs and monographs to inform research practices; an online publication (Faculty Vitae) to bring professional development information directly to faculty. (Note the issue on community based research addresses some simple tools of organizing grants; the issue on mentoring highlights research intensive institutions.)
First promotion	The Early Career Women Faculty Professional Development program specifically addresses academic career paths and tracks. Participants are all assistant professors between 2 and 6 years from first appointment; approximately 20% are PhDs and about 60% are actively engaged in funded research. The purpose of this program is to inspire women to continue in their academic paths and to provide guidance in accessing resources and mentors to accomplish their goals.
Opportunities for institutional leadership	The Mid Career Women Faculty Professional Development program accepts women associate and early full professors for four days of management and leadership training with the purpose of recognizing their potential and strengthening their institutional leadership contributions. The Executive Development Seminar for Associate Deans and Department Chairs includes in its curriculum sessions on successful funding of research programs and strategic thinking about departmental and institutional actions as well as sessions on individual effectiveness. In addition, the association works to maintain diverse membership in programs and committees, thus bringing more women into national leadership activities.

In considering the critical transitions that face women in science, engineering, and medicine, academic institutions have historically considered career development and achievement in terms of moving from dependence to independent research with status awarded by academic appointment, and little attention paid to preparation for leadership. And yet, it is well known that research success requires active networks of colleagues and establishment of personal relationships with colleagues and staff. Increasingly, the academy is recognizing the need to pay special attention to policies and practices that impose small but cumulative advantages to majority men. The following table presents a perspective that might shape a discussion of a new generation of connected scientists and their pathways to leadership.

Markers of Achievement	Historically	Future-oriented
Professional development	Focused on recruiting a "pipeline" of qualified women who would "rise to the top" and be individually mentored by top scholars	Create an environment of support for work-family balance; provide career guidance and management/ leadership skills in the course of training; more use of peer and small group mentoring
Recognition of achievement	Individual "independence" from mentor with sustained RO-1 awards; excellence within a focused area	Collaborative design and shared achievements; team development that includes staff and a range of research skills and foci
Professional participation	Full-time/ "overtime" demonstrating dedication to career	Full-time/ "balanced time" with interruptions of part-time with paths for continuing engagement and re-entry (and re-direction); flexible and adaptable careers
Dissemination of findings	High status journals and peer review by select few	Rapid release and wide dissemination over Internet; broadened definitions of scholarship to include community engagement
Visibility (opportunity)	Largely related to status in field (you "earn" your opportunities for leadership by first earning your credibility in the field)	Communities of contributors with different experiences and different skills; opportunity for leadership contributions all along the career path

The AAMC considers these discussions of generational change in biomedical faculty and staff, cultural change in academic medicine, and diversity of our workforce to be critical to the ability of science, clinical medicine, and higher education to be able to serve the nation.

AMERICAN INSTITUTE FOR MEDICAL AND BIOLOGICAL ENGINEERING, WOMEN IN MEDICAL AND BIOLOGICAL ENGINEERING COMMITTEE

The Need to Study Advancement of Women in Medical and Biological Engineering

Introduction

Among engineering fields, biomedical engineering (BME) has one of the greatest proportions of female students. While progress has been made towards improving female entry into biomedical engineering studies and professions, more remains to be done, particularly in the higher echelons. Therefore, additional study and outreach are needed to attain gender parity in the biomedical engineering field.

Trends in Female BME Representation

From 1998 to 2005, females pursuing B.S. and M.S. degrees in BME made the largest relative gains, with increases of 36% to 42%. More recently, more than 38% of BME B.S. degrees were awarded to females during the 2006-07 period, making BME second only to environmental engineering in fields most equally representing women. M.S. degrees also had impressive gains from 1998-2005, rising from 31% to 44% female involvement. Improvements in the percentage of women in Ph.D. programs were less impressive, only increasing from 22% to 29%, with most of the gains occurring by 2000. Nonetheless, BME M.S. and Doctorate degrees both have the third highest percentage of females, with 39.5% and 34.5% female involvement, respectively.

This trend does not continue at higher levels of experience. From 2001-2005, the proportion of female Assistant Professors actually shrank from 28% to 22%. Minimal growth occurred among Associate Professors, where the proportion of females rose from 16% to 20%. Among Full Professors, the women's share of positions grew from 4% to 7%. In 2005, only about 22% of Assistant Professors, 20% of Associate Professors, and less than 10% of Full Professors of BME were female.

Why understanding female preference for BME is important

In spite of continued male domination of the BME discipline, it still has one of the highest proportions of women of any engineering subfield. Understanding why women prefer BME might provide valuable insights on how to broaden engineering curricula or other factors to attract more females to engineering as a whole. AIMBE plans to spearhead this effort through focus groups with key constituencies, workshops, seminars, and mentoring programs and the activities of its Women in Medical and Biological Engineering Committee.

The American Institute of Medical and Biological Engineering (AIMBE) represents the top minds serving both public and private interests working to advance medical and biological engineering. AIMBE's Women in Medical and Biological Engineering Committee, consisting of members from corporate, academic, and government institutions, celebrates women's contributions to both the field and to the health and well-being of our society.

AMERICAN INSTITUTE OF PHYSICS

Stressors in Careers for Women in Physics

Aggregated data from physics faculty members and department chairs show that women are represented on physics faculties at rates consistent with PhD production in the past (Ivie and Ray, 2005). Once women have earned a PhD in physics, a small, but representative, number of them are able to advance up the academic ladder.

However, this does not mean that women in physics do not encounter barriers to advancement in their careers. One area of inequality is salary. Controlling for years of experience and sector of employment, women physicists in academe earned 5% less on average than men. The salary gap exists not only in academe, but also in other sectors of employment for physicists, including industry and government labs (Ivie and Ray, 2005).

In addition to receiving lower salaries, women often work in hostile environments. Since 1990, the Committee on the Status of Women in Physics of the American Physical Society has conducted site visits at the request of physics departments to assess the climate for women. These site visits and surveys of other groups (Ivie and Guo, 2006; Ivie, Czujko, and Stowe, 2002) continue to document hostile environments for women physicists. Women physicists often report that they have encountered behaviors ranging from being ignored to blatant sexual harassment and that these behaviors affect them deeply.

Physics is a relatively small field, so why should the committee be concerned with these trends? First, compared to other scientific disciplines, physics is last in terms of representation of women. During the last several years, for example, between 13% and 18% of PhDs in physics have been earned by women. These are significantly lower rates than mathematics, chemistry, and the life sciences. Secondly, physics has detailed data that are not available to other disciplines. For example, we have data on the average time since doctorate for academic physicists by rank. These data can be used to gain a better understanding of the situation in physics and as a model of data that should be collected for other disciplines. Most importantly, physics offers a wide range of career options. Women should be encouraged to pursue physics, not turned away by salary differences and the bad behavior of a few. Finally, evidence and logic suggest women are treated differently in physics than they are in other sciences. Perhaps some of these differences are to women's benefit (such as advancement into faculty positions), but many are not. Our understanding has advanced beyond the point of studying women in science as if it is homogenous. Rather, we should look at differences among scientific disciplines for a more thorough understanding of the problem.

References

Ivie, R., R. Czujko, and K. Stowe. 2002. "Women Physicists Speak."http://www.aip.org/statistics/trends/reports/iupap.pdf

Ivie, R. and S. Guo. 2006. "Women Physicists Speak Again."http://www.aip.org/statistics/trends/reports/iupap05.pdf

Ivie, R. and K. N. Ray. 2005. "Women in Physics and Astronomy, 2005." http://www.aip.org/statistics/trends/reports/iupap05.pdf

AMERICAN PHYSICAL SOCIETY, COMMITTEE ON THE STATUS OF WOMEN IN PHYSICS

The participation of women in the sciences is increasing, but not in a uniform way across all disciplines. The recent advances of women in the biological sciences have not been matched in the physical sciences. Even among the physical sciences, the inclusion rates are not equal. From 1991 to 2000, the percentage of Ph.D. degrees awarded to women in all science and engineering fields increased from 28.9% to 36.2%. In physics the increase was from 11.0% to 13.5%. Yet the percentage of women in physics faculty positions at doctoral institutions is still only 7%. When compared to some other disciplines [1] physics has a pipeline that is not only leaky but also tiny [2, 3]. The Committee on the Status of Women in Physics (CSWP) of the American Physical Society (APS) works to address this under-representation of women in physics at all levels from undergraduate students to full professors and on into prominent leadership roles in the field. The goals of CSWP address diversity throughout the entire career path to give tools to women physicists that will best allow them to succeed and advance in the current environment.

Currently, women are severely underrepresented in the physical sciences and engineering [4]. As of 2003, women receive 22% of the BS/BA degrees in physics, but only 18% of the PhDs, and only 5% of full professors in physics were women in 2002 [5]. In addition, women are less likely than their male peers to be nominated for prestigious prizes and awards [6, 7, 8].

CSWP works to increase the inclusion of women in physics. Recently (May 2007), they held a workshop on Gender Equity (www.aps.org/programs/women/workshops/gender-equity.cfm) that involved the chairs of 50 top physics departments and 14 unit leaders from national laboratories. This highly successful workshop was the first stage in an overall effort to instigate institutional transformation in the field of physics by creating change agents. The Gender Equity Workshop produced a set of "best practices" guidelines to help any department improve its climate. The committee has numerous other programs (e.g., travel grants, job registry, listserv) and publications (CSWP Gazette) to aid and support women physicists in their career development as well as improve the climate in general. A follow-up conference will be held in May 2009 to assess the progress made by the departments and national labs resulting from the original workshop.

Other committee activities include the speaker program, which exposes more students to female scientists and gives these women some exposure [9]. Site visits by representatives of the committee to university physics departments and national laboratories help improve the climate for women in these settings. The new website for departments to enter information about their family friendly policies for graduate students (www.aps.org/programs/women/female-friendly) allows individual departments to showcase their efforts; to date, more than 160 departments have responded.

In 2005, with the support of the NSF, APS launched a series of three successful career development workshops held in conjunction with national APS meetings. These were modeled on a successful outline developed by the Committee for the Advancement of Women in Chemistry (COACh). The workshops focused first on strengthening communication skills of the participants and second on negotiating strategies for career advancement. Each workshop was

aimed at a different population: tenured faculty, non-tenured faculty, and those in non-academic physics research.

NSF has provided funding for additional workshops (2008-2010) which target postdoctoral associates as well as women physicists in academia and research and has made special efforts to recruit women of color as participants (see http://www.aps.org/programs/women/workshops/skills/index.cfm). Two international conferences on women in physics sponsored by IUPAP (International Union of Pure and Applied Physics, 2002 and 2005) identified the postdoctoral associate career stage as the point when women are most likely to leave physics [10].

CSWP maintains a presence at the two major annual meetings of the APS by sponsoring an invited session at each. It also hosts receptions at both. This year it provided modest childcare grants to early career attendees at these meetings.

References

1. V. Kuck *"Refuting the leaky pipeline hypothesis"*, C&EN November (2001). http://pubs.ace.org/cen

2. Science and Engineering Doctorate Awards (2000). NSF 02-305.

3. Howard Georgi *"Is there an unconscious discrimination against women in science?"* APS News, Jan (2000). http://www.aps.org/apsnews/0100/010016.html

4. National Science Foundation (NSF). *Women, Minorities and Persons with Disabilities in Science and Engineering: 2007*. NSF 07-315. Washington, DC. Table H-5, Employed scientists and engineers, by occupation, highest degree level, and sex: 2003. http://www.nsf.gov/statistics/wmpd/employ.htm

5. R. Ivie, S. Guo, & A. Carr, *2004 Physics & Astronomy Academic Workforce*. American Institute of Physics Statistical Research Center, College Park, MD (2004). http://www.aip.org/statistics/trends/reports/awf.pdf

6. G. Sonnert and G.Holton. *"Gender differences in science careers: the Project Access Study"*, Rutgers University Press, New Brunswick, NJ (1995).

7. V. Valian, *"Why So Slow? The Advancement of Women"* MIT Press, Cambridge, MA, (2000) 233-234.

8. M. Urry, *Speeding up the long slow path to change*, American Physical Society News, February 2003. http://www.aps.org/apsnews/0203/020306.html

9. APS Women Speakers Program http://www.aps.org/programs/women/speakers/index.cfm

10. Meg Urry *"The Status of Women in Physics – An international meeting on what why and how to change"* (2002). http://units.aps.org/units/fps/newsletters/2002/july/urry.pdf

AMERICAN SOCIETY FOR CELL BIOLOGY

Proposal for Enhancing the Number of Women Scientists and Physicians in Leadership Positions

The Women in Cell Biology Committee (WICB) of the American Society for Cell Biology (ASCB) has multiple mentoring programs that address critical early transitions from doctorate to post-doc to jobs. These include a mentored Career Lunch at the annual ASCB meeting, a monthly career advice column in the ASCB newsletter, and downloadable publications including *Life Sciences Research & Teaching: Strategies for the Successful Job Hunt* and *Career Advice for Life Scientists* (CALS), Volumes I and II. New this year, with funding from the Elsevier Foundation, are competitive grants to help pay for childcare so that the primary care-giving parent can attend the ASCB Annual Meeting. The Office of Research on Women's Health at NIH is funding a third CALS volume. Thus, we have experience with effective approaches to help advance women from their graduate training into their first professional positions.

However, little energy or innovation has been applied to the opposite end of the professional spectrum – dealing with the dearth of women in leadership positions like deans and directors. Although it may be assumed that this problem will self-correct when enough women are in the pipeline, it is also likely that it will not. Two converging patterns currently work against institutions in finding a woman scientist/physician candidate pool for these positions: 1) Institutions that seek chairs, directors, and deans screen candidates who are typically in their early 50's, 2) Among the many successful women scientists/physicians in this age group, there are few with institutional administrative experience, since most have focused almost exclusively on their research and therefore have eschewed administrative responsibilities.

Why would 50-year-old women (as opposed to men) not have administrative experience?

It is widely acknowledged that being a successful scientist/physician requires maximal efforts and is highly competitive. Thus, whatever distracts from this effort places a scientist at risk of failing in her or his chosen career. This includes administration. It is not surprising that many early- and mid-career scientists/physicians currently choose not to divide their attention further or decrease research/teaching/clinical responsibilities. Taking on leadership responsibilities often incurs a risk to one's success as a scientist/academic. The scholar's life is, after all, the career for which one trained, the embodiment of one's emotional investment, and the challenge that drives one forward daily.

Many women scientists/physicians are routinely balancing management of home/family and management of research, and therefore are, in fact, developing their "administrative skills." However, this administrative experience will not show up as lines on a resume or CV, nor will these scientists appear on a radar screen or on a list of optimal candidates for dean/director positions. We hypothesize that women under age 50, specifically those with children, obtain their "management fix" at home, and have no need to seek management opportunities at work. However, once the children leave home, these women now need an outlet for these skills, and are primed for taking on leadership roles at work.

We propose a two-pronged approach:

First, we propose that the time clock imposed by our institutions for advancement to leadership, which traditionally begins for candidates in their mid-40's, could be re-set to 10-15 years later for women than men. This is not to exclude younger women ready to take on leadership roles earlier. However, this means that "older women" should be intentionally screened in a candidate pool. Recruiting them for these positions would also reflect the reality of our current potential individual life spans and the corresponding duration of an effective career.

Second, we propose the institution of management training courses that promote administrative skills, where the emphasis for early- and mid-career women scientists/physicians would be on the balancing of career and family pressures. Such training will give women the tools for "conventional" administrative positions at such time that these positions seem appealing. Such training would also be offered to senior scientists/physicians. Thus, we would give women the tools for administration at a high level (and a credential testifying to this), whether early in their career when they are doing a balancing act, or later when they are ready to take on a different emphasis. The long-term benefit is that participants' management skills will be sharpened and available for application to leadership positions after the primary parenting responsibilities have lessened or passed.

We predict that institutions choosing leaders from the mature-scientist/physician group of women will find outstanding, analytic, well-balanced leaders. Women in their 50's and 60's often describe feeling liberated, with boundless energy to apply to their careers. If they are armed with both management skills and a successful scientific career, they would be in an excellent position to successfully take on positions of dean or director.

Any discussion of the "glass ceiling" in leadership positions needs to focus on understanding that the current pattern of advancement fits the career pattern of a male scientist who is not a primary caregiver, not the pattern of many of our most talented women scientists. The challenges that women scientists/physicians face – in particular the role of being both mentors *and* role models, the limitations imposed by inflexible schedules and unrealistic time frames, and the dichotomy between how recruitment currently works and how it should work – have evolved in a previously male-dominated field.

To take advantage of the outstanding women requires attention at early-, mid-, and late-career stages. Efforts are needed at the department and institution level, as well as through leadership by NIH, NSF, AAMC, and other federal entities and professional societies. This proposal adds to what has already been implemented for early career mentoring by the ASCB.

AMERICAN SOCIETY FOR MICROBIOLOGY, COMMITTEE ON THE STATUS OF WOMEN IN MICROBIOLOGY

The Committee on the Status of Women in Microbiology (CSWM) of the American Society for Microbiology has discovered that women leave science at critical transition points in their careers. Women leave the field of Microbiology between two-year undergraduate college and four-year undergraduate college, between undergraduate college and graduate school, between graduate school and potential post-doctoral positions, between post-doctoral positions and higher, permanent career positions. Women also leave the field if they have spent any amount of considerable time away from the field, for example to raise children; in attempting to return to the field, they feel that they have lost considerable experience time and can no longer be competitive.

The CSWM has recently identified that women microbiologists who are at the post-doctoral level are a group that have their own specific problems, and that the "leave rate" at this juncture is especially pronounced. The CSWM conducted a survey of women attending the annual general meeting of the society in 2007-2008. This survey was geared specifically toward the post-doctoral career level.

While there can be many reasons that women will leave the field of Microbiology, the CSWM has identified two significant potential causes. One perceived cause is the lack of mentoring. Women, and men for that matter, are mentored during their undergraduate college years by their professors. This mentoring again occurs during the graduate years by their appropriate discipline mentors. However, once women are in a post-doctoral position in academia or in industry, the mentoring slowly ceases. Post-doctoral-level scientists are expected to perform independently. Men often have other male colleagues on whom to rely; a woman may be the only woman in that facility. Without sufficient networking support, a woman might be impeded from moving into a higher career position.

Another potential cause is salary. A microbiologist with a bachelor's degree is severely limited in salary and in upward mobility because of the lack of education. The obvious choices are to leave the field or go to graduate school. Unfortunately, the science fields almost demand that further education be sought. If graduate school is chosen, the scenario does not always significantly improve. Often, in academia, it is expected that a doctoral-level microbiologist will then follow with a post-doctoral position; post-doctoral positions do not generally pay well. A doctoral-level scientist has a professional graduate degree. However, in comparison to other professional graduate degrees, such as attorneys or physicians, the post-doctoral scientist in academia is paid very little for the equivalent time that was spent obtaining the degree. If the post-doctoral scientist is unable to locate a self-sustaining, tenure-track academic appointment, the obvious choices are, very disappointingly, to remain as a post-doc or leave the field.

ASSOCIATION OF ENVIRONMENTAL ENGINEERING & SCIENCE PROFESSORS

Critical Transition Points in Environmental Engineering

Current Status of Environmental Engineering

Environmental engineering is a recognized specialty on professional engineering licensing exams. The U.S. Bureau of Labor Statistics counts over 54,000 environmental engineers employed in the U.S. and Jones et al. (2005) reported the upper range may be as high as 100,000. As a profession, environmental engineering is significantly larger than biomedical, materials, and chemical engineering (which only employed 14,000, 22,000, and 30,000 engineers respectively in the U.S. in 2006). Environmental engineering is 1 of 2 engineering disciplines the U.S. Bureau of Labor Statistics predicts will have "much faster than average growth" over the next 10 years. In addition, the projected 25% growth in the number of environmental engineers to 68,000 by 2016 is the largest of any engineering discipline. In contrast, overall engineering growth will be 11%.

Gender Diversity in Environmental Engineering

The Association of Environmental Engineering and Science Professors (AEESP) completed a study of the diversity of students and faculty of named environmental engineering degree programs (2005). AEESP's survey concluded that the environmental engineering student body has better gender diversity than the field of engineering as a whole. Women received 42, 42, and 31% of environmental engineering BS, MS, and Ph.D. degrees, respectively, in 2003–2004 compared with 20, 22, and 17% of BS, MS, and Ph.D. degrees from all of engineering (ASEE 2004). Gender diversity was lower among environmental engineering faculty (14.9% women), but higher than all engineering faculty (9.9% women). Women appeared to be better represented in the environmental engineering workforce (22% female) than in all engineering (11% female) (Bhandari et al., 2006). Unfortunately, we have no data on the transition of female environmental engineering faculty members to administrative positions (e.g., chair, dean, provost).

Transition Points and Methods to Increase Diversity

The data suggest that environmental engineering still has room to add additional female representation between pre-college and undergraduate years. In addition, because environmental engineering degrees are not keeping up pace with the demands of engineering workforce demand, there is still a large pool of positions at universities and in practice that could be filled by females. For example, environmental engineering practitioners (Selna et al., 2006) have documented a steady decline in enrollment in MS Environmental Engineering programs (up to 50% at some institutions) in the past 10 years, while issues such as population trends, changing regulatory requirements, and decaying infrastructure have created an even larger demand.

The decrease in percent female involvement in environmental engineering is much larger during the transition from MS to PhD and even greater during the transition from PhD to academic

positions. Thus, in environmental engineering, efforts need to be made to recruit (and retain) more women into doctoral and academic environmental engineering positions.

Many of our members have collected data that supports the work of others that suggests underrepresented groups in engineering, particularly women, are attracted to careers where they feel that they can have a positive impact on society. A review of enrollment in some sustainability initiatives supports our belief that educational and research experiences related to the environment and sustainability, with their focus on societal impact and interconnectedness, hold broad appeal to students, especially to young women (Bielefeldt, 2006; Mihelcic et al., 2006; Hokanson et al., 2007; Zimmerman and Vengas, 2007). For example, interviews of incoming male and female Master's International environmental engineering students (a graduate program that combines the MS environmental engineering degree with service in the U.S. Peace Corps) that have a first degree in engineering other than civil or environmental, clearly indicate they look for connections between engineering and society. In fact, female Master's International environmental engineering students with first degrees in Mechanical, Chemical, and Electrical Engineering have joined the program for reasons that include: merging personal convictions with career; wanting to learn how to apply technology that is culturally, economically, and socially suitable; and, seeking a change so they can apply their engineering skills for the protection of ecosystems and natural resources (Mihelcic, 2004). This message may also resonate with other underrepresented groups who may be attracted into these types of programs to improve the living conditions in their cultural origins (Mihelcic et al., 2006).

References

1. American Society of Engineering Education _ASEE (2004). "Engineering College Profiles and Statistics for 2004," http://www.asee.org/about/publications/profiles/index.cfm, accessed, Jan.2006.
2. Bielefeldt, A. "Attracting Women to Engineering that Services Developing Communities," *Proceedings of the Conference of the American Society for Engineering Education*, 2006.
3. Hokanson, D.R., J.R. Mihelcic, L.D. Phillips, "Educating Engineers in the Sustainable Futures Model with a Global Perspective: Education, Research & Diversity Initiatives," *International Journal of Engineering Education*, 23(2): 254-265, 2007.
4. Jones, S. et al., An Initial Effort to Count Environmental Engineers in the USA, *Environmental Engineering Science*, 22(6):772-787, 2005.
5. Bhandari, A., Jones, S., Clapp, L., Fennell, D., LaPara, T. "Diversity in environmental engineering—Successes and Challenges." *Journal of Environmental Engineering*, pg. 701-702, July, 2006.
6. Mihelcic, J.R. "Educating Tomorrow's Global Engineer through a Unique Partnership with the U.S. Peace Corps," *Woman Engineer*, 30-33, Fall, 2004.
7. Mihelcic, J.R., L.D. Phillips, D.W. Watkins, Jr., "Integrating a Global Perspective into Engineering Education & Research: Engineering International Sustainable Development," *Environmental Engineering Science*, 23(3): 426-438, 2006.
8. Selna, M.W., H.T. Glaser, R.R. Trussell, G.R. Chan, M. Sullivan, "Declining Enrollment has Water and Wastewater Professionals Concerned," *Proceedings of the 79th Annual Water Environment Federation Conference & Exposition*, 2006.
9. U.S. Bureau of Labor Statistics, http://www.bls.gov/oco/ocos027.htm
10. Zimmerman, J.B. and J.A. Vanegas, "Using Sustainability Education to Enable the Increase of Diversity in Science, Engineering, and Technology Related Disciplines" *International Journal of Engineering Education*, 23(2):242-253, 2007.

ASSOCIATION OF BIOMOLECULAR RESOURCE FACILITIES

Approximately 50% of the membership in the Association of Biomolecular Resource Facilities (ABRF) is comprised of scientists working in core facilities, i.e., a biological resource facility. A core facility, whether it resides in an academic, government or industrial sector, provides affordable access to technologies and expertise that would otherwise be too expensive for most individual labs to acquire, such as proteomics-related techniques, mass spectrometry, DNA sequencing and analysis, bioinformatics and N-terminal protein sequence analysis.

The critical transition point in a core facility career is from bench scientist to core facility director. The role of the bench scientist is to maintain a high working level of technological proficiency in the techniques currently offered as a service by the laboratory while continuing to expand their skill set to incorporate the latest technological advances. In an ABRF survey study published in *Nature* in 2000 [1], across all core facility sectors, the percentage of male employees holding MDs or PhDs was significantly greater than the percentage of female employees (24% to 9% respectively). The government core facilities showed the highest level of disparity – 39% male MD or PhD vs. 7% female MD or PhD among all employees (N=42 government employee respondents). Of all the male employees hired by government-run core facilities, 54.6% hold MDs or PhDs. Among all the female employees hired by government-run core facilities, 19.4% hold MDs or PhDs.

In contrast to national trends, there is no significant difference in salaries for men and women at the same degree level at core facilities [1] in all sectors. Since compensation for men and women holding PhDs in core facilities is equal, why do the numbers of men and women at the PhD level working in core facilities differ significantly? These discrepancies raise the important question as to whether women with PhDs are represented in the job applicant pool in the expected ratio and whether women are selected for core facility director positions in numbers that are reflective of their overall numbers within the field. If the former do not contribute to the skewed ratios, one potential reason for the disparity could be gender hiring biases.

Alternatively, the number of years on the job could have also skewed the results if more female PhDs were newer hires (data not reported), as newer employees feeling increased job stresses might be less likely to respond to such a survey. The critical question remaining is whether these skews translate into fewer female core facility scientists entering director positions, as most facility directors hold advanced degrees. As this study is somewhat dated, it is important to readdress, perhaps with a new comprehensive survey, whether these disparities still exist in core facilities, especially now when women and men in the sciences are earning their PhDs at nearly equal rates [2].

There is no tenure system in most core facilities. The lack of a tenure system sets a core facility career and other traditional academic careers apart. The ABRF as an organization could potentially provide the resources, such as a mentoring program, to help women scientists along a career track from bench scientist to core facility director in the absence of other institutional support such as tenure reviews and departmental support. Currently, there are no such programs established. The paucity of such mentoring programs is not uniquely felt by core facility scientists, as the current cohort of women chemists in academia reported mentoring gaps and

gender biases at some point during their careers [3]. It is not clear whether the lack of such programs indicates that there is limited interest in mentoring female scientists who wish to become core directors or if few female scientists are on such a track and seeking assistance. With the growing need for proteomics, bioinformatics and genome sequencing services, core facilities are in high demand and now found at almost every major research university and medical center. This growth translates into more job opportunities for women scientists. Given the rapid growth of this relatively young career path, the absence of mentorship support and the unequal numbers of male and female employees holding advanced degrees in core facilities, the ABRF and its members believe it would be desirable to learn about and implement proven strategies to help female members rise from the ranks of scientist to core facility director.

The ABRF requests that this statement be considered at the upcoming workshop so as to highlight a distinct new career path for women scientists and some of the unique barriers they may have to overcome while pursuing the career as core director. During the transition from scientist to director, a woman faces professional challenges similar to those faced by faculty members as well as by university administrators and personal challenges faced by all working female scientists [2]. Therefore, they are entitled to the same training and mentoring programs available to these other professionals.

References

1. McMillen, D.A., et al., *Job compensation in the biotechnology core laboratory*. Nat Biotechnol, 2000. **18**(6): p. 686-9.
2. Byko, M., *Challenges and opportunities for women in science and engineering.* Journal of Materials, 2005. **57**(4): p. 12-17.
3. Nolan, S.A., et al., *Training and mentoring of chemists: a study of gender disparity* Sex Roles, 2008. **58**: p. 235-50.

AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES ENGINEERING WORKFORCE COMMISSION

Percentage of Women Earning PhD's in Engineering Continues to Climb

Introduction

While more women than men pursue college degrees, more then five times as many men earn engineering bachelors degrees. The numbers are similar at the PhD level and the data does not promise statistical parity any time soon: women are now earning 20 percent of the Ph.D.'s in engineering—way up from the 4 percent of the 1960s, but still far behind the rate they are winning doctorates in other fields.

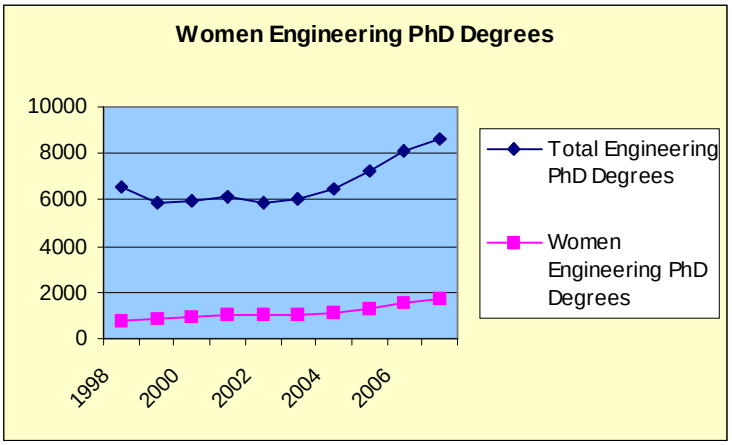
EWC Background

For more than 50 years the Engineering Workforce Commission has been committed to assessing America's technical and engineering workforce. The EWC tracks the entire engineering student population in U.S. colleges and universities. In a series of annual surveys, the EWC collects data that is used to predict the ebb and flow of new engineering professionals, including the participation rates of women and minorities.

Statistical Data

Women earning PhD degrees in engineering continue to grow at a rapid pace. The 2007 class grew by 498 students and stands at 8,614 according to the Engineering Workforce Commission's survey report *Engineering & Technology Degrees, 2007.* This marks a 6 percent increase over 2006, not as dramatic as the 11.5 percent increase from last year, but still exhibiting strong growth.

Starting in 1999, the number of PhD's in engineering began to grow, although the number dipped down in 2002. These rising numbers suggested a subsequent increase in women earning PhD's in engineering, which indeed began to happen in 2000.



For the last ten years, women have been increasing as a percentage of PhD degrees in engineering. From 1998 to 2007, the percentage has risen from 12.3 percent to 19.6 percent . There is no doubt that women have come a long way from the sub 5 percent days in the 1960's and 1970's but 20 percent is still much further below most other fields of study.

While the high participation rate of foreign nationals in graduate engineering is nothing new, it has been growing in the past few years. American women account for 14 percent and 8 percent of the master's and doctoral totals. Foreign national women earned nearly as many degrees: At the master's level, American women earned 5,226 degrees; foreign national women 3,505. At the doctoral level, American women earned 669 and foreign national women 923.

Bottom Lines

Recent undergraduate engineering enrollment trends seem to indicate that long-term gains in numbers of women awarded engineering bachelor degrees are in serious jeopardy. Enrollment data shows that the percentage of women earning bachelor's degrees may be decreasing in the near future. The percentage of female freshman engineering students reached an all-time high of 19.9 percent in 1995. In 1996, that percentage remained unchanged, but since then it has been decreasing. In 2006, it stood at 17 percent. At the graduate level, the numbers tell a different story, but only short term if the undergraduate decrease is not turned around.

There needs to be a study to explore the various factors that lead women to enroll in some PhD programs and not others. Perhaps part of the issue lies in the dearth of women engineering faculty, particularly the number of women engineering Deans, Directors or Chairs currently set at 11.3%.

EXECUTIVE LEADERSHIP IN ACADEMIC MEDICINE (ELAM)®

Ensuring Success of Women Scientists in Senior Leadership Positions: Continuum of Education and Support

The number of women scientists, physicians and dentists advancing into leadership positions in academic health centers (AHCs) has progressed very slowly during the past 25 years. There is a need for a critical mass—a stable cohort of senior women leaders--if we are to change the organizational culture which remains woefully inadequate to fit the needs of the increasingly diverse workforce, students and patients of the 21st century. Further, we are losing some of our best talent and role models, as senior women leaders disappear from our institutions. Our thesis is that: (a) the situation will not alter without explicit interventions, (b) increased attention needs to be given to ensuring that women leaders have *sustained success in their leadership roles* so that; (c) *a critical mass of experienced women leaders* is available to bring about essential organizational culture change.

The ELAM program, now in its 14th year, has educated over 500 senior women faculty for leadership in academic health centers (see www.drexelmed.edu/elam). The curriculum of this year-long part-time program focuses on three main areas – mini-MBA with emphasis on finance, strategic planning, and organizational design and dynamics; personal professional assessment and development; and emerging issues facing our institutions – together with building a close community of practice among the participants, alumnae, faculty, and AHC leaders. As of March 2008, 27% of all the women deans of the 274 U.S. and Canadian allopathic and osteopathic medical, dental and public health schools were ELAM alumnae. The success of the program is additionally shown by research that demonstrates that the curriculum increases self-efficacy of participants,[1] increases knowledge and readiness for leadership as compared with women who did not participate in ELAM,[2] and that deans view ELAM as having a positive impact on their schools as well as on the participants and their promotability to leadership roles.[3]

The **Leadership Continuum Project** sponsored by ELAM has the goal to increase understanding about the ways in which women obtain and are sustained in senior level leadership.[4] Through conversation with senior level women faculty leaders in universities and schools of medicine and dentistry, the continuum construct has been developed to conceptualize the process women traverse as they seek leadership positions and effect organizational change. This continuum is envisioned as:

[1] Sloma-Williams, L, SA McDade, RC Richman, PS Morahan. The role of self-efficacy in developing women leaders: a case of women leaders in academic medicine and dentistry. In: Diane Dean et al. (ed.). Chap. 3. Women and academic leadership. Arlington, VA: Stylus Publications, in press 2008.
[2] Dannels, SA., H Yamagata, SA McDade, Y-C Chuang, KA Gleason, JM McLaughlin, RC Richman, PS Morahan. Evaluating a leadership program : a comparative longitudinal study to evaluate the impact of the Executive Leadership in Academic Medicine (ELAM) program for women. Academic Medicine 2008;83:488-495.
[3] Dannels SA, McLaughlin J, Gleason KA, McDade SA, Richman R, Morahan PS. Medical school deans' perceptions of organizational climate: useful indicators for advancement of women faculty and program evaluation of a leadership program's impact. Academic Medicine. In press 2009.
[4] Morahan, PS, SE Rosen, KA Gleason, and RC Richman. A continuum of women's leadership development – a model for sustained success in academic medicine. AAMC Faculty Vitae. In press 2009.

- *preparing for* leadership;
- *transitioning into* leadership;
- *ensuring sustained success during* a leadership position; and
- *transitioning again into* another leadership position.

A basic tenet that we believe merits consideration by the NAS CWSEM is that, unlike the tenure of a full professor academic role, leadership positions are not forever. More attention needs to be directed at the last two elements of the continuum to reach a critical mass of seasoned women leaders. Better strategies and support need to be developed to ensure that women leaders: (a) have sustained successful terms as leaders despite the extra hurdles of being the 'only,' 'first,' or 'one of only a few' and (b) learn resilience and how to transition from one leadership role into another once they have accomplished their agenda. Only then will we have the stable critical mass of women leaders for the vital changes in organizational culture, policies and procedures that are necessary to address issues such as: increasingly diverse student and workforce; changing expectations for work and life balance; change from emphasis on individual to team science and healthcare; and new forms of participative research and scholarship needed to address the complex challenges of the 21st century.

FEDERATION OF PEDIATRIC ORGANIZATIONS

The field of pediatrics is undergoing a major shift in gender makeup. Nearly 75% of incoming pediatric residents are women. The issues that affect women at critical transition points are not exclusive to women. However, since significant gender disparities still exist throughout medicine, the Federation of Pediatric Organizations (FOPO) created a Task Force on Women in Pediatrics to provide a forum where the issues affecting women in pediatrics are discussed. Recommendations and actions are proposed and disseminated throughout the pediatric community. We envision this Task Force serving the entire pediatric community as it calls upon all of us, men and women, to identify ways to improve our institutions, practices, and policies that will contribute to higher levels of professional satisfaction and achievement.

A brief background about FOPO provides a context for the work of the Task Force: FOPO is an umbrella organization made up of seven major pediatric organizations including the American Academy of Pediatrics (AAP), the American Board of Pediatrics (ABP), the Association of Medical School Pediatric Department Chairs (AMSPDC), the Academic Pediatric Association (APA), the American Pediatric Society (APS), the Association of Pediatric Program Directors (APPD), and the Society for Pediatric Research (SPR). Its purpose is to promote high standards of health care for infants, children, and adolescents through education and training, foster child health research, promote high quality care, and educate the public, government and other organizations in matters related to child health. The strategies to achieve this purpose are embraced through the strategic initiatives of FOPO:

1) Develop a Leadership Academy to provide a focus for leadership training
2) Develop a strategy to position pediatricians as leaders within organized medicine
3) Promote an increase in GME funding and understand best practices of funding GME
4) Enhance the entire child health research agenda with increased support for research
5) Establish the global health priorities of academic pediatrics
6) Disseminate a position statement regarding health insurance for all US children and youth

The Task Force on Women in Pediatrics aims to identify barriers and bring about organizational changes to address these barriers that will permit women in pediatrics to maximize the contributions that they can bring to the field. The Task Force selected four issues on which to focus its attention over the subsequent two years: (a) to routinely provide the option to train and work part-time at specific career stages; (b) to allow flexibility in the career paths of physician/scientists; (c) to draw more women into leadership positions; and (d) to address child care issues. At the 2008 Pediatric Academic Societies (PAS) Meeting, the Task Force hosted a Symposium focusing on the second issue: to provide flexibility in the career paths of physician/scientists. We believe that this issue is especially relevant to the considerations of the National Academy of Science. The percent of women in medicine quadrupled in past 30 years, but women represent only 14% of tenured faculty and 12% of full professors This is not a "pipeline issue" as women represent nearly 75% of pediatricians in training, and 50% of all practicing pediatricians; rather the problem is that academic institutions require women faculty to adjust to their organizational structures, policies and procedures that were established at a time when the majority of faculty were males, whose spouses have fulltime (or nearly so) commitment to the household.

Despite the vast changes in the demographic make-up of our nation's medical schools, institutional requirements for physician/scientists have remained rigid. In most universities, the physician/scientist path is a tenure track position with the traditional restrictions and requirements to attain tenure, including typically a restricted time frame, explicit requirements for obtaining grant funding and producing publications, prohibitions (generally formal) against part-time appointments, and inflexibility of the tenure clock (or flexibility on a case-by-case basis). These requirements are not realistic for women faculty given their multiple roles, such as responsibilities to their families and for childbearing/rearing, forcing parents to choose between needs of their families and the demands of their profession in lieu of career advancement. More importantly, there is no evidence that these requirements are necessary for the advancement of science. To the contrary, the experiments presented at the PAS symposium noted conducted by two of the nation's leading institutes in pediatric basic science research (Stanford and Cincinnati Children's Hospital) suggest that women will flourish if these barriers are reduced. Currently the Task Force is analyzing data obtained from over 400 of the nation's elite physician (pediatric) scientists regarding their experiences in establishing their scientific careers and the extent to which institutional requirements facilitated or impeded this progress.

The National Academy of Science is unique in its position as it is able to examine and, as appropriate, challenge and persuade the existing structure and standards, beginning with national funding requirements for training physician scientists and extending through criteria for promotion and tenure of physician scientists. The Federation of Pediatric Organizations and its Task Force on Women in Pediatrics stand ready to work collaboratively with the National Academy of Science to forge a path to sustain the next generations of physician-scientists as they traverse through these critical transition points in their personal and professional lives.

FEMALE ASSOCIATION FOR CLINICIANS, EDUCATORS, AND SCIENTISTS

The Female Association for Clinicians, Educators, and Scientists (FACES) is an organization established to provide mentoring, networking and advocacy for women MD/PhD students in the Tri-institutional Medical Scientist Training Program (MSTP) of Weill Cornell Medical College, Sloan-Kettering Institute and Rockefeller University. FACES was founded in 2003 by a group of first-year MD/PhD students working with Debra Leonard, MD, PhD, Professor of Pathology and Laboratory Medicine at Weill Cornell Medical College, with the support of Olaf Andersen MD, Program Director and Ruth Gotian, Administrative Director of the Tri-institutional Program. Since its inception, FACES has rapidly become an invaluable forum where students in all levels of training and faculty members in all stages of their careers can connect and share advice on topics relevant to women in academia. The goal of FACES is to support career development of Tri-I women MD/PhD students through initiatives in four areas: networking, mentorship, skill-building, and life issues that affect women's careers.

Mentorship is fostered by career talks from female faculty that enable female MD/PhD students to gain insight and perspective from the personal experiences of women physician-scientists. The content of these talks varies with the speaker, and may include discussion of the speaker's career path, suggestions for how to achieve specific work-related goals, and work/life balance. We also have panel discussions, often including alumnae from the program.

FACES provides many networking opportunities for the women students. We participate annually in the international Pearl Meister Greengard Award, established by Paul Greengard PhD with his Nobel Prize winnings to honor women scientists. In 2008, Gail Martin PhD, Beatrice Mintz PhD, and Elizabeth Robertson PhD were honored for their pioneering work with embryonic stem cells. FACES hosts a discussion with the award recipients for women of the Tri-Institutional community prior to the awards ceremony. We also host a keynote speaker each year, chosen for her ability to inform us about the larger picture of women in academic medicine and policy developments affecting women in science and medicine. Our 2008 speaker was Joan Steitz PhD, a member of the committee that generated the National Academies *Beyond Bias* Report. We also participate in specific events organized by the Memorial Sloan-Kettering Cancer Center (MSKCC) Program for Women Faculty Affairs, including Athena meetings, an informal group for women faculty that meets monthly, and facilitates networking of the women MD/PhD students with faculty from MSKCC.

We have developed skill-building sessions for women MD/PhD students that have received outstanding reviews. Prior sessions have addressed critical skills such as grant-writing, personal financial management, and negotiation, as well as understanding the male and female cultures in which women work. For the 2008-2009 academic year, FACES has planned a series of panel discussions focused on the major transition points in the life of an MD-PhD student, specifically choosing a thesis laboratory, selecting a residency/post-doc, attaining a first job and getting promoted. In organizing these seminars, we tap into the resources of each of the three institutions in the MSTP Program as well as our own excellent alumni network.

In addition to fostering a community of networking and mentoring among its members, FACES also serves as a catalyst of change in the Tri-Institutional area on life issues relevant to the

success of women students. Through efforts of FACES in conjunction with our program Director, we were the first MD/PhD program to define a maternity and family leave policy for MD/PhD students. Currently, FACES is lobbying to improve access to child care for MD/PhD students with children. The infrastructure of FACES facilitates our role as a change agent for these life issues recognized by the NAS*Beyond Bias and Barriers* report as critically important for the career success of women in science.

The FACES leadership found the CWSEM workshop*From Doctorate to Dean or Director: Sustaining Women through Critical Transition Points in Science, Engineering, and Medicine* particularly relevant in light of our own series on the path of women MD/PhD students, looking further down our career path. We are grateful for the opportunity to participate in the workshop and discussions, and bring back lessons learned from the meeting to the entire FACES community.

SOCIETY FOR DEVELOPMENTAL BIOLOGY

Approaches the Society for Developmental Biology has taken to address critical transition points in the career development of women scientists and unresolved issues facing women scientists that the Society considers of greatest need.

The Society for Developmental Biology (SDB) has been in existence for almost seventy years, providing resources and services to scientists studying plant or animal development. Approximately half the current SDB members are women; the same is true for the elected Board of Directors and the members of SDB committees. (It is traditional for the Society's presidency to alternate between a man and a woman, a practice that is maintained by nominating two women candidates one year and two men the following year.) Service as an officer or on the board of directors provides members with increased national visibility and networking opportunities. Moreover, the annual national meeting and each of the five to eight regional meetings include career development sessions for the broader membership. Given the gender diversity of the society's membership, it has not seemed necessary or appropriate to target these sessions solely to women. Along with disseminating recent, exciting scientific discoveries, SDB seeks to advance its members in their professional careers. Most of these efforts have been coordinated by the SDB Professional Development and Education Committee. Participant evaluations and follow-up surveys are used to assess the effectiveness of the programs. Here we highlight recent successful SDB activities that have helped women (and men) scientists transition through their postdoctoral training and early career, and describe a new program the Society is contemplating, aimed at advancing mid-career scientists.

The SDB national and regional meetings are important venues for career advancement. The regional meetings are particularly important for early career scientists and the organizers ensure that most of the speakers are undergraduates, graduate students, postdocs and new faculty. At national SDB meetings, one scientific session is run by postdoctoral fellows, with all the platform presentations given by postdocs whose abstracts have been chosen by their peers. In addition, all postdoctoral trainees and students are invited to meet the SDB Board at an exclusive social hour. To promote successful transitions beyond the PhD, SDB has hosted workshops on scientific writing skills, international postdoctoral training, exploring career choices in industry, scientific journalism and law, interviewing skills, and on successful grant writing. Opportunities have also been provided to meet with the editors of prominent journals, including *Science*, *Nature*, *Development* and *Developmental Biology*, and each year the annual meeting includes a session where NSF and NIH program officers outline available granting mechanisms. Each SDB meeting includes an education session aimed at pedagogical innovations, and SDB's Library of Educational Annotated Developmental Biology Resources (LEADER) is a partner of the NSF-funded digital library BEN (BiosciEdNet) which provides peer-reviewed on-line resources for teaching and learning in the biological sciences.

At national meetings about half of the session leaders and speakers are women; and special effort is made to feature young investigators. To facilitate the transition to independent investigator, SDB has hosted two-day Boot Camps just prior to the national meeting. Under this program a group of senior scientists act as instructors to 20-25 new faculty. The "recruits" enjoy hands-on lab work with several model organisms while getting advice on curriculum development, finding

and becoming great mentors, and the tenure process. Having taken a Myers/Briggs Type Indicator assay beforehand, the participants also receive counseling on how personality may affect their laboratory management style. Given the success of this program for new faculty, SDB is currently considering developing a parallel program for mid-career scientists. This "Re-Boot" Camp would be centered around "-CTRL" (work-life balance), "-ALT" (alternate paths for research use of administrative skills and risk taking) "-DEL" (prioritizing/time management). One of the goals of this program would be to advance mid-career members toward full professor, dean or director positions, as well as updating their research and teaching techniques.

SDB wishes to encourage the upcoming NAS workshop to emphasize the importance of creating a family-friendly work environment as a means of addressing the unresolved needs of women scientists. Problems related to trying to balance home and work life are not new and have been considered at several previous workshops, including Achieving XXcellence in Sicnece (AXXS) 2002, at which these same issues were prominent. As Dr. Carola Eisenberg stated in that meeting's opening address "We are now engaged in a battle for academic norms that acknowledge the importance of family life as a legitimate value.", and Dr. Ruth Kirschstein reiterated "We need to do something about the major problem, as you have heard all through this workshop, of what we are going to do about child care in the US." Efforts by CWSEM to lobby Congress to appropriate funds for NIH and NSF training grants (and for the prestigious Ruth Kirschstein postdoctoral awards) in order to provide modest stipends to help with childcare for trainees with small children would be a significant step. Graduate students and postdocs frequently cannot afford childcare on their modest stipends, yet these career stages are coincident with a woman's child-bearing years. Colleges and universities should be encouraged to expand their menu of benefits to provide students and employees access to affordable child care/elder care help, in addition to college tuition remission for the children and spouses of faculty. Childcare benefits enhance recruitment and retention of faculty, and particularly of women faculty, and therefore should be an important priority for these institutions. Because women today remain the primary caregivers in two-career families, they are more likely to settle for convenient, rather than desired, jobs. Universally available and affordable child care will almost certainly open up options to women seeking careers in academic teaching, medical or research environments. There also is a tremendous need for flex-time and part-time positions that offer opportunities for future advancement, as well as more flexible tenure clocks for faculty raising children. Creation of an academic environment that values and supports work-life balance will eliminate a major roadblock on the "Road to the Professorate" that often arises ***after*** the PhD and which stalls many more women than men.

http://www.sdbonline.org

SOCIETY FOR WOMEN'S HEALTH RESEARCH

The RAISE Project: A Program of the Society for Women's Health Research

Sustaining women in STEMM (Science, Technology, Engineering, Mathematics, and Medicine) through critical transitions requires both discipline-specific organizational efforts and inclusive cross-disciplinary efforts to appreciate and reward the contributions of women. That there is much work to be done is emphasized by high attrition rates of skilled women in these fields. Recognized contributing factors include a hostile work environment, a sense of isolation and limited rewards.

The RAISE (Recognition of the Achievements of Women In Science, Engineering, Mathematics and Medicine) Project seeks to sustain women in STEMM across critical transitions by increasing the recognition of the achievements of women. Increased recognition may help neutralize the hostile environment, provide role models for women who feel isolated and supply women with concrete means for schedule and salary negotiations and promotions.

The question of disparities between scientific awards to men and women was raised by the announcement in 2005 of the winners of the 2003 National Medal of Science. There were no women among the recipients. Similarly, there were no women recipients of the 2004 and 2005 Medals of Science. This observation suggested a broader problem in recognition of the achievements of women in science, technology, engineering, mathematics and medicine, which culminated in the establishment of the RAISE Project, a national awards website and clearinghouse dedicated to recognizing the achievements of women in these fields, sponsored by the Society for Women's Health Research.

The first priority of The RAISE Project was to collect objective data to test the hypothesis that there are gender disparities in scientific awards and prizes. Over 1,000 scientific and medical awards with over 20,000 recipients since 1981were cataloged and analyzed. The data (which can be found at www.raiseproject.org) confirms the hypothesis that there is a substantive discrepancy between awards and prizes given to men and women. A striking finding was a concomitant increase in awards restricted to women recipients.

The gender distribution of awards was our initial focus of analysis. Analyses were performed initially including all awards regardless of whether the award was restricted by gender to women only. Including all awards, 321 of 1,000 (32%) had never been given to a woman and five hundred ten of 1,000 (51%) of the awards in the database had been given to a woman less than 10% of the time. As expected, awards restricted to women or for mentoring of women were almost always presented to women.

The changing distribution of awards over time was analyzed and compared with the changing number of women in respective fields. The number of women holding PhDs in science, mathematics, engineering and technology has increased significantly since 1981, such that in 2004 women comprise 37.4% of STEM PhDs and 51.2% of MDs. However, the upward trend evident in the percentage of women entering STEMM fields is not reflected in the number of women receiving STEMM awards. When awards restricted to women are excluded; women still

only received 16.76% of STEMM awards in 2004, a 20% lag behind the number of women entering the field.

The RAISE project data clearly establishes that women receive a disproportionately small share of awards and prizes when compared with the number of women in these fields as measured by the women PhD and MD recipients. A common explanation for the discrepancy between men and women is that there are a small number of women in the pool of those eligible for awards. If this were the case, then the expectation would be that as more women enter these fields, the number of women receiving awards should increase, approximating the percentage in the field. However our data suggests that the disparity is not purely a "pipeline effect" since 25 years after women entered the fields in larger numbers there continues to be a substantive disparity. For instance, in the social sciences (including psychology) where 47% of academic faculty is female, only 27% of awards are presented to women. Overall, despite the gains in educational achievement and entry into the scientific, medical, and technical professions awards to women increased only modestly in science, technology, engineering, and mathematics.

Rewards and recognition are both critical markers of approval and inclusion. The observations of the Swiss economist Bruno Frey suggest that as salary and benefits between men and women become more equal, awards and prizes are becoming increasingly important in distinguishing achievement. Thus, almost paradoxically the achievement of parity in salary benefits makes the need to achieve unbiased evaluation of award nominations increasingly important. Sustaining women through critical transitions in their professional development will greatly benefit women by renewed attention on broadly recognizing the accomplishments of them as part of the requisite admission of the particular professional club.

SOCIETY OF WOMEN ENGINEERS

To respond to your Committee's request for input on these critical transition points, I would like to draw your attention to the 2007 SWE retention study, a comprehensive analysis we conducted on the attitudes and experiences of engineering alumni to understand, address and quantify retention issues surrounding women in the engineering workforce. As you discuss what can help women through critical transition points, we think it important to recognize that these transition points are both professional and personal in nature.

In 2005, SWE partnered with Harris Interactive and university alumni organizations to conduct this study, which was commissioned by SWE's Corporate Partnership Council (CPC). Comprised of a diverse cross-section of 55 industry leaders, the CPC is SWE's partner on tackling emerging issues impacting women in engineering. For a complete list of CPC members, please visit: www.swe.org/cpc.

With only 20% of bachelor's degrees in engineering and technology being awarded to women, retention of those women in the profession is crucial to building and maintaining a diverse work force. The corporate community's understanding of retention issues has been largely anecdotal, thus hindering effective, proactive solutions. Thus, the study focused on identifying:

- The current retention and advancement rates of women in engineering and benchmark those against the rates of men;
- The reasons women and men leave the engineering profession; and
- The reasons why women and men do not advance in the engineering profession.

Some of the major findings include:

A. Women have lower retention rates in engineering than men

Despite similar levels of job satisfaction and education backgrounds among women and men engineering alumni, fewer women than men report staying in the engineering field.

B. Women and men express job "satisfaction" in similar terms

Women who continue to work in the engineering field report high levels of satisfaction with their jobs. The majority of engineering alumni, both women and men, view their career path in a positive light and express satisfaction with many aspects of their jobs. The job satisfaction of women and men who are employed in engineering or related fields are similar. Women are most satisfied with the content and personal challenge of their engineering jobs. Fundamentally, though, job satisfaction levels are significantly higher for those who think that their engineering skills are being well-utilized as compared to those who do not.

C. Women and men express job "dissatisfaction" in different terms

Engineering alumni who are not currently employed in engineering or a related field cite work/life balance issues, career-advancement and compensation discrepancies, and better or

more interesting work opportunities in other professions as reasons for leaving engineering. However, women are more likely than men to cite a more family-friendly work environment and more interesting work as a motivation for leaving engineering. As compared to women, men place more emphasis on salary and advancement.

Across all age groups, women are much less likely than men to be earning $100K+ and much more likely to be earning less than $50K. Women who earn $100K+ are twice as likely to be satisfied with their jobs as women who earn less money.

Women and men tend to seek employment in different non-engineering professions. While women gravitate toward teaching, men are about twice as likely to choose a career in finance.

"Better job prospects" are the top motivation to return to engineering for both men and women. However, in defining what makes a job "better," women want a more convenient work location and more flexible work arrangements, while men want the opportunity to move into management.

D. Whether and why women and men do not advance in engineering

Women express lower levels of satisfaction with management and advancement opportunities than men, and gender differences are also apparent in perceptions of career obstacles and inequities, and success in terms of advancement and compensation. Of employed engineering alumni, work/family balance is at the top of the list of career obstacles, with women feeling that this obstacle is more of a career hindrance than men. Women are also more likely to believe that, to some extent, work place inequities exist.

While women and men report equal levels of satisfaction with their advancement opportunities, women are less likely to hold management positions. Men aged 45+ are nearly twice as likely as women of the same age to be at or directly below the CEO level. Whereas, women aged 45+ are more likely than their male counterparts to be one management level below that. Similarly, senior level engineering positions are more likely to be held by men than women.

AMERICAN ASTRONOMICAL SOCIETY
COMMITTEE ON THE STATUS OF WOMEN IN ASTRONOMY

According to the AIP (American Institute of Physics), in 2005, 21% of physics bachelor's degrees and 14% of physics PhDs went to women. That same year, 40% of astronomy bachelor's degrees and 33% of astronomy PhDs were awarded to women. The exact reasons for why astronomy boasts a larger percentage of women are unclear. However, it may be a result of a better climate for women in this field. Going from assistant professor to associate professor to full professor, the percentage of women in both astronomy and physics as a whole drops even further. (Postdocs were not included in this study.)

Anecdotally, both women and men leave academia for a variety of reasons. The drop in representation of women with seniority is often called "the leaky pipeline," inferring women experience greater attrition than men from academia, whether due to work-life balance issues, a hostile climate, or discrimination.

However, a 2005 AIP Report on Women in Physics and Astronomy by Rachel Ivie and Kim Nies Ray (AIP Publication Number R-430.02) demonstrated that the percentage of PhD recipients who are women is roughly consistent with the numbers of female entering graduate school, after taking the average time to PhD into account. In fact, the percentage of women among those hired into tenure-track and tenured positions is roughly consistent with the percentage of PhDs earned by women in the past. This is true for both physics as a whole, and astronomy by itself. In other words, the decrease in the percentage of women with seniority might be explained by an ever increasing percentage in women receiving PhDs with time. In fact, the biggest leak in the pipeline appears to be at a very early stage, between high school and bachelor's degree. Nearly half of high school physics students are girls.

This is not to say that all hiring is gender-blind. The same AIP report also noted women faculty are more highly represented in physics departments that grant only bachelor's or master's degrees. Women are also disproportionately represented among non-tenure track faculty: i.e. adjunct, temporary, or part-time positions. AIP surveys also indicate that after controlling for employment sector and years since degree, women earn significantly less than men.

In early 2007, the American Astronomical Society Council and the AIP Statistical Research Center began a longitudinal study of a cohort of current astronomy graduate students to better understand the reasons why both men and women leave astronomy and determine where they go. More than 800 graduate students have volunteered to participate in this study, which will track the career paths of these students for at least ten years. We anticipate this study will help separate anecdote from data and uncover the real reasons for attrition in the pipeline.

ASSOCIATION FOR WOMEN IN SCIENCE

The Association for Women in Science (AWIS) is a national advocacy organization championing the interests of women in science, technology, engineering, and mathematics (STEM) across all disciplines and employment sectors. By breaking down barriers and creating opportunities, AWIS strives to ensure that women in these fields can achieve their full potential. Although we have made great strides in achieving equality for women in many fields of science, there is still a dearth of women in the upper echelons and leadership positions within the scientific community. AWIS strongly supports policies and practices that recognize and facilitate the important contributions women make in the scientific workplace.

Policy Changes to Solve the "Leaky Pipeline" in Academia

Significant progress has been made in improving the status of women within the scientific workforce, particularly in regards to training. In many STEM fields, women have achieved or exceeded parity in the number of doctoral degrees received and are well represented in the ranks of postdoctoral researchers. However, as detailed in the recent report of the National Academies, *Beyond Bias and Barriers, Fulfilling the Potential of Academic Science and Engineering,*[5] at each stage of advancement, from postdoctoral training to first position to tenure and beyond, the proportion of women represented drops off substantially. Moreover, studies have shown that gender bias is still a significant barrier for the success of women in science and engineering, particularly in academic research institutions.[6] ***AWIS affirms the need for national and local policy changes aimed at retaining and creating opportunities for the best and brightest women in the highest ranks of the scientific community and recommends the following solutions:***

- Enforcement of Title IX policies by federal agencies and academic institutions;
- Expansion of federally-funded programs to facilitate reentry into the workforce of scientists who have taken time off to care for a child or dependent family member; and
- Support and promotion for the development of federal programs, such as ADVANCE, that seek to cultivate a broadly inclusive science and engineering workforce.

Institutional Approaches and Family Friendly Policies

Many of the factors discouraging women from entering the higher academic faculty ranks and leadership positions in STEM fields are related to institutional climate and the balance between work and home responsibilities.[7,8] In particular, because the academic tenure clock typically coincides with the biologically-constrained childbearing and rearing years of women, female faculty are especially vulnerable to obstacles related to work-life balance. Universities and academic departments have a primary responsibility to ensure that all faculty have the opportunity to be successful and productive throughout their careers through promotion of

[5] National Academies. (2007) *Beyond Bias and Barriers: Fulfilling the Potential of Academic Science and Engineering* . http://www.nap.edu/catalog.php?record_id=11741
[6] Clayman Institute for Gender Research. (2006) "Top Issues and Solutions for Women Faculty in Science and Engineering." http://www.stanford.edu/group/gender/ResearchPrograms/TitleIXTopIssues.pdf
[7] *ibid*
[8] University of California. (2007) Creating a family friendly department: chairs and deans toolkit. http://ucfamilyedge.berkeley.edu/ChairsandDeansToolkitFinal7-07.pdf

policies, development of resources, and fostering a climate and culture that includes zero tolerance for discriminatory comments or behavior. *AWIS strongly supports institutional and departmental policies to support the career advancement of female scientists and recommends as preliminary, albeit significant, steps:*

- Adoption of comprehensive policies designed to foster and promote the development of faculty careers concomitant with major life circumstances or transitions. These might include, but are not limited to, policies related to: provision of child or senior care; tenure clock stoppage or modified duties for advancing faculty who have significant responsibility for the care of young children; funds for faculty with dependent children with who must travel for research or conference purposes; and family-friendly scheduling of departmental or university meetings and events;
- Use of dual career assistance, child or senior care support, and relocation expenses as a standard part of recruitment practices for new faculty;
- Regular evaluation by department chairs and administrators of the current practices and climate of the department or institution in regards to gender bias and family-friendly issues;
- Transparency in the promotion and tenure process, with clear guidelines to eliminate negative consequences for faculty who have taken advantage of family accommodation policies; and
- Establishment of mentoring programs for junior faculty.