TITLE IX SUMMARY LITERATURE REVIEW

In developing its Title IX onsite review program, NASA conducted a review of literature regarding gender and STEM programs, including Title IX policy and enforcement in the STEM context.[1] The review continues to be updated as new research and analysis on gender and STEM emerges. It also continues to assist NASA, and we hope, our recipients, to better understand concerns regarding gender and STEM and how Title IX compliance efforts can assist to address such concerns.

Reports and Studies on STEM: Key Findings and Recommendations

In general, the studies and reports NASA reviewed in the literature describe a broad range of gender-related issues in STEM. For example, the 2004 report of the U.S. General Accountability Office (GAO) (referred to above) described participation rates by gender, observing continued low participation for women in certain STEM programs, such as physics and some engineering disciplines. The GAO report also noted the greater drop-off of women as compared to men at every stage, from high school to doctoral programs. The report highlighted the need for steps to help address this, such as strong outreach efforts to increase the interest of younger students in the sciences.[2] In addition, the report recommended that agencies with science missions, such as NASA and the U.S. Department of Energy, conduct Title IX compliance reviews to ensure that grant recipient programs are providing equal opportunity regardless of gender.

---

[1] See generally The National Academies, National Research Council, *Gender Differences at Critical Transitions in the Careers of Science, Engineering, and Mathematics Faculty* (2011); Marc Goulden, Ph.D., Karie Frasch, Ph.D., and Mary Ann Mason, J.D., Ph.D., The University of California, Berkeley Berkeley Center on Health, Economic, & Family Security and The Center for American Progress, *Staying Competitive: Patching America's Leaky Pipeline in the Sciences* (November 2009); The National Academies, National Research Council, *To Recruit and Advance: Women Students and Faculty in Science and Engineering* (2006); National Academy of Sciences, National Academy of Engineering and Institute of Medicine, *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering* (2006); American Institute of Physics Statistical Research Center, *Women Physicists Speak Again*, April 2006 (accessible at: http://www.aip.org/statistics/trends/reports/iupap05.pdf); Ellen Sekreta, *Sexual Harassment, Misconduct, and the Atmosphere of the Laboratory: The Legal and Professional Challenges Faced by Women Physical Science Researchers at Educational Institutions*, 13 Duke J. Gender L. & Pol'y 115 (Spring 2006); Catherine Pieronek, *Title IX and Gender Equity in Science, Technology, Engineering and Mathematics Education: No Longer an Overlooked Application of the Law*, 31 J.C. & U.L 295 (2005); Government Accountability Office, *Gender Issues: Women's Participation in the Sciences Has Increased, but Agencies Need to Do More to Ensure Compliance with Title IX* (July 2004); American Institute of Physics Statistical Research Center, *Women in Physics Speak: The 2001 International Survey of Women in Physics*, 2001 (accessible at: http://www.aip.org/statistics/trends/reports/iupap.pdf); Corinne A. Moss-Racusin, John F. Dovidio, Victoria L. Brescoll, Mark J. Graham and Jo Handelsman, "Science faculty's subtle gender biases favor male students," *Proceedings of the National Academy of Sciences* (2012), accessible at http://www.pnas.org/content/early/2012/09/14/1211286109.full.pdf

Jean M. Curtain, Geneva Blake, and Christine Cassagnau, American Institute of Physics, "The Climate for Women Graduate Students in Physics," *Journal of Women and Minorities in Science and Engineering*, vol. 3, pp. 95-117 (1997); Mildred S. Dresselhaus, Judy R. Franz, Bunny S. Clark, "Improving the Climate for Women in Physics: A Program of Site Visits Funded by the National Science Foundation" (American Physical Society and the American Association of Physics Teachers: 1995) (ME Program Summary, accessible at http://www.ME.org/programs/women/sitevisits/summary.cfm) (ME Program Summary).

[2] U.S. Government Accountability Office (GAO) report, *Gender Issues: Women's Participation in the Sciences Has Increased, but Agencies Need to Do More to Ensure Compliance with Title IX* (July 2004).

NASA also relied on a number of scholarly reports and publications. Prominent among these were the National Academy of Sciences, National Research Council report, *To Recruit and Advance: Women Students and Faculty in Science and Engineering* (2006) (hereafter cited as NRC Report or *To Recruit and Advance*); the University of California Berkeley, Center on Health, Economic & Family Security report, *Staying Competitive Patching America's Leaky Pipeline in the Sciences* (2009) (hereafter cited as UC Berkeley Report); the American Association of University Women's report, *Why So Few? Women in Science Technology, Engineering, and Mathematics* (2010); and "Science faculty's subtle gender biases favor male students," in *Proceedings of the National Academy of Sciences* (hereinafter cited as the PNAS Report) (2012).

The Need for a Sustained Commitment to Diversity among University Leaders and Administrators

The NRC Report, *To Recruit and Advance*, was based on a comprehensive literature review and site visits to four universities "recognized for successfully advancing and retaining women students, faculty or leaders."[3] *To Recruit and Advance* was a valuable tool to better understand women's experiences in science, technology, engineering, and mathematics (STEM) studies and helped to guide NASA's assessment under the instant review of promising practices regarding recruitment and advancement of women students in STEM programs.[4] For example, the report identified the need to create and institutionalize a sustained commitment to diversity among university leaders and administrators.[5] This commitment should be demonstrated by dedicating resources to that effort, e.g., Women in Engineering programs, and through ensuring visibility for women students and faculty in communications materials and the Department's Web site, which can help to show that the program is welcoming and inclusive of women.[6] Another key strategy is to extend outreach to students at the K-12 and undergraduate levels in the form of summer science and engineering camps, lecture series, career days, and mentoring programs.[7]

Emphasizing the Societal Impacts of STEM Work

The NRC Report indicated that specific retention tools such as curricular modifications and "family friendly" policies might also be of assistance in increasing the numbers of women in STEM programs. For example, courses designed to emphasize the societal benefits or "real-world" applications of engineering have broadened the appeal of engineering studies, helping to create more diverse engineering student populations.[8] The AAUW report, Why So Few, supports the notion that emphasis on the societal impacts of science and engineering work, something that has often been lacking in the undergraduate curricula in the STEM disiplines:

> [W]ell-documented gender differences exist in the value that women and men place on doing work that contributes to society, with women more likely than men to

[3] NRC Report, Summary, p.2.

[4] NRC stated that it "sought to move beyond yet another catalogue of challenges facing the advancement of women academic in STEM to provide a document describing actions actually taken by universities to improve the situation for women." Ibid., Preface, p. vii.

[5] Ibid., chap. 1, p.8.

[6] Ibid., chap. 2, p.47.

[7] Ibid.

[8] Ibid., chap. 3, pp. 53 (citing Busch-Vishniac, I., and J. Jarosz, *Can diversity in the undergraduate engineering population be enhanced through curricular change?* Journal of Women and Minorities in Science and Engineering 10:255–281, 258 (2004)), 55, 60 (citing Farrell, E. F., "Engineering a warmer welcome for female students," Chronicle of Higher Education," February 22, 2002).

> prefer work with a clear social purpose . . . [M]ost people do not view STEM occupations as directly benefiting society or individuals. . . As a result, STEM careers often do not appeal to women (or men) who value making a social contribution. Certain STEM subdisciplines with a clearer social purpose, such as biomedical engineering and environmental engineering, have succeeded in attracting higher percentages of women than have other subdisciplines like mechanical or electrical engineering."[9] (Citations omitted)

A key takeaway from this research for undergraduate STEM programs is the need to consider pedagogical enhancements to emphasize the societal or "real world" impacts of STEM work in meaningful ways. This is especially needed in freshman survey courses, in which many students are sampling a field to see if it might be the right major for them. A curriculum alive with examples of STEM work that is changing the world might very well help to increase the overall student diversity in the program.

Family Friendly Policies

A 2009 report of the University of California at Berkeley, *Staying Competitive: Patching America's Leaky Pipeline in the Sciences* (UC Berkeley Report) notes that to be in compliance with Title IX, recipients must: 1) treat pregnancy as a temporary disability for purposes of calculating job-related benefits, including any employer-provided leave, and 2) provide unpaid, job-protected leave for "a reasonable period of time" if the institution does not maintain a leave policy for employees."[10] The UC Berkeley report also notes that, to help address family and care giving issues, institutions should have in place family responsive policies, benefits, and resources, including time-based policies and benefits such as stopping the clock (i.e., tenure-clock extension), various child care supports such as on- and off-campus centers, monetary supplements such as tuition remissions, and other resources such as lactation rooms.[11]

Overall, the UC Berkeley Report, a major study on experiences of women scientists, found that unfriendly family policies—not lack of interest or commitment—are what turn many women away from academic science. Moreover, the report recommended universities adopt family supportive policies for all classes of researchers, not just faculty members, noting that graduate-student researchers and postdoctoral scholars receive the most limited benefits and yet are arguably the most important people affecting the future of U.S. science. In fact, the report found that this is the biggest leak in the pipeline: the point at which women who have received their Ph.D.s or are working as postdoctoral scholars are making the critical decision of whether to continue their careers in academic research. According to the report, too many of them are deciding not to, often because of their interest in starting a family.

---

[9] American Association of University Women, *Why So Few? Women in Science Technology, Engineering, and Mathematics* (2010), pp. 22-23 (citing Eccles [Parsons] et al., 1983; Eccles, 1994, 2006; Jozefowicz et al., 1993; Konrad et al., 2000; Margolis et al., 2002; Lubinski & Benbow, 2006; Eccles, 2006; National Academy of Engineering, 2008; Diekman et al., 2009; Eccles, 1994; Sax, 1994; Gibbons, 2009.

[10] Marc Goulden, Ph.D., Karie Frasch, Ph.D., and Mary Ann Mason, J.D., Ph.D., The University of California, Berkeley Berkeley Center on Health, Economic, & Family Security and The Center for American Progress, *Staying Competitive: Patching America's Leaky Pipeline in the Sciences* (November 2009), p. 5 (citations omitted).

[11] Ibid., p. 6.

Research conducted by the Alfred P. Sloan Foundation found that family formation—most importantly marriage and childbirth—accounts for the largest leaks in the pipeline between Ph.D. receipt and the acquisition of tenure for women in the sciences. [12] According to the Sloane Foundation research, women in the sciences who are married with children are 35 percent less likely to enter a tenure track position after receiving a Ph.D. than married men with children and 27 percent less likely than their male counterparts to achieve tenure upon entering a tenure-track job. [13] Tenured women are nearly three times more likely than men to be single without children.[14] In addition, the Sloane Foundation found that tenure-track faculty women who were married with young children were 21 percent less likely than tenure-track men who are married with young children, 26 percent less likely than tenure-track women who were married without young children, and 19 percent less likely than single women without children to have their work partially or fully supported by federal grants or contracts on a year-to-year basis.[15]

Young scientists early in the pipeline are the least likely to receive benefits. Only a fraction of research universities offer a baseline family-responsive maternity leave policy of at least six weeks of guaranteed paid leave following childbirth to graduate students, postdoctoral scholars, and academic researchers, with only 13 percent of universities making this baseline policy available to graduate students (43 percent of them offer only ad hoc paid leave, or no paid leave at all). Many universities do provide some maternity and parental leave, but the limitations associated with these policies significantly affect contingent classes of researchers such as graduate students, postdoctoral scholars, and academic researchers. These limitations include requirements that limit the number of individuals who qualify for the policy, limitations on the length of the policy or the percentage of salary paid, and limitations focused on the accrual of sick and/or vacation leave.[16]

As stated, to be in basic compliance with Title IX, universities must 1) treat pregnancy as a temporary disability for purposes of calculating job-related benefits, including any employer-provided leave, and 2) provide unpaid, job-protected leave for "a reasonable period of time" if the institution does not maintain a leave policy for employees. The Sloane Foundation paper recommends that Universities, in partnership with Federal agencies:

- Promote clear, well-communicated, baseline family responsive policies for all classes of researchers.
- Provide federal agency or university supplements to offset family event productivity loss.
- Collaboratively move toward a full package of family friendly policies that take into account the career-family life course.
- Remove time-based criteria for fellowships and productivity assessments that do not acknowledge family events and their impact on career timing.
- Collect and analyze the necessary data to make sure existing and future policy initiatives are effective in meeting researchers' needs and comply with Title IX. [17]

---

[12] Alfred P Sloan Foundation, "Keeping Women in the Science Pipeline," Drs. Mary Ann Mason, Marc Goulden, Karie Frasch, University of California, Berkeley, presented at the Workforce Flexibility Conference, Georgetown Law School, Washington, DC, Nov. 29-30, 2010.

[13] Ibid., p. 5

[14] Ibid., p. 7

[15] Ibid., p. 10

[16] Ibid., p. 8

[17] Ibid., pp. 12-13

Education and Awareness Opportunities for STEM Faculty and Students

Another important tool for STEM departments is training to raise awareness among faculty and students on gender issues such as sexual harassment prevention.[18] NASA's Title IX compliance review program has shown a number of instances where STEM departments may benefit from targeted training to address issues relating to inappropriate gender-related conduct occurring in program settings, such as study groups, labs, and field trips.

Possible Presence of Implicit Bias

The PNAS report documented a randomized double-blind study conducted to test for the presence of gender bias on the part of science faculty that could contribute to the gender disparity in STEM fields. In this study science faculty from research universities rated the application materials of a student, who was randomly assigned either a male or female name, for a laboratory manager position. The study found that faculty rated the male applicant as significantly more competent and employable than the *identically-qualified* female applicant. These faculty members also selected a higher starting salary and offered more career mentoring to the male applicant.

What is especially noteworthy is that the gender of the faculty participants did not affect responses, such that female and male faculty study participants were equally likely to exhibit bias against the female student. This study also found that preexisting subtle bias against women on the part of participating faculty was associated with less support for the female student, but was unrelated to reactions to the male student.

"Unanticipated" Issues

The NRC report also described issues that "may not be anticipated" influencing the working environment of the laboratory.[19] For example, personal safety issues may be different for women working alone at night in a lab. One faculty member interviewed by NRC commented that whereas general safety issues had been "background noise," as he put it, the issue of personal safety became a much higher priority when women students joined the lab.

Title IX Compliance Reviews

Title IX compliance reviews are also recommended in the literature as a means of addressing environmental issues that may negatively impact women in STEM. For example, the AAUW report *Why So Few?* states "Title IX reviews can help identify institutional policies and practices that negatively, and in some cases inadvertently, affect personal choices in gender-specific ways. Simply put, Title IX can help create a climate where women and men of similar talent who want to be scientists or engineers have equal opportunity to do so."[20]

[18] NRC Report., chap. 4, p. 78
[19] Ibid., chap. 2, p. 41.
[20] AAUW Report, p. 13 (citations omitted).

Gender Issues in Physics Programs: Surveys and Site Visits

American Institute of Physics (AIP) Survey Results

To be aware of experiences of women in the physics context, NASA reviewed data collected by the American Institute of Physics (AIP). This data showed some of the concerns of women physics students about their program experiences. For example, a 1993 AIP "climate" survey of physics programs showed that only 27 percent of women graduate student respondents in the U.S. believe that their department encourages self-confidence.[21]

In its 2001 survey report *Women Physicists Speak*, AIP observed that: "[w]omen . . . face barriers in the form of strongly held beliefs that [they] are incapable of doing good science"[22] and that "[c]onfidence in one's ability can be especially important for female students when they confront the negative effects of sexism, which can cause women to question their ability or their right to pursue advanced degrees."[23] And, in its 2006 report, *Women Physicists Speak Again,* the AIP continues to identify climate as one of the top reasons women physicists give for being discouraged about physics.[24]

American Physical Society Site Visit Program

In its literature review, NASA also relied on the summary report of the American Physical Society (APS) Committee on the Status of Women Site Visit Program. The report, "Improving the Climate for Women in Physics," provides valuable information gathered by APS about women's experiences in physics programs, based on site visits to over 40 university physics departments across the country since 1990.[25] For each site visit, APS reviews quantitative and qualitative information to assess the climate for women at the host facility.

The findings generated from APS's site visit program provide valuable context for gender equity issues in physics programs. According to APS, problems commonly experienced by women in the physics departments reviewed include instances of inappropriate behavior and attitudes such as pictures and computer printouts with inappropriate images of women in teaching assistants' communal offices; thesis advisors who call their female students "honey" or the equivalent and "a prevalent assumption that all rewards obtained by women are "only because you are a woman."[26] APS found that the long term effects of these experiences "takes much of the enjoyment out of the graduate experience of many female physics students and helps to explain why only the very committed and the very tough remain in physics."[27]

---

[21] See Jean M. Curtain, Geneva Blake, and Christine Cassagnau, American Institute of Physics, "The Climate for Women Graduate Students in Physics," *Journal of Women and Minorities in Science and Engineering*, vol. 3, pp. 95-117 (1997); see also ME Program Summary

[22] American Institute of Physics Statistical Research Center, *Women in Physics Speak: The 2001 International Survey of Women in Physics*, 2001, p. 19. Accessible at: http://www.aip.org/statistics/trends/reports/iupap.pdf.

[23] Ibid, p. 7.

[24] American Institute of Physics Statistical Research Center, *Women Physicists Speak Again*, April 2006, pp. 10-12. Accessible at: http://www.aip.org/statistics/trends/reports/iupap05.pdf.

[25] APS Program Summary.

[26] Ibid.

[27] Ibid.

However, APS reports that the climate for women varies dramatically among the departments it has reviewed, with many positive climates reported.[28] Based on its Site Visit Program, APS finds that important ingredients for a positive climate can include: at least several active, mainstream female faculty; a group of female students who interact regularly with each other; a supportive department chair who listens and responds to concerns of students; and efforts to create a safer physical environment.[29]

Overall Recommendations

What the research literature tells us is that there are some proactive steps that STEM programs can take that are consistent with the purpose and intent of Title IX. A small sampling of these steps, representative of the larger themes in the literature on women and STEM, include:

- Engaging in targeted outreach and recruitment
- Establishing mentoring programs
- Sustaining strong partnerships with campus professional organizations, such as the Society of Women Engineers
- Adopting policies that enable faculty, students and employees to combine work, family and other personal responsibilities
- Providing ongoing education and awareness opportunities for faculty and students that is both tailored to the STEM environment and addresses issues such as implicit gender bias and inappropriate gender-related conduct that may not rise to the level of discriminatory harassment but is still unacceptable
- Conducting on-going self-evaluation efforts consistent with Title IX regulations, that is, a focus on admission and treatment of students, and employment.

Overall, NASA has found that Title IX compliance efforts of educational institutions can help to address such concerns regarding gender and STEM. For example, effective Title IX coordination can establish collaborative partnerships between the Title IX Coordinator's office and academic departments, ensuring, among other things, appropriate training for faculty and students to raise awareness on gender issues, e.g., harassment and gender bias. Effective Title IX coordination may also ensure that individuals fully understand the process for addressing discrimination concerns, and how to avail themselves of it.

In addition, periodic self-evaluation can greatly assist efforts to identify concerns regarding admission and treatment of students, and help programs to address problem areas in a host of specific areas, from stronger outreach and recruitment efforts, to greater transparency in program policies and practices, to program participants' perceptions of the program environment. NASA has found that the process of a Title IX review itself provides schools with an excellent opportunity to step back and assess their programs in these respects.

[28] Ibid.
[29] Ibid.