

Retaining Women in STEM Careers: Graduate Students as the Building Blocks of Change

“Wringing out the buffalo intestines is the *worst* part, but it’s exciting when you find the parasitic worms,” Sarah explained as she passed the salad.

“What a nice prize,” Dara wryly remarked.

Discussing parasites over dinner requires particular company – like the “Parasite Ladies,” our circle of six female graduate students. Since discovering our mutual interest in disease ecology, we have supported each other’s research endeavors during weekly dinners. While we plan to sustain our support through lifelong research careers, current trends predict that 2 of the 6 of us will leave science. Although women in the U.S. now earn half of STEM doctorates, they represent 21% of full professors in science and 5% in engineering¹. Outside of faculty positions, women comprise only 25% of the STEM workforce². In the window between starting graduate school and applying for senior-level positions, the U.S. is losing women from STEM fields. Retaining and advancing women in STEM fields is a serious challenge with consequences for technical innovation, economic growth, and the status of the U.S. as a global leader in STEM disciplines³.

While overt gender discrimination has been largely eliminated, other barriers that disassociate women from STEM fields remain widespread. First, a paucity of successful female role models and mentors reinforces women’s lack of “belongingness” in STEM fields⁴. Second, subtle gender biases and stereotypes persist and unintentionally create discriminatory decision-making. For example, STEM employers asked to evaluate identical resumes from “Jennifer” or “John” deemed the female less competent and deserving of a lower starting salary⁵. Third, the fact that women with young children are 28% less likely than women without children to get tenure-track jobs testifies to the conflict between the policies of many STEM workplaces and the desires of women to balance family and work demands⁶. Together, these barriers signal to women the unlikelihood of a fulfilling science career⁴ and drive many to opt out of research.

Many recent initiatives aim to remove barriers by engaging K-12 girls in science and promoting retention of women in STEM field careers⁷. These recent programs do not address graduate students, yet implementing changes in graduate education could be effective for changing the number of women remaining in STEM fields. Graduate school represents a crucial period when many students make career decisions⁵. In a survey of chemistry doctoral students 70% of first-year female students planned a career in research; by their third year, only 37% maintained that goal (whereas the interest of their male counterparts did not significantly change)⁸. Enabling women to envision and pursue lifelong, rather than short-term, research careers will require supporting, preparing, and engaging scientists during graduate school.

SOLUTIONS

We propose three improvements to graduate education to help retain and advance women in STEM fields: (1) *preparing graduate students to overcome career obstacles through mentorship and dialogues about career decisions and work-life*

balance; (2) targeting the subtle biases and stereotypes that hinder the advancement of women; and (3) empowering graduate students to improve universities and STEM workplaces to be more flexible and equitable.

1. Lifelong and Equal Academic Futures (LEAF) Website

Mentors and role models serve as evidence to women graduate students that achieving successful careers in science is possible⁹. However, for scientists in graduate school, finding a mentor with whom they are comfortable discussing career decisions, work-life balance, or other challenges can prove difficult. To fill this critical gap, we propose developing a website (LEAF) to connect graduate students to mentors (faculty and post-docs). LEAF mentors would be available for approximately 2 hours per month for individual meetings (scheduled through the LEAF website) with graduate students to discuss issues such as developing healthy habits for a successful career, dealing with subtle biases, and achieving work-life balance.

Further, tools such as career coaching (e.g. scientific writing) can increase the success and retention of minority Ph.D. students^{10,11}. We propose live, on-line panel discussions featuring LEAF mentors and other experts addressing topics such as organizational politics, work-life balance, and salary negotiation. Negotiation skills are particularly germane because, on average, women in the U.S. earn 82% of what their male counterparts earn¹. The panel format would be flexible to allow questions from graduate students, options to answer questions anonymously via the LEAF website, and recording of sessions in a searchable database. By creating a space for shared wisdom, the LEAF website will foster a supportive community and better prepare graduate students for future career decisions and challenges.

Incentive for LEAF mentor participation could be partial fulfillment of the outreach component of NSF and NIH grants. To expand the number of participating mentors, we also recommend offering a “small grants” program (\$250-\$1000 in research funds). We suggest this program be funded by the NSF, NIH, or institutions such as the Association for Women in Science. Ultimately, the program would aim to engage at least two faculty mentors per university to ensure access to mentors within and across institutions.

2. Equality Training

Many implicit biases operate at the level of the subconscious and stem from socialization rather than direct teaching¹². These biases are malleable and can be modified through education that focuses on diversity¹² and awareness¹³. Thus, we propose an initiative to develop a short on-line training module to (a) encourage awareness through an anonymous questionnaire about personal biases which may unconsciously impact behavior in the workplace; and (b) highlight the importance of maintaining a diverse workforce. Many universities already require STEM employees to complete an on-line ethics course, and this module could be easily included. We also recommend including this module in the NSF Ethics Training course required for grant recipients. Results for personal bias questionnaire would be tracked at each institution to provide a benchmark of progress and indicate areas for improvement. We foresee this training improving the learning environment for all graduate students.

3. Equality Ambassadors

To attract and retain all talented STEM professionals, regardless of gender or family status, academic institutions and industry must adopt more inclusive, flexible, and supportive policies. We propose a relatively inexpensive but effective national program to identify, train, and empower graduate student leaders to be advocates for change in their home institutions and future workplaces. Equality Ambassadors will be selected during within-institution competitions where graduate students give short talks describing their interest in improving STEM workplaces. During their 2-year term, Equality Ambassadors will have three missions: (a) Draft a letter from STEM faculty, post-docs, and graduate students requesting specific workplace policy changes at their home institution. Policies may include: granting faculty with new children automatic tenure clock extensions to avoid perceived adverse career consequences of extension requests¹⁴, and options for flexible work hours and e-commuting; and on-campus child care; (b) Meet with university administration to assert the need for such policies; (c) Organize one panel discussion (see Initiative 1) on campus to discuss a career development topic.

To help Equality Ambassadors accomplish these goals, we recommend a three-day workshop, where Ambassadors will receive communication training; select panel topics (see Initiative 1); and discuss ways to promote equality in STEM fields. Students will learn how to develop effective talking points and cultivate collaborations with the goal of starting dialogues among graduate students, faculty, and administrators. Ambassadors will learn to present their proposals to administrators by emphasizing mutually beneficial aspects (e.g., utility as a recruitment tool) of institutional changes to retain women in science. Second-year ambassadors will report back on successful and unsuccessful strategies during the workshop.

CONCLUSIONS

We have described three feasible and effective plans to improve graduate education and empower more women to remain in STEM careers: LEAF website, Equality Training, and Equality Ambassadors. Borrowing terminology from ecology, our proposal addresses bottom-up factors to improve gender equality in STEM fields, as well as top-down approaches that facilitate and support institutional changes. Our proposed ideas will fill a gap in current women-in-science initiatives by targeting graduate students as they progress through their graduate education and begin making career decisions. We are optimistic that our proposed ideas, in combination with ongoing efforts, will improve graduate education with positive impacts for STEM professionals and society. By preparing graduate students for the challenges ahead and engaging them in improving workplace policies, these initiatives will empower young scientists to pursue productive and lifelong STEM careers. For the “Parasite Ladies,” these initiatives would provide stepping stones to ensure that we continue our careers in science – and our gruesome dinner conversations.

¹Shen. 2013. *Nature*; ²U.S. Department of Commerce. 2011, ESA Issue Brief #04-11; ³National Academies. 2006. *Beyond Bias and Barriers*; ⁴Cesi et al. 2011. *IntJAdvancePsychTheory*; ⁵Moss-Racusin. 2012. *PNAS*; ⁶Goulden et al. 2009. Center for American Progress; ⁷White House Press Release. 2011. <http://www.whitehouse.gov/the-press-office/2011/09/26/white-house-and-national-science-foundation-announce-new-workplace-flexi>. ⁸Royal Society of Chemistry. 2009. *Change of Heart*; ⁹Nolan. 1992. *StatSci*; ¹⁰Byars-Winston et al. 2011. *CBE-LifeSciEd*; ¹¹Shah et al. 2009. *AcadMed*; ¹²Rudman et al. 2001. *JPersonalitySocPsych*; ¹³Devine and Monteith. 1999. *Dual-process theories in social psychology*; ¹⁴Bhattacharjee. 2004. *Science*