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Advancing Women in Oceanography

How NSF's ADVANCE Program Promotes Gender Equity in Academia

By Mary Anne Holmes

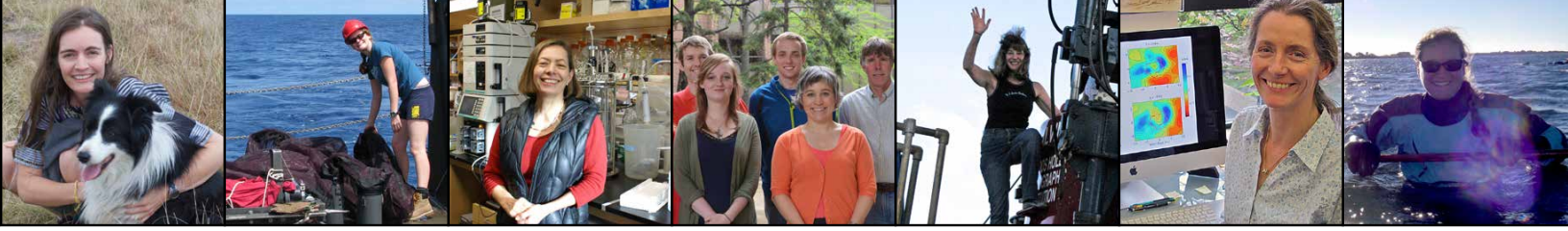
ABSTRACT. Gender equity in science, technology, engineering, and mathematics (STEM) has remained elusive because there are multiple causes of inequity that interact in complex ways. These causes have been the subject of interdisciplinary research funded by the National Science Foundation's ADVANCE program. Outcomes demonstrate that some barriers to women's retention in faculty and leadership positions in STEM result from individual challenges, such as lack of networks, mentors, and advocates. Some barriers result from interactional challenges among colleagues, such as implicit assumptions about who "does" science. And some barriers are institutional, the product of a system designed for men with families to support their personal lives. Solutions designed by research address one or more of these causes with source-specific interventions. For individual barriers, professional development workshops help make the implicit explicit. For interactional barriers, learning about implicit bias can reduce its impact. For institutional barriers, policy review and reform, such as enacting stop-the-tenure clock and dual-career policies, make the academy more people-friendly. To include as many excellent minds as possible in the STEM enterprise, it is necessary to transform the institution, not "fix the women." Such transformation must be well thought out and purposefully enacted. Still, change is slow: even the best programs will take a decade or more to reap the benefits.

GENDER INEQUITY IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM)

The proportion of ocean science doctoral degrees awarded to women has increased from 0% in 1966 (NSF, 2004) to 40% in 2002 and 48% in 2012 (NSF, 2013). However, as Orcutt and Cetinić (2014, in this supplement) show, with a couple of exceptions, there are fewer women on the faculties of oceanographic institutions than the number of women PhDs would predict: 20% at the full professor level, 30% at the associate professor level, and 40% at the assistant professor level.

In response to a mandate from Congress, the National Science Board (the US National Science Foundation's [NSF] governing body) has provided data biannually since 1966 on science and engineering indicators. These data reveal gaps in the supply of women to STEM (science, technology, engineering mathematics). Among the findings: women are earning an increasing share of STEM undergraduate and graduate degrees, but there are not corresponding increases in STEM faculty. During the 1980s and 1990s, NSF program officers responded to this issue by launching a series of programs (Rosser and Lane, 2002), including grants for visiting professorships, graduate fellowships, and POWRE (Professional Opportunities for Women in Research) awards, all designed to retain women in the academic pipeline by providing them with financial support. These programs were well intentioned, but yielded frustratingly few results: the numbers of women retained in faculty positions did not increase substantially, particularly in the physical sciences (Rosser, 2004).

In 1999, MIT released a report on data gathered by the



> To include as many excellent minds as possible in the STEM enterprise, it is necessary to transform the institution, not "fix the women." Such transformation must be well thought out and purposefully enacted.

institution's own faculty demonstrating that MIT resources were not distributed evenly by gender after accounting for years at rank and productivity of faculty (MIT, 1999). The MIT president then convened a January 2001 meeting with presidents of eight additional prestigious universities, along with women scientists, to discuss gender inequality. The participants released a statement admitting there was structural, systemic gender inequity at their institutions, and announced steps they would undertake to address the issue (Rosser, 2004; MIT News Office, 2001). MIT published an updated report in 2011, describing the progress made in gender equity at that institution (MIT, 2011).

Two months after the release of the 2001 report, NSF launched the ADVANCE (not an acronym) program (NSF, 2001). The program offered several "tracks" (types of grants). One track, which is no longer available, took a traditional approach, offering fellowships to women in career transitions. The signature track, Institutional Transformation (IT), which is still being funded, takes a different route to gender equity. It acknowledges and addresses what is now understood to be a systemic problem: the academic institution, including its climate, its policies, and practices. ADVANCE-IT is designed to fix the institution, not the women, to transform academia into a place where women as well as men can thrive. IT awards go to academic institutions and enable self-study to identify institutional barriers to women's success and to devise and implement creative ways to lower the barriers.[1] Each institution is unique; some barriers may be idiosyncratic while others are shared among many or most institutions of higher education. As of this writing, 60 institutions have received ADVANCE-IT awards, and analyses of the impacts are currently in press (see NSF's ADVANCE website for a portfolio analysis to be released soon).

The IT-Catalyst track (formerly IT-START) has a similar goal of institutional transformation. These awards go to historically funding-challenged institutions to conduct self-studies to begin the process of institutional transformation. Additional tracks in the ADVANCE program include Leadership, replaced by PAID grants, and PAID, recently replaced by Partnerships for Learning and Adaptation Networks, PLAN. These grants are awarded to individuals or collaborators to target specific challenges women face within a discipline, set of disciplines, institution, or set of institutions. All of these ADVANCE awards have yielded a significant body of research revealing the multiple small inequities that add up to significant barriers for many women trying to become successful scientists, and, importantly, offering strategies to address them.

Of the 25 US institutions identified as having oceanographic programs by reviewing the American Geological Institute's 2011 *Directory of Geoscience Departments*, 10 have received ADVANCE awards (IT, IT-Catalyst, or PAID): Texas A&M

[1] IT awards go to teams at academic institutions that include men and women administrators, lab-and-bench STEM women faculty, and scientists who specialize in social sciences, organizational sciences, and studies of higher education. The team uses demographic and survey or focus group data from the institution that allows the team to identify the institution's own barriers to women's hiring, retention, and promotion.

“Research from ADVANCE awards reveals that barriers for women have different sources; thus, strategies for addressing a given barrier should be designed to fit the source or sources.”

University, Oregon State University, Lamont-Doherty Earth Observatory of Columbia University, and the Universities of Delaware, Maryland-College Park, Miami, Rhode Island, Washington, and Wisconsin-Madison. At these institutions, women constitute 17% of the oceanography faculty compared to 14% of the faculties of the remaining 15 institutions that did not receive ADVANCE awards (Florida International, Dauphin Island, Louisiana State University, the Naval Postgraduate School, Nova Southeastern, Old Dominion, Princeton, University of Texas-Austin, UCLA, UC San Diego, University of Connecticut, University of Hawai'i-Manoa, University of Massachusetts-Boston, University of South Carolina, and University of South Florida).

WHY DOES INEQUITY PERSIST? WHAT CAN WE DO ABOUT IT?

Research from ADVANCE awards reveals that barriers for women have different sources; thus, strategies for addressing a given barrier should be designed to fit the source or sources. The first two rounds of IT awardees experimented widely with strategies while conducting detailed sociological, psychological, ethnographic, and/or organizational research on the processes they were undertaking (e.g., Bilimoria and Liang, 2011). Later awardees built on these results and expanded and refined strategies. I offer here a personal summary of what's been found that works, and in what context. It is not meant to be a scholarly evaluation of the impact of ADVANCE strategies, but rather some suggestions that, in my experience, work effectively to make academic institutions more gender neutral.

There are barriers to women's success that arise from omissions in training, misperceptions, and misconceptions among individuals in the academy. There are barriers that arise in social settings as faculty interact with one another and with students, staff, and administrators. There are barriers that arise from institutional practices and policies (Risman, 2004). Different approaches are required for addressing a given type of barrier, and they are discussed in turn. Potential barriers, along with solutions devised by ADVANCE awardees, are also described.

INDIVIDUAL BARRIERS »

If women are not linked to networks where informal mentoring takes place, they may not know the rules that men pick up in informal settings (e.g., the bar, the racquetball court, around the water cooler). We are usually not aware when informal mentoring occurs—it seems a natural part of a conversation. Women do perceive exclusion from informal networks within academic departments (e.g., Maranto and Griffin, 2010, and references therein).

Solution 1 » Professional development for women at all career stages. These activities may take place at workshops or panel discussions, possibly led by professional facilitators or local faculty. Topics might include “How to Start Up Your Lab,” “How the Teaching Evaluation Process Works” for new hires, or “How to Put Together Your Promotion-to-Full Packet” for faculty at associate professor rank. Workshops and panel discussions have the added benefit of bringing professionals from across an institution or from several institutions to an informal setting for networking (providing food as an incentive to attend always helps). Although much attention has rightly been paid to the needs of beginning faculty, ADVANCE research indicates that the promotion-to-full process is obscure for many faculty—of both genders (Britton, 2010; Berheide, 2014); fully promoted faculty also benefit from professional development.

Solution 2 » Assign mentors (note that the plural "mentors" means more than one mentor for an individual). Multiple mentors offer different perspectives on how to be successful. There may be an effective mentor within a department or from another department within the same college or institution. Mentors from outside of the institution provide confidentiality and a broader perspective on the particular discipline. A faculty member or committee should provide formal oversight to a department's mentoring program. Mentors should be given guidance on how to be a good mentor (Pfund et al., 2006); mentor-mentee pairs should meet on a regular basis with a goal for each meeting. When the pair is not a good fit, it should be OK to acknowledge it and reassign faculty with no guilt and no blame.

Note that these solutions are not intended to "fix the woman," to mold her to fit the institution. The purpose of these solutions is to make the implicit explicit, to help leaders identify and communicate the information necessary for their colleagues to succeed. Note also that such programs will benefit men as well. Not all men are plugged into the "right" informal network, particularly men from under-represented groups, including those who were not born in the United States. ADVANCE teams discovered early on that what makes good practice for promoting the success of STEM women is good practice for promoting the success of all STEM faculty.

Susan Lozier of Duke and her colleagues developed an excellent mentoring program for early career scientists in physical oceanography: MPOWIR (Mentoring Physical Oceanographers to Increase Retention; see Clem et al., 2014, this supplement). This program hosts a biennial conference that brings aspiring physical oceanographers together with seasoned veterans (men and women) who formally mentor their junior colleagues and welcome them into their professional networks. Connections are then maintained and strengthened through regularly scheduled teleconferences (Lozier, 2009; Gerber, 2010). ASCENT (Atmospheric Science Collaborations and Enriching NeTworks) is a similar program for women in meteorology (Avallone et al., 2013; Hallar et al., 2015).

In addition, women may lack *advocates*. Mentors provide advice and counseling; advocates will stand up for a colleague and actively promote his or her advancement.

Solution 3 » Assign advocates. If a faculty member feels that he/she cannot advocate for a junior faculty member, then try another one. If no one wants to advocate for a junior faculty member, that person is not likely to succeed at promotion and tenure time.

INTERACTIONAL BARRIERS 1 » ***How do we treat one another in the academic setting? Do we feel that we belong? Is it easy to discuss scientific and other issues with colleagues? Do we feel as though we can do our best work where we are, or we can't wait to leave? The answers to these and similar questions measure sociological climate. ADVANCE researchers use surveys of faculty to determine departmental-level and institutional-level climate. Negative climates have been demonstrated to reduce a faculty member's intention to stay at an institution, and they can have a negative effect on a faculty member's productivity (e.g., Fox and Mohapatra, 2007). There are external forces that impact faculty members' perceptions of their institution or department, such as budget cuts, scandal, or legislative or regent/trustee actions. Within departments, however, how we treat one another, and whether department chairs and heads hold faculty members accountable for their behavior, has a large impact on departmental climate and faculty intentions to leave or stay.***

Solution » Faculty must behave in a civil, adult, respectful manner toward one another. The academic department is like a family that must live together for a decade or several decades. Conflicts cannot be allowed to persist and fester. Conflict resolution training and outside intervention can help. Many institutions have a facilitator who can help a department achieve civility. Generally, most faculty want a civil atmosphere; engaging these faculty as allies to turn around a negative atmosphere can be effective. Hiring the right people is also important; but this does not mean hiring people "just like me" (Sutton, 2007).

INTERACTIONAL BARRIERS 2 » ***Implicit bias is a more insidious interactional issue that may also be known as implicit assumptions or unconscious bias. Implicit assumptions are the unexamined assumptions we have about one another that we may not even be aware of. They may even conflict with our stated beliefs. They are shared***

by all members of a given society or culture because they are generated by the culture, by family, by media. Men and women share the same implicit assumptions, and in our society, that means "scientist" = "male." In a recent study, for example, both men and women faculty in the physical sciences preferred to hire a fictional male as a lab assistant over a female with the same qualifications; both men and women faculty offered a lower starting salary for the fictional female applicant; women faculty offered the lowest starting salaries (Moss-Racusin et al., 2012). Additional examples of our communal bias for hiring men for STEM positions abound in the literature (see Resources, below).

Implicit bias impacts every form of assessment we undertake of one another, for example: selecting graduate students, selecting short lists for faculty searches, selecting the new faculty member from the short list, annual evaluations, evaluation of tenure and promotion packages, selecting speakers for a symposium or conference, nominations for awards, selecting awardees, and nomination for leadership positions at an institution and in professional societies.

A little bit of bias may not matter, but it accumulates through each selection process, winnowing the pool until the under-represented disappear altogether. Computer simulations that provide a 1% better evaluation for one group over another yield smaller and smaller percentages of the disadvantaged group with each successive move up the career ladder (Martell et al., 1996). Valian (1999) calls this the "accumulation of disadvantage."

Solution » Reduce the impact of implicit bias. Learn about it (take the original Implicit Association Test available at https://implicit.harvard.edu/implicit) or educate the faculty about it by bringing in a speaker. There is probably someone on your campus who can speak about implicit bias, or a network of experts can be found through Virginia Tech's ADVANCE portal (see Resources below). Many ADVANCE institutions form faculty committees dedicated to educating themselves about the impact of implicit bias—the original was the University of Michigan's STRIDE Committee (Meyerson and Tompkins, 2007; see also Resources). Faculty on these committees are a great resource for learning about implicit bias.

Before evaluation of any sort occurs (selecting graduate students, creating a short list of candidates for a new faculty position, annual evaluations), decide what criteria will be used to make the assessment. Should your next faculty member, for example, have a certain number of publications? In specific journals? Or do grant dollars to date carry heavier weight? How will you weigh the candidate's alma mater or major professor compared to publication history? Before the selection committee reads through applications, the criteria should be explicit. It may be helpful to use a rubric that lists the criteria and the relative weighting of each criterion. The University of Wisconsin's ADVANCE program, WISELI, provides sample evaluation rubrics (see Resources).

Question selections and hold evaluative committees accountable. Once selection from the pool is made, stop and ask: does this list/selection have evidence of our implicit biases? Can we take another look at the applications to make sure we haven't skipped over a promising candidate? Is our evaluation biased? Both men and women write better letters of recommendation for men than for women (Trix and Psenka, 2003).

Pay attention to which of your faculty have been nominated for what prestigious awards, for awards from the institution, as well as awards from professional societies.

Make sure any search or evaluation committee is diverse, but this need must be balanced with not overloading faculty from under-represented groups with service work. The University of California, Irvine's ADVANCE program initiated a Gender Equity Advisor program that has been replicated at many ADVANCE institutions (see Resources). This program trains faculty to serve as representatives of under-represented groups while not necessarily being from those under-represented groups (such a program may overlap with the STRIDE-type committee). This practice shares the responsibility of equity "eyes and ears" among all faculty and relieves faculty from under-represented groups from being the only voices to speak up for equity. Such faculty are often in lower status positions in departments and may not wish to speak up on what might seem a controversial topic. The Equity Advisor relieves them of this burden.

INTERACTIONAL BARRIERS 3 » The Applicant/Candidate Pool. *Not only is selection from a pool subject to bias, forming the pool from which we draw candidates and nominees is subject to bias as well.*

Solution » ADVANCE institutions have generated a number of practices designed to broadly expand the pool of applicants. These mechanisms generally involve taking a

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long-term approach to a search by seeking and cultivating potential candidates even years in advance of an anticipated search and advertising in minority-serving venues such as the National Association of Black Geoscientists (NABGG), the Association for Women in Geoscience (AWG), and the Earth Science Women's Network (ESWN). SACNAS (Society for Advancement of Hispanics/Chicanos and Native Americans in Science) holds annual meetings showcasing research results from students from these under-represented populations. The Society of STEM Women of Color (see Resources, below) holds annual conclaves. One or more faculty should be designated to be on the lookout at all times, particularly at conferences, for potential new colleagues. Invitations should be extended for potential colleagues to present at a colloquium series as a sort of "first look" for both candidate and department.

INSTITUTIONAL BARRIERS » ***Women, and increasingly men, lack access to basic support for their families, including physical structures, such as affordable, conveniently located childcare. For new mothers, federal law now mandates lactation facilities. In addition to the physical structure of the workplace, policies and practices that support faculty are needed (Quinn et al., 2004; Monroe et al., 2014). At one Midwestern ADVANCE institution, only 13% of STEM faculty have a stay-at-home partner who handles all family logistics (Hill et al., 2014); all others are in dual-career situations or are single. Having children should not be an insurmountable barrier to a career in science: on average, women leave the workforce for only two years over the arc of a career (Hewlett and Luce, 2005). As Shirley Malcolm, former president of the American Association for the Advancement of Science said: "This is NOT a woman's problem; it is a HUMAN problem."***

Solutions » For physical structures, if building a daycare facility is not possible (and potential funding sources have been fully explored), many ADVANCE institutions have created referral services. Tech Valley Connect spun off the Rensselaer Polytechnic Institute's (RPI's) ADVANCE program (Dean and Koster, 2013). It not only provides referrals for childcare services, but helps new hires at RPI (and many local academic institutions and private firms) find housing, schools, services for kids with special needs—all challenges new faculty may face when moving to a new home. It helps partners find work in the area as well (see Dual Careers, below).

Solutions for Policies and Practices »

1. Most ADVANCE institutions have enacted "stop-the-tenure clock" policies for births, adoptions, care giving, health issues, and eldercare. For faculty who use such policies, departments and institutions need to give careful thought to the letter that is written to external letter writers for delayed tenure bids, explaining how the policy works.
2. Temporary assignment shifts, for example, a faculty member's full-time equivalent (FTE, or whatever acronym is used by your institution) may be assigned to all research, or all teaching for short terms, as needed.
3. Leave for fathers should be equal to leave for mothers. Recent research indicates that men need and take such leaves to help their families and not to "game the system" by using the time to write papers and grant proposals; STEM faculty in general are less likely to take leaves for fear of falling behind in their research (Lundquist, et al., 2012). Institutions should provide a climate that supports using the policies.
4. Part-time appointments, whether temporary or not, can enable faculty to get through critical family transitions while the institution need not lose its investment in the faculty member.

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5. Address Dual Careers. Eighty percent of STEM women are partnered with a STEM man; nearly 60% of STEM men are partnered with a STEM woman (Schiebinger, et al., 2008). ADVANCE-generated solutions include the Rensselaer-spawned Tech Valley Connect (see above). The University of Nebraska-Lincoln temporarily had an office that sent a letter to each short-list candidate describing possibilities for the partners of potential hires and had a “point person” to facilitate communication among the necessary players when a dual-career opportunity arose (Holmes, 2012). One mechanism to address ubiquitous (and no longer unusual) dual-career needs is for colleges/institutions to hold back some percentage of potential new positions to enable hiring qualified partners. Institutional self-study can indicate what that percentage should be. In addition to ADVANCE-generated solutions, there is a Dual Career Network that links higher education dual-career offices for exchanging information on useful strategies. And there is the Higher Education Recruitment Consortium (HERC), which provides a website for all member institutions in a given geographic area to post open positions; couples can use the website postings to look for two positions in a given geographic area.

In addition to having the policies, the policies must be widely known and understood through repeated dissemination. A single mailing or email blast will have little impact on entrenched practices within departments. ADVANCE institutions offer department head/chair workshops, newsletters explaining policy, departmental visits from institutional leaders, and workshops and informal gatherings for faculty to disseminate the policy and information on how to implement it. Because the policies are not used often, one department chair/head can have a steep learning curve for implementing new policy; he or she can be a great resource for other heads and chairs who face new policy implementation. Policy opt-out might be a more effective means of encouraging faculty to use the policies (i.e., the faculty member is automatically given the extension or leave rather than having to ask for it; Risman and Adkins, 2014).

SUMMARY

Thirteen years since the first ADVANCE awards were made, we are beginning to see changes in the academy. At the 2014 ADVANCE PI meeting in Alexandria, Virginia, Abigail Stewart, a first-round IT awardee from the University of Michigan presented data demonstrating the improvement in departmental and institutional climate as well as increased hiring, retention, and promotion of excellent STEM women faculty 12 years after the award began. No significant improvements were observed in climate after only five years. Institutional transformation is difficult; it takes concerted effort, continued attention, and time to see changes. Many ADVANCE institutions have experienced initial declines in climate indicators as consciousness and expectations were raised. But it takes time to formulate and enact policies, and further time, as well as continued attention and effort, to disseminate the policies on campus, to educate the faculty on the policies’ existence, and to support the faculty to develop practices that enable individuals to use the new policies without stigma (Drago, et al., 2006). It takes time to convince faculty that the way we’ve been doing things needs to change, to provide and model mechanisms to enact change, and to develop support and accountability systems to see the change though.

One of the great strengths of the ADVANCE program is its interdisciplinarity: the partnership of men and women in science, technology, engineering, and mathematics with colleagues in the social and behavioral sciences as well as organizational and higher education scholars. This issue is, after all, one of human behavior and human interactions. Social and behavioral scientists bring training and perspectives to the table that enable bench and field scientists and mathematicians to view their routine practices in a new light. Bench and field scientists enlighten social and behavioral scientists with their perspectives on current practices and what language to use to communicate to colleagues that a new way of conducting routine business holds promise for hiring and keeping excellent faculty.

Higher education is evolving rapidly: online and blended courses and MOOCs (massive open online courses) are placing new demands on faculty. Funding remains flat, or, if it rises, as when National Institutes of Health funding doubled in the early part of this decade, a flood of new PIs arises to share in the enterprise (White, 2013). Computer science is an increasingly essential component of geoscience research; new mechanisms are needed to harvest useful information from "big data." These factors suggest that the type of work the academy most values may be undergoing a radical shift.

Another set of factors affects how our newest colleagues obtain their first jobs. Postdoctoral positions last longer, and excellent people move from one postdoc to another with no promising "permanent" job in sight. Many students begin their careers saddled by debt. These students are lured away from academia by jobs that will help them eliminate that debt. Will excellent students be lost from the academic pipeline forever? We might contemplate what the business world calls "on-ramps" and "off-ramps" (Hewlett and Luce, 2005): mechanisms to ease faculty into and out of non-academic hiatuses, hiatuses that enrich their experiences and make those who take them even more valuable to the academy. The University of Washington's ADVANCE program developed an "on-ramps" workshop for engineers (http://www.engr.washington.edu/onramp). Would such a program be effective for oceanography?

Ensuring faculty diversity is not just about being fair. Diversity has been demonstrated to improve creativity in working groups: when a set of people in a group feel as though "we are all the same," they implicitly assume that all hold the same knowledge and often fail to share unique knowledge. But in a group where it is clear that people come from different backgrounds, that implicit assumption doesn't activate, and group members share more knowledge, arriving at more creative solutions to problems (Page, 2008; Phillips, 2014). The ADVANCE program has taught us a great deal about what needs to change in the academy and how to change it to be more equitable to all. The ocean sciences will benefit if we keep thinking about our work as a social enterprise that welcomes the best and brightest, whatever they look like.

RESOURCES

Association for Women in Science RAISE project to increase the number of women who receive awards from professional societies: http://www.awis.org/?Awards_Recognition

Dual Career Networking: An annual conference is hosted by a different institution each year; search "Dual Career Network" on the Internet to find the next one. The HERC (Higher Education Recruitment Consortium) website offers a list of institutions with Dual Career programs: http://www.hercjobs.org/dual_career_couples/campuses_with_dual_Career_programs

Gender Bias Bingo, a way to introduce faculty and staff to the impact of implicit bias: http://www.genderbiasbingo.com

FASIT: Texas A&M ADVANCE program to address civility between faculty and staff: http://advance.tamu.edu/index.php/FASIT/FASIT-interaction.html

Society of STEM Women of Color: http://www.sswoc.net

Tech Valley Connect: http://www.techvalleyconnect.com

Virginia Tech Portal attempts to capture all ADVANCE programs and research: http://www.portal.advance.vt.edu

University of California, Irvine Equity Advisors program: http://advance.uci.edu

University of Michigan STRIDE Committee: http://sitemaker.umich.edu/advance/stride_committee

University of Washington "On-Ramps into Academia" workshop: http://www.engr.washington.edu/onramp

University of Wisconsin WISELI (evaluation rubrics): http://wiseli.engr.wisc.edu

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