Background Materials and White Papers for the NSF ADVANCE Summit on the Advancement of Senior Women Scientists at Liberal Arts Colleges
June 2–4, 2010

- Summit Schedule

- Faculty Engagement and Career Satisfaction at Liberal Arts Colleges, Kerry K. Karukstis

- Why Does Mentoring End? Cindy Blaha, Amy Bug, Anne Cox, Linda Fritz, Barbara Whitten

- Improving Communication Skills: Being Heard on a Regular Basis, Laura L. Wright

- Integrating Work and a Personal Life: Aspects of Time and Stress Management for Senior Women Science Faculty, Julie T. Millard and Nancy S. Mills

- Improving Professional Development and Morale for Senior Women Faculty, Miriam Rossi

- Support from Academe - Identifying departmental and institutional resources, policies, and infrastructure to support senior women STEM faculty, Ruth Beeston, Jill Granger, Leslie Lyons, Darlene Loprete, and Carol Ann Miderski

- Leadership Support for Women Faculty Members in Science, Technology, Engineering and Mathematics (STEM) Disciplines at Liberal Arts Colleges (LAC): Perspectives on Practices, Policies and Infrastructure Related to the Position of Department Chair, Bridget L. Gourley

- Publications
    - K. K. Karukstis, "Women in Science, Beyond the Research University: Overlooked and Undervalued," The Chronicle of Higher Education 55 41 p. 23 (2009).
    - L. Wright, "**Strength in Numbers**", *Furman Magazine*, Summer 2009, pp. 8-9 http://www.furman.edu/fumag/summer09/summer2009.pdf
    - K. K. Karukstis, B. L. Gourley, L. L. Wright, M. Rossi, "Mentoring Strategies To Recruit and Advance Women in Science and Engineering," Journal of Chemical Education, 87, 355-356 (2010).

- List of Participants

NSF-ADVANCE Summit Meeting for Senior Women Faculty in Chemistry and Physics at Liberal Arts Colleges - June 2-4, 2010

Wednesday, June 2 - Windows over Washington - 14th Floor	
5:00-6:00 pm	Registration and reception
6:00-6:45 pm	Dinner buffet
6:45-7:30 pm	Opening address and discussion: *Outlining the Challenges Facing Senior Women STEM Faculty at Liberal Arts Colleges*, Kerry K. Karukstis
7:30-8:30 pm	Dessert reception

Thursday, June 3	
7:00-8:30 am	Breakfast **- Washington Ballroom - Lobby level**
8:30-9:15 am	*Session 1 -* Mentoring - Identifying a personal career support network Session Chair: Laura Wright; Presenters: Anne Cox, Barbara Whitten, Amy Bug, Linda Fritz, and Cindy Blaha
9:15-10:00 am	Breakout groups on various questions related to topic #1
10:00-10:15 am	Break
10:15-11:00 am	Breakout group reports and Discussion
11:00-11:45 am	*Session 2: Integrating Work into One's Life - Examining Aspects of Time and Stress Management for Senior Women Faculty* Session Chair: Kerry Karukstis; Presenters: Julie Millard, Nancy Mills, Joanne Stewart, Janis Lochner, and Melissa Strait
11:45-12:30 pm	Breakout groups on various questions related to topic #2
12:30-1:30 pm	Lunch
1:30-2:15 pm	Breakout group reports and Discussion
2:15-3:00 pm	*Session 3: Identifying the institutional policies and infrastructure that might support women STEM faculty at liberal arts colleges* Session Chair: Miriam Rossi; Presenters: Carol Ann Miderski, Darlene Loprete, Leslie Lyons, and Bridget Gourley
3:00-3:15 pm	Break
3:15-4:00 pm	Breakout groups on various questions related to topic #3
4:00-4:45 pm	Breakout group reports and Discussion
	Dinner on one's own
8:00-10:00 pm	Refreshments and conversation - Kerry's suite

Friday, June 4	
7:00-8:30 am	Breakfast **- Washington meeting room - Lobby level**
8:30-9:15 am	*Session 4: Recommendations for Individuals, Departments, Institutions, Professional Societies, and Funding Agencies to Support the Professional Development of Women STEM Faculty at Liberal Arts Colleges* Session Chair: Bridget Gourley; Presenters: Kerry Karukstis, Laura Wright, Miriam Rossi, and Bridget Gourley Group Discussion
9:15 - 10:15 am	Breakout groups to prioritize recommendations
10:15-10:30 am	Break
10:30-11:45 am	Group discussion to finalize a set of recommendations
11:45-noon	Wrap-up

- **All group presentations, breakfast and lunch buffets, and breaks on Thursday and Friday in Washington Ballroom - Lobby level**
- **Breakout groups in Washington, Van Buren, and Wilson meeting rooms - Lobby level**

Faculty Engagement and Career Satisfaction at Liberal Arts Colleges

Kerry K. Karukstis, Professor of Chemistry, Harvey Mudd College

If you do not take the time to get the career you want, be prepared to take what you get.

- George Bernard Shaw

All organizations benefit from the engagement and retention of talented and motivated employees. Committed employees enhance organizational productivity, spur innovation, and contribute to a collaborative and supportive working environment. In particular, faculty satisfaction in academic settings will reduce faculty attrition, boost morale, and substantially lower costs by avoiding unnecessary recruitment expenses. Institutions facing budget constraints from the current economic climate can maximize the morale and thus retention of faculty through a conscientious effort to keep faculty members engaged in the institution and satisfied with their careers.

How does one measure career engagement? The term "engagement" is a multidimensional and complex concept that includes aspects of job satisfaction, professional empowerment, job involvement, and organizational commitment [1]. Yet, as these terms are all difficulty to quantify, many assessments of employee engagement simply poll the employee on his or her level of job satisfaction. For example, earlier this year a report released by The Conference Board [2] found that only 45 percent of 5000 American households surveyed say they are satisfied with their jobs, down significantly from 61.1 percent in 1987 when the survey was first conducted. One factor contributing to the level of dissatisfaction for all age brackets was the fact that only 51% find their jobs interesting. An "interesting" job is key to developing employee enthusiasm and dedication, thereby contributing to employee engagement.

Faculty Satisfaction at Baccalaureate Institutions

Surely in academe both faculty engagement and career contentment would be expected to be high, given the educational focus of our work and the passion that we profess for our disciplines and scholarly pursuits. Here, too, measures of engagement are often conflated with measures of satisfaction. For example, an overall job satisfaction of 74.8% was reported in the recent Higher Education Research Institute (HERI) survey of over 22,000 full-time faculty members at nearly 400 accredited four-year colleges and universities who teach undergraduates as all or part of their duties [3]. Autonomy and independence, job security, and freedom to determine course content are the three principal factors contributing to job satisfaction for both men and women and faculty at all ranks. For many individuals, these factors are the prime reasons why they were attracted to the profession, and it is understandable that the presence of such empowering work conditions would influence a faculty member's sense of satisfaction with their academic environment. As Table 1 indicates, those at the full professor rank report exceptionally high levels of satisfaction in these three areas.

A closer look at the results of the HERI survey reveals that both gender and rank influence job satisfaction with respect to several additional measures. At each rank men are more satisfied than women on almost all measures, and the greatest disparity is noted at the full professor rank. As noted in Table 1, male full professors at baccalaureate institutions are generally more satisfied with their careers than women. Factors contributing significantly to the observed disparity include satisfaction with (a) visibility for jobs at other institutions/organizations; (b) prospects for career advancement; (c) opportunity for scholarly pursuits; (d) reasonable teaching loads; (e) clerical/administrative support; and (e) childcare support. These differences suggest that professional development initiatives directed toward

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enhancing the visibility, productivity, and leadership of senior women faculty will enhance

careers and contribute to greater job satisfaction.

Table 1. Satisfaction of Full Professors at Baccalaureate Institutions with Career [3]						
Aspect of Career	**Satisfaction Measure**	**Men**	**Women**	**≈ Same**	**≤ 5% Diff**	**> 5% Diff**
	Overall job satisfaction	80.6%	74.4%			x
Academic freedom and tenure	Autonomy and independence	87.5%	85.4%	x		
	Job security	93.4%	92.3%	x		
	Freedom to determine course content	95.1%	92.4%	x		
Visibility and Advancement	Visibility for jobs at other institutions/organizations	62.8%	54.2%			x
	Prospects for career advancement	67.2%	58.2%			x
Scholarly work	Opportunity for scholarly pursuits	66.0%	50.8%			x
	Office/lab space	72.9%	68.6%		x	
Teaching	Course assignments	88.2%	84.5%		x	
	Teaching load	66.3%	53.3%			x
	Quality of students	58.6%	60.6%	x		
Professional Environment	Professional relationships with other faculty	80.1%	78.8%	x		
	Social relationships with other faculty	65.3%	70.9%		x	
	Competency of colleagues	78.9%	79.7%	x		
	Departmental leadership	71.2%	67.3%		x	
	Relationship with administration	59.6%	54.4%		x	
Compensation	Salary	57.4%	52.3%		x	
	Health benefits	69.5%	69.0%	x		
	Retirement benefits	70.1%	63.9%		x	
Professional support	Clerical/administrative support	62.0%	51.1%			x
	Availability of child care at institution	38.2%	31.0%			x

Does Gender Affect Job Satisfaction at Other Institutional Types?

Two recent reports of faculty at research universities also support the notion of gender disparity in job satisfaction. One such study of 250 faculty members at a single research university [4] found that men and women also construct job satisfaction in slightly different ways. In particular, the study revealed that men derive greater job satisfaction from the receipt of academic resources from their institution as well as a "research-supportive" workload. These resources include research equipment, office and laboratory space, research and teaching assistance, and technical and administrative support. A "research-supportive" workload is one that protects research time and limits non-research activities such as teaching and service. Alternatively, the women faculty surveyed indicated that they appear to derive career satisfaction from a supportive work environment that is inclusive and respectful as a consequence of colleagues who value the contributions of the women faculty. For both male and female faculty, the perception of effective institutional leadership was positively related to job satisfaction, to high ratings of academic resource availability, and to significant feelings of a collegial, inclusive, and respectful immediate work environment. Indeed, a department chair or a dean is key to creating the academic climate that is conducive to career performance and to facilitating access to resources that will advance careers. Department chairs and deans of faculty distribute faculty workloads, apportion resources and space, facilitate collaborations and connections, and provide leadership and guidance to foster the welcoming and collegial environment.

An additional study [5] examined attrition and turnover of over 1200 female and male tenured and tenure-track full-time faculty in STEM disciplines at research and doctoral institutions. Turnover was defined as leaving a faculty position for another full-time or part-time position in academe; moving to a full-time or part-time position outside of academe constituted attrition and was deemed the "leakage" that decreases the female STEM professoriate. The

study found that a higher likelihood of turnover by women within academia was highly correlated with dissatisfaction with research support, advancement opportunities, and free expression of ideas. The difference in the experience of men and women in terms of access to resources, promotion prospects, and a supportive work environment suggests several directions for changes in workplace environment and institutional culture. Clearly, an adequate and equitable allocation of resources such as research support must be achieved. Transparency in the distribution of resources - research support, clerical support, teaching assignments, technology, office and lab space, endowed professorships, etc. - is essential. Ensuring that female faculty members perceive that they are valued, recognized by their peers and by their institution, and encouraged to have input and influence in governance and decision making is essential. Communication mechanisms, reward structures, election policies, committee assignments and committee chair appointments are all areas where deficiencies in departmental climate and departmental influence can be addressed.

Conclusions.

Attracting greater numbers of women STEM faculty is a necessary but insufficient step to advance women in the professoriate; fostering a satisfying work environment that enables women to prosper is also required. Understanding the elements that make for a satisfying academic career for senior STEM women at liberal arts colleges will help guide our institutions to create the welcoming, supportive climates that enable women faculty members to thrive.

References

1. W. H. Macey and B. Schneider, "The Meaning of Employee Engagement", Industrial and Organizational Psychology, 1 (2008), 3–30.

2. J. M. Gibbons, "I Can't Get No...Job Satisfaction, That Is: America's Unhappy Workers", Research Report #1459-09-RR, The Conference Board, http://www.conference-board.org/publications/describe.cfm?id=1727, Last accessed May 2010.

3. L. DeAngelo, S. Hurtado, J.H. Pryor, K.R. Kelly, J.L. Santos and W.S. Korn, "The American College Teacher: National Norms for the 2007–08 HERI Faculty Survey", Higher Education Research Institute, University of California, Los Angeles, 2009, p. 118.

4. D. Bilimoria, S. R. Perry, X. Liang, E. P. Stoller, P. Higgins, and C. Taylor, "How Do Female and Male Faculty Members Construct Job Satisfaction? The Rules of Perceived Institutional Leadership and Mentoring and their Mediating Processes", Journal of Technology Transfer, 31, 355-365, 2006.

5. Y. J. Xu, "Gender Disparity in STEM Disciplines: A Study of Faculty Attrition and Turnover Intensions", Research in Higher Education 49, 607-624 (2008).

Why Does Mentoring End?

Cindy Blaha, Amy Bug, Anne Cox, Linda Fritz, Barbara Whitten

1. Introduction

> *An email appeared out of the blue from someone I did not know at Harvey Mudd College. It invited me to participate in an NSF-sponsored mentoring alliance for senior women faculty in physics at liberal arts colleges. "Why?" I asked the email, "Why me? Why a mentor? I am a mentor to students, junior faculty in my department, and women faculty across the sciences. Why would someone mentor me? And what is "horizontal mentoring" anyway?"*

This, to varying degrees, describes the initial reaction of members of the physics of the NSF PAID-ADVANCE initiative, "Horizontal Mentoring Alliances to Enhance the Academic Careers of Senior Women Scientists at Liberal Arts Institutions." (Karukstis, et al., 2006). This reaction was based on the standard model of mentoring exemplified in Greek mythology where the goddess Athena takes the form of "Mentor" to Telemachus, the young son of, Odysseus, in the Odyssey. Athena, in the form of the older and wiser Mentor, gives advice and provides encouragement and support. As Mentor, Athena helps Telemachus find his own identity, apart from his father. As faculty, we often embody this character for our students and our younger colleagues. Hence our surprise at the email. It never occurred to us to ask: Who will mentor the "Mentor"?

> *As I re-read the email, I wondered, "Did someone know? Has someone seen through my façade of being an organized, efficient, successful senior faculty member? Does someone know I need mentoring, even now at this advanced point in my career?"*

When we consider the subject of mentoring in the context of academic careers, our discussions often focus on the earliest career stages. Many papers and articles highlight the importance of good mentoring in graduate school and early career environments (Boyle and Boice, 1998, and references therein). Much literature focuses on advice for new faculty members (Luna and Cullen, 1995; Olmstead, 1993). But why would one think, that the need for good mentoring ends when a faculty member achieves tenure? As faculty members, we face changing needs and expectations in our teaching and research, in our contributions to campus and professional communities and in the continual struggle to balance our personal and professional lives. Wouldn't a good network of mentors be extremely helpful in navigating an ever-changing career path? The mysterious email started us down a path where we experienced the benefits of mentoring at an advanced stage in our careers. This allowed us to eventually ask "Why Does Mentoring End?"

2. Mentoring

A. Importance of Mentoring

Why is mentoring needed? The scientific community is not, as it is sometimes naively characterized, a group of individuals struggling alone to produce work whose quality is manifest to all. Rather, it is a community of overlapping and interacting networks (Ziman, 2000). Members of a network provide support at all stages of the scientific enterprise. As scientists, we ratify and critique each others' plans, offer encouragement when work or personal life does not go as hoped and celebrate and publicize each others' success in a way that leads to career advancement. Furthermore, in order to increase our pool of scientific talent, it is generally agreed that we must open our community to race, gender and other kinds of diversity. It stands to reason then that we must affect much of this change by leveraging a network-laced structure. We must build and maintain professional networks, and help our colleagues do the same.

The literature makes it very clear that social networks in science are powerful entities.   For example, the study by Wennerås and Wold (1997), shows that the likelihood of getting grants is increased by knowing someone (or knowing someone who knows someone) on the committee. Blau, et al.(2010), compared young women economists who had participated in a mentoring workshop to those who had not. Women who participated in just this one workshop had more publications overall, more top tier publications, and more successful grant proposals. (It was too early to tell whether the workshop had an effect on tenure.) A recent National Research Council report found that 93% of women with mentors received funding for grant proposals compared to 68% of women without a mentor (NRC, 2010).

Etzkowitz et al.(2000) have discussed the importance of `social capital' to a scientific career. A store of social capital resides within a network of collegial individuals; and is accumulated by the exchange of valuable items like scientific information, career advice, and good recommendations.   Social capital is needed if we are to maintain the other types of capital— financial, physical, and human—essential for ongoing scientific success, even when we are at advanced faculty rank. They note that "Formal positions are only a rough indicator of success, since individuals of the same rank differ widely in the strength of their networks and their access to scientists with relevant knowledge for possible collaboration." (p. 124). Etzkowitz et al. maintain that the lack of adequate social capital provides a framework for analyzing the differences in "the success of men and women in a social context in which productivity is based on managing interdependence with others." (p. 118).

B. Traditional Mentoring and Women Scientists

A scientific career usually begins in graduate school, but of course, grad school cannot teach a scientist all she/he needs to know. It is primarily focused on training research scientists and providing the knowledge and skills necessary for doing research in a specific subfield. Grad students are coached as scientific apprentices and a thesis and post-doctoral work are their "journeyman's" projects, a sign that they are ready to practice their craft in their professional community. But after leaving grad school (and perhaps a postdoctoral position as well), career paths diverge and evolve. The trained research scientist may need to know how to be a good

teacher or staff scientist, department chair or lab manager, campus administrator or program director. This suggests that career mentoring may be valuable, not just at the outset, but throughout an entire career.

What types of mentoring are useful in a scientific career? Are effective mentoring methods the same for women and men? In the physical sciences, men outnumber women at all academic ranks and the gender disparity is most pronounced at senior academic levels. (See Section 3) It is important that all scientists, regardless of gender, be able to serve as effective mentors. In order to examine the role of gender in mentoring relationships, one of us (Whitten, 2010) has done interviews with a number of women physical scientists. Their mentoring experiences, while not presumed to be comprehensively representative, illustrate a variety of mentoring situations. (Pseudonyms will be used in the following descriptions.)

Marilyn, an African American physicist, had had an elite education and understood about networks. But she couldn't make the existing networks work for her. As a student, she and other Black students were not introduced to recruiters and other important speakers. She did favors for others but couldn't call on them for return favors.

Christine, a Native American geologist, has been spectacularly well mentored in some ways. A famous geologist called her up when she was a graduate student because they were working on the same type of rock. He took her all around the area, sharing his deep knowledge. He phoned her to ask how she was doing; when she was broke, he gave her money to pay her bills and buy her kids Christmas presents. But more than one professor at her own institution subjected her to discrimination and poor advice. She ended up having to change schools because of this bad treatment by professors and advisors.

Jane, a White mathematician, worked with Richard, another "different" scientist (he is blind). He was her Ph.D. advisor, and Jane has continued to work with him her entire career. They both consider the other to be their best collaborator. They feel lucky to have found each other, and to be able to work together consistently. Yet Jane feels that her career is incomplete because she has never become independent of her advisor.

Dolores, a Hispanic physicist, educated at an elite institution, had a well-known advisor who told her to "You have to run as far away from me, as far away from guys as possible". The advice was perhaps well-meant— intended to force Dolores to craft her own professional identity (in the way that Jane did not, to her perceived detriment)— but taking that advice put Dolores at a disadvantage. In her postdoctoral years, she was deprived of an important source of advice and influence. She had to compete with others who kept closer to their mentors and could be advised, recommended for speaking opportunities, and helped with writing grants and interacting with granting agencies.

These examples illustrate that women scientists can certainly be mentored effectively by men. Sometimes such relationships turn out quite well. But there are risks. The advice to Dolores to separate herself from her advisor was well-meant, but ultimately injurious to her career. For various reasons, some male mentors don't actively mentor women in the comprehensive way that they would mentor another man. Nolan et al. (2008) surveyed early career chemists about their

mentoring experiences. Women tended to have equal academic mentoring with men (e.g. research meetings with advisors), but less professional mentoring (career-building opportunities, advice on career choices). They found, however, that when women were mentored by women faculty, these discrepancies disappeared.

C. Mentoring in Academia: Life-long Mentoring

When is the right time to "leave the nest", and pursue a career in science, sans mentor?

> *In her talk "Crossing the Bridge" at the Feb. 2010 American Physical Society meeting, Fisk University student Erica Morgan described the various mentors she has encountered as she progresses toward a Ph.D. in physics. When asked at what stage in her career she would no longer need to benefit from mentoring, she was very definitive. "Never!" she said.*

The premise of this white paper is that a scientist should *never* find herself/himself without a mentor. Moreover, a scientist needs not just one, but a network of people able to serve as mentors. The types of issues that scientists face will change over the course of an academic career. Networks of mentors can provide ongoing support and encouragement throughout the various stages.

1. Early Years
As we've mentioned above, mentoring efforts in academia are typically aimed at faculty just beginning their careers. New faculty need help in order to learn how to teach, establish a research program and write successful proposals to supplement start-up funds and support ongoing research. Without missing a beat, they must go from being grad students (or postdocs) to serving as advisors to their own students. For some women, this transition is complicated by domestic issues like managing a two-career family and raising young children.

In liberal arts colleges, new professors face additional challenges. Undergraduates need careful advice on courses and careers – calling on experience that a new faculty member does not have yet. Teaching loads are heavy in comparison with research universities, and physics faculty, in particular, are required to teach many new courses, sometimes ones that are outside their area of direct expertise. Faculty must tailor their research projects to match the needs and abilities of the undergraduates they seek to engage, and the smaller scale of research that small colleges can support.

Experienced mentors can help at this stage by identifying a variety of choices and their possible outcomes, illuminating previously unknown possibilities and helping new faculty begin to carve out their own career path and work out career/family balance issues. All young faculty members need advice in navigating the tenure process. But each liberal arts college has its own unique "personality". Helping a young faculty member perceive, and thus meet, the particular criteria of excellence at that particular college is something that only mentors familiar with the both the department and the college can do.

2. Middle Stages

When faculty enter the middle stages of their academic careers, they still need advice and support. What was earlier called "mentoring" is now referred to as "collegial advice" or "peer networks." Faculty now turn to professional peers for advice and support when they write new grants or publish the results of their work. This peer mentoring is very helpful when faculty face changes in their research, teach new courses, or add new pedagogical techniques or technologies to their existing courses. While typical departments will protect pre-tenure faculty from heavy teaching loads or committee duties, at mid-career, large workloads can suddenly surface. Thus, mid-career, faculty must make decisions about which committees or projects to support (either in their home institutions or in their professional communities). The need to juggle personal and professional goals continues as family needs change but do not disappear.

 A good mentoring network can help faculty make these difficult professional choices. Mentors remind the faculty member how to say 'no' when appropriate, establish priorities, remain flexible, and maintain a balance that respects personal needs and goals, as well as professional ones.

3. Later Career Issues
Senior faculty face some compelling new issues.   Leadership expectations increase while teaching and research demands continue. Research can become more difficult as the momentum that was acquired in graduate school and start-up initiatives have both run out. At a liberal arts college, heavy teaching loads and isolation from research colleagues further complicates the situation. Senior faculty might be chairing a department, or a division of their college – so must balance teaching and research with these important duties. They might also be called upon to serve at the national level.

The needs of adult children and aging parents replace those of infants and young children. The problem of finding gainful employment with a spouse might turn into the problem of separation, divorce, or the loss of a spouse. Senior faculty nearing the end of their regular teaching and research careers face uncertainties in the transition to retirement.

Advice and support from peers is indispensable at later career stages. Peer mentors can encourage each other to try new research avenues and expand their intellectual horizons. They can provide fresh perspective and insight. That is, experienced senior faculty are expected to be the font of wisdom for younger colleagues, but they may be too close to their own situation to apply the same creativity to their own careers.

D. Horizontal Mentoring

In the broadest and most useful sense, then, mentoring connotes an activity that is not necessarily "top down" or "from one generation to the next." As we've mentioned above, most studies of mentoring are about the effect of faculty mentors helping students, and tenured faculty mentors helping colleagues up through the time of their tenure decision. However, Lederman, et al. (1994), describe a group of four women who were all in non-tenure track positions and formed a mutual mentoring to help them advance their careers. The group focused on professional issues, particularly research. They met frequently, set goals and schedules, read and critiqued each other's work, and gave each other strategic advice. Three of the four achieved tenure; the fourth

was offered a job at another institution. They attribute their success to several factors: The small size of the group which created intimacy and made scheduling easier; its single-sex nature which made it more honest and less "academic", the similarity of disciplines and employment histories, and an ethos involving mutual respect.

The premise of these successful NSF Advance alliances is consistent with this study that "horizontal mentoring" between individuals of similar rank, field, academic environment, and perhaps also matched by race and gender, is a highly beneficial enterprise. The roles of mentor and mentee are fluid, and the interaction is beneficial to both.

Whether the people engaged in horizontal mentoring are at an early, middle, or late career stage, the activity of mentoring promotes flexibility and supports the career growth of not only the mentee, but also the mentor. It provides the mentee with external feedback and novel views from another's perspective while challenging the mentor to be flexible in gathering ideas and insights that can be of use to someone in a similar, but not identical, career. This exercise can help mentors identify new options in their own careers.

Mentors both within and outside of a faculty member's home institution have a role. External mentors are extremely helpful at providing a fresh perspective. Internal mentors have specific insights born from knowing the ins and outs of the institution. Also such mentoring relationships create a strong sense of community within an institution.

It goes without saying that having numerous mentoring relationships constitutes a web of support. A horizontal mentoring relationship, even one between just a couple of people, is important. It not only is useful in its own right, but it acts as a basic building block for a larger network - creating additional "nodes" for expansion. Networks provide the varied and sustainable system of support that a single mentor-mentee relationship cannot duplicate. So it is clear that we must build and maintain professional networks, and help our colleagues do the same.

3. Our Demographic: Senior Women Physics Faculty at Liberal Arts Colleges

A. The Numbers
Senior women in physics, especially those at liberal arts colleges, face special challenges in trying to develop a network of support. We benefit greatly from mentoring: both top-down and horizontal mentoring, from people who have had similar experiences. But this is often difficult to come by. We generally do not have senior women peers[1] at our own institution who have the relevant experience to guide us. While there is much that we can learn from our junior colleagues, the issues we face and the demands on our time and energy are often different, as outlined above. Furthermore, society's expectations for women in professional situations are often quite different from the expectations of men (Valian, 1998). Our male colleagues, as well intentioned as they might be, are often not able to provide the guidance that we need, when they reason from their own lives and professional experiences. Senior women in other departments, even other science departments, may not fully understand the specific issues that we face as women in physics. We may have been the only woman in the department for years, feeling that

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[1] In 2006, 13% of physics faculty at all ranks were women, while 6% of full professors were female. (Ivie, 2006).

we must constantly prove ourselves worthy while "swimming against the tide" of expectations that women are not natural leaders, or equals in the domain of physics.[2] Neither male colleagues nor colleagues in other departments will understand, firsthand, what this entails. It takes time and effort to seek out possible mentors. Relying on serendipity to encounter such people is not practical given our small numbers.

B. Small College Life

The challenges faced by women physicists at small colleges are often quite different from those faced by women in other academic institutions. We are doubly isolated by being a woman and by being in a department so small that no one works in a related research field. In small departments and small colleges there are often well defined, but not necessarily well-articulated, cultural norms within which we must function. We often need guidance in discerning and adapting to our culture. We may also need guidance in forming strategies for instituting cultural change. Students at private liberal arts colleges may have specific expectations that aren't always consistent with our own expectations as educators, or our previous experiences, when we were students ourselves. It has been shown in numerous studies that women in authority, including academic authority, face expectations that are different from those of men (Sinclair and Kunda, 2000; Rudman and Kilanski, 2000; Hall, 2007). Students may expect us to nurture and support them in a stereotypically "maternal" way, and will penalize us if we do not.[3] We may also be differentially penalized when we hold students to high standards.

Senior faculty at liberal arts colleges are expected to take on many simultaneous roles in a way that would not be typical at a research university. These demands come not only from within our department or from our research programs. They also come from the college as a whole. Small colleges survive only because some faculty members are willing to put enormous amounts of time into institutional governance, long-range planning, and other projects for which there is little direct reward. We are given little advice about carefully choosing the causes to which we are willing to contribute and saying 'no' to others. As women we may not only be pressed into service more often due to our 'token' status, but we may fall more readily into the trap that if something needs to be done, it is our responsibility to see that it gets done. As senior faculty members, we often feel as if we have to/should be able to "do it all". The role of a mentor with similar experiences is thus to help us set reasonable boundaries, and give us permission to prioritize service projects. This includes giving a priority to time that we take for our personal wellbeing.

C. Physics versus Chemistry
Senior women in physics and chemistry share many concerns. Our fields are lumped together as "physical science" by many reporting agencies, and for good reason. We share important modes of scientific praxis: a reliance on mathematics, laboratory experiments, and a "theory-rich"

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[2] 4 out of 5 were the only woman in the department when they were initially hired; the one of us who was hired into a department with another woman was delighted to know she was hired on her own merits, not because the department needed a woman.

[3] A President of a small liberal arts college tells a story of her first days in office, when a student (female) strode into her office without an appointment, and requested that the new President help her find her lost backpack. She was shocked when the president would not comply.

knowledge base. For example, one of us (AB) , though trained as a physicist, did a postdoc and virtually all of her off-campus research in chemistry departments. From a gender equity point of view, when one looks beyond the bachelor's degree level, there is no environment (grad school, academia, industry, ...) in which one can find equal numbers of women and men in either physics or chemistry. The metaphor of a "leaky pipeline" has been utilized for many decades to describe the outflux of women from both chemistry and physics at critical junctures. One could use this metaphor with confidence as recently as a few years ago, and speak truthfully of women being hired or tenured in both fields at lower rates than men (National Academy of Sciences, 2006). Now, recent data indicate that, as a group, women are now more successfully passing careeer milestones[4] so the pipeline is less leaky. (Ivie, 2010) Regardless, a lack of gender balance between women and men in both fields at all given career levels remains.

Despite our similarities, there are some differences as well between women physicists and chemists. First of all, there are fewer women in physics percentage-wise. Figure 1 (also Leggon, 2002) shows that the percentage of women bachelor's recipients in chemistry is roughly 50% nowadays; while it is roughly 25% in physics. If one reads past percentages to the raw numbers, there are significantly fewer women in physics, both as students and faculty members.   Women physics faculty are likely to be isolated, especially in a small department, where having a little over 10% women means having one woman.   This is not at all an uncommon situation for physics departments; in 2006, approximately 39% of all physics departments had zero or one woman in professorial ranks (Ivie, 2006). In most small colleges, chemistry departments are larger, so this situation is less frequent.

The lower percentage of women in physics faculty at all ranks at R1 institutions is shown in Figure 2. Interestingly, a smaller proportion of female PhD recipients go into academic positions in chemistry than do in physics (compare Figures 1 and 2, see also NRC, 2010). The reasons for this are not yet understood (a gender-related decision that favors industry over academia?).

In terms of our teaching responsibilities and the departmental "climate", there are differences as well. For one, chemistry departments tend to split up the undergraduate curriculum, so that organic chemists do not teach physical chemistry and so on. In physics, by contrast, the model is more often "everyone teaches everything." In this case a young (or not so young) physics faculty member is faced with teaching new courses, most of which are outside her specialty.

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[4] An important qualifier: this refers to non-minority women. For underrepresented minorities, both men and women, the equity situation remains dire.
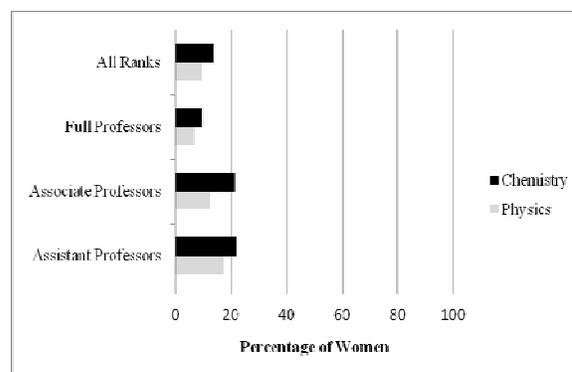
Figure 1. Women Degree Recipients in the Sciences
Data are from NSF (2007), Tables C-5, F-1.
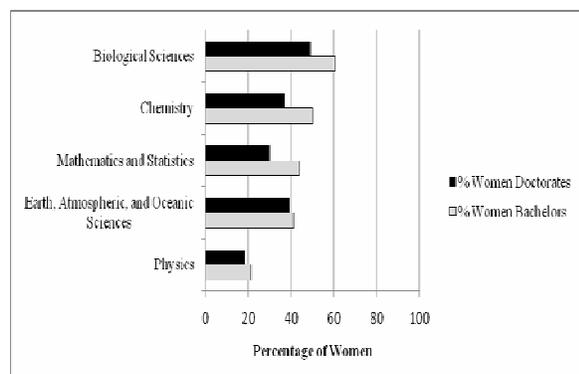
Figure 2. Women Faculty in Top 50 Research Universities
Data are from CSWP (2005)

4. Mutual Mentoring and Our Alliance

In this section we describe our alliance—what we did, why we think it has worked so well, and what we consider to be essential. These ideas are summarized in Table 1.

Table 1. Summary of Essential Elements of our Alliance

- We are similar in age and rank, so our professional and personal issues are similar.
- We are from different institutions and subfields, so we are not in competition.
- NSF funding helped us (and our colleagues) take this project seriously, so it didn't get lost in the myriad other demands on our time.
- The initial face-to-face meeting was essential for us to get to know each other and build trust. Eating meals together created an informal atmosphere.
- Regular Skype calls help us keep in touch with each other's professional and personal lives at no cost.
- Reading *Every Other Thursday* helped us with our initial agenda and gave us some language to identify and discuss our dilemmas and challenges.
- Regular (once or twice a year) meetings maintain our relationships (and are a lot of fun).
- Phone calls and meetings involve discussion of immediate issues and longer-term projects.

A. The Nuts and Bolts

Given the relatively small numbers of women in physics, particularly at the full professor level, it was no small feat to pull together our horizontal mentoring alliance of women full professors at liberal arts colleges. Establishing a mutual mentoring network across geographic regions and time-zones was non-trivial. What made our group a success in terms of mutual mentoring was a combination of a number of factors, beginning with the alliance structure designed in the NSF-ADVANCE grant. After being (mysteriously) selected and then agreeing to participate in a

physics alliance, we began to organize an initial face-to-face meeting. Meeting in person was essential to the success of the group because it allowed us to build a sense of trust and community. This, of course, meant that the grant money used to support travel, housing, and meals was crucial.

We met for the first time at the APS meeting in April of 2008. Some of us had known each other personally or professionally beforehand, but all five of us had not met together before. We were somewhat confused about how to organize ourselves, and structural details (e.g. why we had to eat together to be reimbursed). We began over lunch, by introducing ourselves. In addition to the usual professional information, we included our family situation (We found that all of us had children, though their ages varied from elementary schoolers to 20-somethings.), and a brief discussion of career issues about which we had concerns.

During this conversation and later ones at this meeting, a professional theme emerged; each of us felt uncomfortable about our research. We all felt that we had drifted from our original graduate school training into administration, curriculum development, and diversity issues. We were ashamed of being "unproductive" compared to physicists at research universities, or to the one or two "superstars" in our home departments. We were wondering if we should try harder to do the work we had been trained in graduate school to do.

All of us, in different ways, were confronting the same series of questions. We agreed to think more about these issues and make that the focus of our next meeting, the following summer. To keep in touch between meetings, we agreed to carve out time for internet conference calls (via Skype) every other week and to begin our alliance essentially as a book group to discuss Ellen Daniell's *Every Other Thursday* (2006*).*

Every Other Thursday, a book about a mutual mentoring network of women scientists, was a good touchstone for our conference calls. In reality, we rarely talked much about the book itself, but it provided a good context in which to share challenges, insecurities, and difficult career issues. It also provided a model of a mutual mentoring network that was useful on our conference calls from logistics—everyone gets a set amount of time to bring up issues and a moderator moves the group along—to language—we started gleefully identifying our own *pigs* (defined by Daniell as "negative self-perceptions").

At our summer 2008 meeting we returned to the theme of our research. We had each worked to define a possible path or paths toward a more satisfactory research career, and to identify some concrete steps we could take along that path. We each took time to describe our possible paths, while others in the group listened carefully and offered comments and advice. Each person ended with a decision and a series of steps to try. One member of our group expressed the following sentiment:

I had been working on diversity in physics for about ten years, getting farther and farther from my original field. I love the diversity work, and feel that it's an important contribution to the physics community. But more and more I missed "real physics." I wondered whether I spend my upcoming sabbatical on new diversity projects, or begin a new technical field. The group advised me, if I really missed technical physics, to go ahead and move into a new field. I just

finished a very interesting and productive sabbatical, beginning a new research project in atmospheric physics.

Another member of the group decided that her curriculum development work *was* her research—she could continue to develop that work without feeling guilty that she was no longer doing her graduate school experimental work. Another decided to prioritize her own research more.

We met in person again in March of 2009, continuing with conference calls in between. Over that time, the conference calls evolved from book group discussion to helping with the immediate crises of the week as well as some longer term accountability. We shared goals as well as accomplishments. Even though the conference calls were incredibly useful, it was difficult to keep them going and for a while after the March 2009 meeting, we did not conference call regularly again until the fall of 2009 (when we felt under pressure to have a "product" as a result of our alliance).

B. Why Does it Work?

We had money to travel to meet together, were "forced" to eat together and felt obligated (by agreeing to participate) to gather on conference calls, but this only begins to touch the surface of why the program had such good results for our group. Almost from the beginning, we were willing to open up with each other. Why were we willing to do that? One of the reasons was that we had nothing to lose and everything to gain: none of us would be evaluating the other on an individual campus; none of us would be evaluating or competing with anyone else for grant applications because our sub-fields were too different. While this is likely to have contributed to our success as mutual mentors, we also think that our successful group is something akin to a "resonant phenomenon". The other members of the group "get it" (whatever the issue) right away, without ancillary explanations or elaborate justifications, because they've had similar experiences. They are not just willing to sympathize, but they are truly able to empathize. For many of us, it was our first time in a group with others who are so much like us - or as one member put it: "For the first time I know that it is really not "just me" in the various career issues I have faced." This group was, then, like a sigh of relief. It brought us out of the isolation of being a sole senior woman physicist on campus, and into the warmth and understanding of a group of savvy, senior, women physicists.

Part of the resonant phenomenon was that we were not only allowed, but encouraged to bring everything to the table. We did not have to separate our professional selves from the rest of our life. Our goals and accomplishments extended beyond the purely professional realm. They included things like making a doctor's appointment for a check-up, getting on-line checking established for paying bills, and going to a yoga class regularly. This was a group that not only recognized, but actually required that we include all of our life in the context of career issues. This may have been because our group members had to deal with a number of family crises: children returning home after college, taking care of elderly parents, and becoming a single mother, as well as some dramatic health issues. But even beyond that, we felt encouraged to approach our mutual mentoring more holistically. As one member put it:

I am allowed to bring all the juggling balls to the table – family-work issues, research-teaching

conflicts, community service-personal need balance. I no longer need to juggle the invisible big ball of family needs. I can discuss all my goals and commitments with others who won't scoff so I can bring it all into better balance.

and from another:

Our alliance has enabled good, healthy career and life choices to "come out of the closet" and become part of my professional life so they can be given the time that they need to be processed.

Out of a resonant phenomenon, our alliance has grown into a supportive network. We have done a lot to support each other in our research work. Our discussions have helped us get clarity in this work as we addressed the questions of what type of research we wanted to be engaged in. We supported individual answers that included switching subfields, staying in the same field, or working in non-traditional research areas (gender issues, curriculum development). Our network helped one of our members in her decision to get back into research within a new field. Through another member, she has made a contact for a sabbatical to begin research in this field. We encourage each other to define goals and priorities to help us focus on important projects and be less distracted by lesser demands. We help each other balance our professional and family demands.

We have provided different perspectives when dealing with a particularly troubling issue. For example, one of us mentored a junior woman science faculty who received a negative tenure recommendation from the promotion and tenure committee. As a group, we worked together to help this member decide how to best provide support for her junior colleague and we celebrated with our alliance member when her junior colleague ultimately did receive tenure.

Our alliance has been more helpful to each of us than we expected when we first agreed to participate. As one member put it: "Our conference calls and meetings are intellectually invigorating as well as one of my most valued sources of wisdom, support and encouragement." While another member says: "Our alliance has given me the courage to accept challenging leadership and difficult tasks because I know I have a backup group for brainstorming and support."

5. Future?

Now that we know how professionally and personally beneficial our mutual mentoring has been, will we still be able to sustain our already established mentoring network once the NSF support expires? Does a group like ours need a funding source to continue? And most importantly, what are the implications for future mentoring networks?

Perhaps creation and support of such mutual mentoring networks would not require enormous amounts of external funding. If NSF or professional society support could be used to establish methods for creating mutual mentoring networks, then professional societies might be able to provide space at national meetings to allow these mentoring groups to have face-to-face meetings. In physics, for example, the Committee on the Status of Women in Physics (CSWP) currently has funds to run and provide support for professional development workshops for

women held in advance of APS national meetings. The workshops have been structured to address the needs women physicists at particular stages of their careers. Structured mentoring networks could be a natural outgrowth of these workshops: a place for the necessary initial face-to-face meetings with their new mentoring cohort.

With modest financial support, members of these small cohorts could gather on a yearly basis when they attend future society meetings. A whole host of social networking technologies and methods of electronic communication could be used to provide more regular "conferencing at a distance". Women who once faced isolation and lack of collegial support and advice would then have the opportunity to participate in a mentoring cohort. Members of these small cohorts could meet periodically in a larger forum to share and collect ideas they have generated , and allow for the professional society to develop action items to address common themes. The IUPAP international conferences for women in physics, three of which have been held so far (Hartline, 2009), are an admirable model for developing action items. Their conference proceedings show the emergence of common themes, and contain recommendations for institutional and governmental change.

With NSF and professional societies promoting the establishment of these networks, mutual mentoring could be given the professional recognition it deserves. The credibility of an NSF project, or formal recognition within the auspices of the field's professional society, is important. It is much easier to justify mutual mentoring conference calls if it is for an "NSF project" than for a "Women in Physics" group. Currently NSF grants require proposers to specify means of assessment and methods of dissemination of project results. Why not also acknowledge the need for effective mentorship to promote creativity and inspire the future generation of scientific questions and research?

As Skype announced that the alliance call was beginning, I thought about the pile of labs I needed to grade, my unfinished grant proposal, and the committee minutes I still needed to write up and thought 'do I really have time for this conference call?' I answered anyway, heard someone sigh and say she was swamped, and I was reminded once again that I wasn't alone… This was definitely worth it.

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Improving Communication Skills: Being Heard on a Regular Basis

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The Problem:

It is not uncommon for me to hear one of my female science colleagues comment on the fact that they couldn't get a word in edgewise at a meeting they had just been in. The women who say this most often are the women that have the most years of experience in their institutions. It is a common experience of these women for their voices to go unheard in their department meetings. When they try to speak up they are routinely interrupted. When they do manage to get a word in it is as though they never said anything. Then several minutes later a male colleague will say the same thing and everyone will say what a great idea it is, forgetting that the woman said it earlier in the meeting. This is in part due to cultural norms. Girls were taught not to interrupt and not to be "bossy." We were told at a young age that it is "not nice" to interrupt so we learned to wait our turn and speak when others were finished. Boys on the other hand were taught to speak up and be heard using whatever technique is necessary, be it increased volume or waving of arms. It is absolutely normal for them to interrupt each other during conversations. They expect to be interrupted and they assume everyone will use this same communication style (Valian, 1999). It is this disconnect between the way men and women communicate that creates the problem of experienced women not being heard.

Most men are completely oblivious to the problem. They honestly don't even notice that the woman is often being talked over and interrupted. This is a more significant problem for older women raised in the 50s and 60s when social norms for men and women were so deeply entrenched. The women scientists who went ahead and pushed the boundary of what were socially acceptable careers for women have lived with this problem throughout their careers. Many were the only woman in a science department when hired and had no female role models to show them how to navigate the communication barriers encountered. Some learned that it was less frustrating to just sit quietly during meetings. Some tried to redirect the conversations afterwards in private discussions or tried to rally support for ideas prior to meetings and then let a male colleague make the pitch, and get the credit for the good ideas. These techniques often derail one's sense of accomplishment and undermine credibility within departments in subtle yet tangible ways.

The Consequences:

When a woman is routinely interrupted or worse yet ignored, whether in a meeting or in more informal settings, it sends the message that her ideas and opinions are not as valuable as those of the other faculty. Students are not oblivious to what is going on around them. They quickly learn who is listened to in a department and who is not listened to. The students follow the lead and often begin listening selectively based on who is speaking. Once they think a woman scientist is not a "power broker" they may begin to question her teaching, her research and her value to the department. If she is

the only female in the department, the students are seeing on a daily basis that women aren't treated the same as men and the female students may begin to select alternative career paths. Junior faculty also get the same message when a senior member of the department is constantly ignored or interrupted. They are focused on getting tenure and understand who the "power brokers" are. The junior faculty are, in essence, given permission to devalue the ideas and opinions of the woman. What begins as a simple communication problem can have serious impacts on the career choices and paths taken by female science majors as well as foster animosity within a department.

Strategies to Address the Problem

So how do we address this problem? The first step is to initiate an awareness campaign. Colleagues will not know there is a problem unless they are informed. But how can this be accomplished without further alienation and causing further departmental problems? The answer to this is not going to be a one size fits all solution. One strategy is to do this on an individual basis, in person, at a time when there is not a specific "problem" or hot button issue on the horizon. The conversation could begin with "I've been noticing lately that when I am at meetings I haven't been very successful at getting my ideas heard." In order for this conversation to be fruitful the other person needs to feel like they are not being targeted as the source of the problem but are being approached to help you find a better way forward (Patterson, 2002). In a larger department this method may not work well because there are just too many people to try to track down. An alternative approach might be to target a few colleagues that you sense would be receptive to assisting you address the issue. Explaining what you have observed and how it is impacting your ability to be a full

participant in departmental decisions is a first step in enlisting their future assistance during meetings. Once they are aware of the problem you can ask them to watch for the interruptions and interrupt on your behalf. Have them specifically ask your opinion when it is apparent you can't get a word in. If you can get several of your colleagues to work with you during meetings the dynamics of meetings will begin to change so that all voices are routinely heard.

   If it is not possible to enlist someone's help it is important that the woman understand the dynamics of how various people interact. In addition to the differences previously mentioned there are other style differences to be taken into account. Some people work out their ideas while speaking out loud while others think things through in their own head before speaking (Patterson, 2002). If the woman is a think before speaking individual it will be even harder to get her ideas out. The think while speaking group will already have begun the interruption process and the "polite" woman will have to wait for an opening in the conversation that may never come.   Understanding that this is the normal dynamics for a particular group, the woman will have to make the decision that it is time for a change. During the meeting she will need to try to interrupt the flow and point out that she is having trouble getting her ideas heard. Point out that you were trying to say something when you were interrupted. This is a very difficult thing to do, especially if it has been going on for years and it has become the norm. It requires a conscious effort on the part of the unheard woman to decide to work on changing the climate at meetings. It will not happen spontaneously on its own. Having people aware of the problem prior to the meeting will make it go more smoothly, but

another thing that will make it easier is having a support network in the wings, so to speak.

I have called upon my horizontal mentoring cohort on many occasions when I knew I was about to head into a situation where I would have to somehow get my voice heard. We know each other and our past histories well enough to anticipate some of the upcoming problems. Our confidential conversations have helped us become aware of some of the dynamics in each of our own institutions. Via email and phone calls with my mentors I have been reminded of strategies which have worked in the past and strategies that have backfired. By preparing my thoughts carefully prior to these meetings and entering the meeting confident that my voice is worth hearing there has been slow but steady progress towards being heard within my own department.

The underlying goal of changing the communication dynamics within a department, or other professional setting, is to allow **all** voices to be heard so that the best overall decisions can be made.

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Integrating Work and a Personal Life: Aspects of Time and Stress Management for Senior Women Science Faculty

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"There is never enough time, unless you're serving it."

-Malcom Forbes

One of the many myths surrounding college teaching is that professors are only working when they are actually in class. Particularly for science faculty at liberal arts colleges, time in the classroom is only a small fraction of a typical workday. Research, mentoring, and service are just some of the other demands on our time. Adding personal responsibilities increases time pressure, which can lead to a constant battle with stress. Increased stress in turn reduces productivity and leads to a decline in physical and emotional well-being. In this paper, we address some of the consequences of the stress encountered in an academic career, some of the special challenges for women science faculty, and some strategies for achieving a better balance between the professional and personal.

Too Much To Do

A constant feeling of having too much to do and not enough time to do it can lead to a high degree of work-related stress. This phenomenon is certainly not isolated to academics but is shared by many working Americans. A 2007 Gallup poll found that 47% of Americans report that they do not have enough spare time (Carroll, 2008). Most Americans also report that they experience stress in their daily life, with a correlation between having insufficient spare time and experiencing stress (Figure 1). For example,

54% of Americans who reported having insufficient time were frequently stressed. On the other hand, only 27% of Americans who reported having sufficient spare time said that they frequently experienced stress.
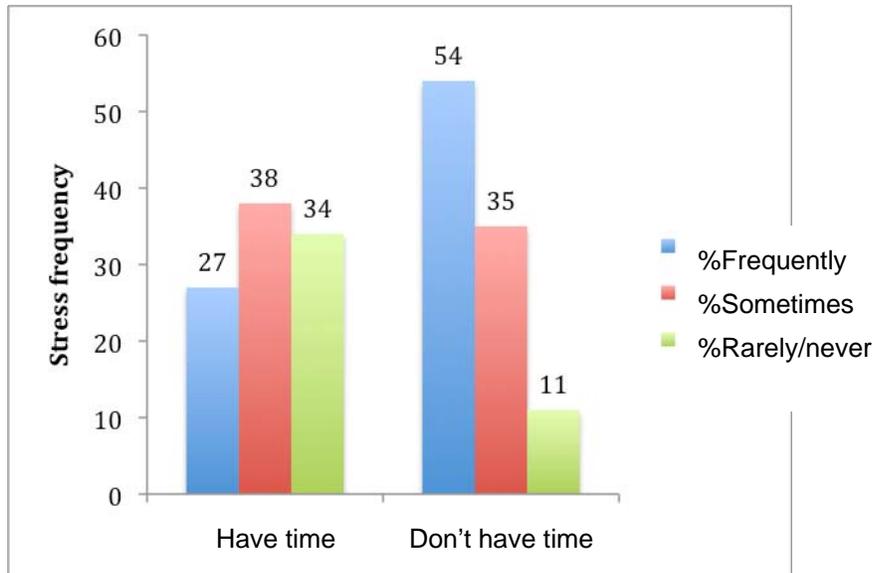
Hidden Consequences

What are the costs for professional women who don't have enough time for a personal life? Few can forget the 1986 Newsweek claim that a college-educated single woman over the age of 40 was more likely to be killed by a terrorist than to get married (Salholz, 1986). This article referred to a study based on figures obtained from the Census Bureau (Bloom and Bennett, 1985), yet shortly after it appeared, one of its coauthors said that *Newsweek* took the findings out of context (Brooks, 1986). For example, the study did not differentiate between women who wanted to get married and those who didn't for any number of reasons. Furthermore, the terrorist angle was mere hyperbole on the part of the author, yet it struck a harsh note with many women of the time. Twenty years later, the numbers looked quite different, with about 90% of baby-boomers of both sexes either married or expected to marry (McGinn, 2006). Nonetheless, the 1985 study highlighted a growing trend on the part of professional

women to delay marriage until their educations were complete and their careers established.

Over the past few decades, the media has also bombarded women with the message that to delay childbirth may result in infertility. However, for women who choose an academic career, the tenure track often conflicts with the ideal reproductive years (Landau, 1991), leading many to opt out of childbearing completely. Whereas 33% of high-achieving women are childless at age 40, female academics have the highest professional rate of childlessness at 43% (O'Reilly, 2005). It appears that the perception of academics conflicts with the reality. As said by Hal Cohen (2002), "It would seem that a university-- with its ability to allow teachers to work from home, its paid sabbatical semester and its famously liberal thinking-- would be an ideal place to balance career and family. But by all accounts, the intense competition, the long hours and the unspoken expectations of the academy's traditionally male culture conspire to make it really, really hard to have a baby and be a professor."

For professional women who do choose to have children, is there a cost? The data suggest that there is. Correll and coworkers (2007) looked for a "motherhood penalty" in the job market. In their studies, two nearly identical application packages were prepared for the same job. The pair of fictional same-gender candidates varied only in the type of community service each had performed, with one applicant easily identifiable as a parent by participation in a parent-teacher organization. Candidates were evaluated both by laboratory subjects and by actual employers. For female applicants, "mommification" of candidates resulted in significant negative penalties, such as fewer callbacks and recommendations for lower starting salaries. In contrast, "daddification" actually benefited male candidates. The authors interpreted the motherhood penalty as arising, at least in part, from the expectation on the part of the evaluators that mothers are more apt to be distracted from their professional obligations by their families. On the other hand, cultural expectations of fathers are not incompatible with the role of "ideal worker."

Bias Avoidance

Given the motherhood penalty in the workforce, it is not surprising that academic women often employ the strategy of "bias avoidance"; that is, engaging in behaviors intended to minimize or hide intrusions of family life on academic commitments (Drago et al., 2006). Furthermore, a growing number of Americans are faced with the challenges of eldercare. Even those who never had children or now have grown children may find themselves responsible for their aging parents. Bias avoidance strategies can also be used to hide leisure activities that could be perceived as distracting from one's professional life, such as training for a marathon or rehearsing for a theatre production.

Table 1. Examples of productive and nonproductive bias avoidance behaviors (Drago et al., 2006).

Productive	Nonproductive
Delay of partnering/marriage	Hiding caregiving responsibilities
Delay of childrearing	Shirking caregiving responsibilities
Limiting the number of children	Opting out of the tenure track

Bias avoidance behaviors can be classified as either productive or nonproductive (Table 1; Drago et al., 2006). All types of bias avoidance behaviors vary in frequency across gender and less so across disciplines. Drago and coworkers studied 4,188 college faculty members from the gendered fields of English and chemistry (Drago et al., 2006). Not only are there differences in the percentages of female professors at the college level (in 1999, 60.1% of university English teachers were female compared to 19.5% in chemistry), but the environments of these departments differ considerably, with absences from a chemistry laboratory much more visible than absences from an English office. In general, women were found to engage in several bias avoidance behaviors more frequently than men (Table 2).

Table 2. Examples of bias avoidance behaviors that differ significantly across genders (Drago et al., 2006).

Behavior	Frequency in Women	Frequency in Men

Stayed single	0.161	0.102
Had fewer children than I wanted	0.255	0.126
Did not ask for a reduced teaching load when I needed it for family reasons because of possible repercussions	0.329	0.189
Delayed second child until after tenure	0.127	0.068
Did not ask to stop the tenure clock although it would have helped me	0.177	0.150
Missed some of my children's important events because I didn't want to appear uncommitted to work	0.441	0.342
Came back to worker sooner that I would have liked after the birth of a new child	0.420	0.103

Differences across disciplines included the facts that women in chemistry reported returning to work too soon after the birth of a new child more often than women in English and men in chemistry were more often partnered and parents than men in English. The atmosphere at the home institution also influenced the degree of bias avoidance behaviors, with supportive supervisors and institutions reducing the frequency. Women at teaching institutions were more likely to miss their children's important events than women at research institutions, presumably because heavier teaching loads lead to decreased flexibility. The authors conclude that greater gender equity and family-friendly policies may reduce the incidence of bias avoidance behaviors.

Increased Demands on Women Faculty in the Sciences

It is clear that science is a demanding field, with a recent study reporting that partnered science faculty at thirteen of the top research universities in the United States work for an average of almost 60 hours per week (Schiebinger and Gilmartin, 2010). While there was no difference between hours worked professionally by men (56.4 hours) and by women (56.3 hours), the authors did find differences in the amount of housework performed by each sex, with females spending about twice as much time on these tasks as their male peers. Female scientists in opposite-sex partnerships do 54%

of core household jobs in their homes, whereas partnered male scientists do just 28%. These tasks, which include grocery shopping, cooking, cleaning, and laundry, require an average of 19.3 hours per week. While males spend more time on average than females on yard and car care, home repair, and finance, these jobs are less time consuming, averaging only about 4.7 hours per week. These findings suggest that on average women scientists have greater demands on their time at home than their male counterparts.

Special Demands on Senior Women Faculty in the Sciences

While there are a number of challenges for female faculty in the sciences, there are several unique issues for those at the senior level. When this group started their academic careers, they were often the first women in their departments, and sometimes the first woman in the science division. This meant that they were frequently asked to serve on college/university committees to provide gender balance. They were often sought after more frequently than other female faculty because they could represent both the perspectives of women and of scientists. That pattern of service has continued throughout their careers. And now, even if they are no longer the only female in their department, they often feel a responsibility to protect their junior colleagues in ways that they were not protected. So, the service load continues.

That service obligation for senior faculty is not limited to their own institutions. As they become more visible, they are often asked to provide service on panel reviews, to serve on advisory boards, and to act as consultants. Upon reflection, one of the co-authors realized that she has served on twenty departmental/divisional reviews with additional ones scheduled for the fall. Again, because the pool of senior female science faculty is small, that group gets tapped more frequently than do male colleagues. Senior female professors may also feel a stronger sense of responsibility to participate in these activities because they feel that some of the activities, such as departmental reviews and advisory boards, offer an opportunity to mentor female faculty in departments in which they may have no female colleagues.

The importance of mentoring cannot be overstated, particularly for women in the sciences who are under-represented in the professoriate. The collegial network provides important information for professional success such as guidance in seeking research funding and advice for establishing a research program. That network can also serve as an important source of referrals for service on advisory boards, and female faculty who are not well-mentored can be at a disadvantage (Rosser and Taylor, 2009) The mentoring by female colleagues has been shown to provide different support for junior female colleagues than that of male colleagues. That is, women with effective female mentors feel more empowered and influential in their departments. On the other hand, male mentors are perceived as more important in supporting objective goals such as increased pay and promotion (Settles et al., 2007) Again, because the group of senior female faculty in the sciences is small, the expectation of mentoring activity falls more heavily on their shoulders.

Finally, because female scientists often put off starting a family, they are more likely to be part of the "sandwiched-generation caregivers", with responsibility for caring for both children and aging parents. This responsibility falls more heavily on the shoulders of women than men, although men are becoming responsible for a larger share of this burden than in the past (Schiebinger and Gilmartin, 2010; Hammer and Neal, 2008). One study, which focused on couples, showed elevated levels of depression for both caregiving husbands and wives, with greater levels for wives (Hammer and Neal, 2008). Female caregivers also had higher levels of absenteeism than did their husbands. The study reported that the mutual support offered by the couple was important in dealing with the stresses of caregiving. While single faculty may not be faced with the challenges of dual-care issues for children and parents, the stress of caring for aging parents without the support system of marriage can present particular challenges. These challenges are more acute for female science faculty as a group because they are more likely to be single.

Seeking Balance

Many female science professors wish to attain better balance between their personal and professional lives. In the long run, such balance is beneficial not only to the individual but also to her colleagues, students, and family members. That is, many skills that are refined through motherhood are extremely helpful in an academic setting. Examples include functioning when exhausted, multi-tasking, not sweating the small stuff, and sometimes settling for "good enough". In other words, "If you can manage enthusiasm for *Candyland*, you can manage alertness for the most petrifying committee meeting about copy machines" (Holloway, 2005). Moreover, children of scientists benefit by their mothers being able to help with most homework, being good role models in a largely male-dominated field, and having skills that can be useful in schools and with extracurricular activities.

Several tips are presented below that may be helpful for those wishing to improve the balance in their lives. First, it could be helpful to reflect on just how much chaos you can comfortably tolerate (Harvey and Herrild, 2005). Are you the type who begins projects well ahead of deadlines, or do you work better under time pressure? Do you like to have several projects going on at once, or do you prefer to complete one task before beginning another? Gaining insight into one's chaos tolerance can be useful to plan your time in your own optimal way, thereby relieving stress. High-energy individuals who thrive when they are busy may be bored when there is too little chaos in their lives, whereas those who don't like surprises may have a low tolerance for chaos. One of the authors of this paper was initially surprised to find that she had a very low "chaos coefficient" but then realized that this preference for control explained a significant amount of stress in her life. (Predictably, she began writing this paper three months before the deadline.)

Reflection on how you are spending your time versus how you would like to be spending your time can also be a useful exercise (Harvey and Herrild, 2005). For example, you might discover that you spend more time on housework than you had thought, thereby curtailing discretionary time that could be spent with your family or on a hobby. A possible solution would be to hire a cleaner. One member of our alliance was

surprised to find that reading the newspaper was actually one of her hobbies, a fact that she would not have discovered without accounting for time spent during a typical day.

Several useful tips for better integrating the personal and professional life are outlined below, with our own commentary relevant to scientists at liberal arts colleges. Many of are found within Harvey and Herrild's excellent self-help book, while others have been learned through our own combined forty-plus years of experience.

- **Prioritize.** During the semesters, teaching must come first. While class preparation can easily expand to fill all available time, grading and meeting with students are also essential tasks. Maintaining a stable teaching load by teaching the same courses as much as possible can help increase efficiency and decrease preparation time. Try not to let course preparation consume entire summers and breaks, but instead dedicate a specific amount of time to organize your course (Karukstis, 2009). Summers and breaks provide the opportunity to mentally focus on research projects in larger blocks of time than during the semesters. Research projects should therefore be given top priority when you are not teaching.

- **Get organized**. Maintain a long-term calendar in which you record class times, meetings, and important deadlines (Karukstis, 2009). Try to leave time before each class to focus. Make sure that you schedule personal time on this calendar, including time for fitness sessions, lunch, medical appointments, and whatever else your own particular needs include. That way, when someone tries to schedule you for those times, you can legitimately tell him or her that you have something on your calendar. From your calendar, create daily and weekly to-do lists. When you complete a task, you get the satisfaction of crossing it off the list. Try to spend the majority of your workday on the critical, although every academic knows that entire days can be spent putting out unforeseen fires. Part of good organization includes cleaning up your office periodically so that you spend less time finding things.

- **Turn off your email alarm.** Most of us have automatic email checking programs that alert us when mail has arrived. While diversions are often welcome during

unpleasant tasks, it is better to turn off such a program in order to focus completely on an important job like grading. It is still necessary to check email several times daily, however. We certainly expect to be able to reach students and colleagues and hear back from them in a timely manner, so we must do the same ourselves. When we do have a few minutes to devote to email, it is best to deal with any simple requests immediately, before they scroll off the screen. Remembering an email request that was not fulfilled (for example, for a letter of recommendation already written) causes stress and wastes time searching for the original request.

- **Spend the minimal time necessary on routine tasks.** Some tasks are multi-hour jobs, whereas others are ten-minute jobs. Learn to recognize the difference between them and apply your efforts accordingly. Don't spend all day on a ten-minute job!

- **Avoid unnecessary meetings.** While it is not only impossible to avoid meetings completely, but also undesirable in an environment where faculty input is so critical, don't feel the need to attend every campus forum. Again, distractions from unpleasant tasks can be welcome, but the job will still be waiting for you when you return.

- **Learn the necessary skills for your job.** Having to rely on help from others, such as informational technology or the audiovisual department, often wastes time. Learning how to create and modify your own webpages or how to troubleshoot classroom computer equipment is likely to be more efficient and less stressful in the long run.

- **Think before you say "yes."** Remember that service is a factor in tenure and promotion, but there are only 24 hours in a day (Karukstis, 2009). If you take on a major new responsibility, such as chairing a department or program, you will need to drop some other commitment. Say "yes" strategically, filling roles that will benefit from your special skills. A good rule of thumb is to wait at least a day before agreeing to a new responsibility.

- **Get good help.** Most of us have little control over who our coworkers are, but we do have control over our research students. Seek out students who have shown

their ability to work independently, perhaps by asking for referrals from laboratory instructors in the introductory courses. Time invested in training a good student early in their career will ultimately yield a higher payoff than a similar student later in their career. Furthermore, hiring good help for household tasks that yield little personal satisfaction can free up time for more important work. Indeed, outsourcing core housework such as cleaning is characteristic of highly productive science faculty (Schiebinger and Gilmartin, 2010).

- **Give up perfectionism.** One of the authors remembers spending several hours baking and decorating loon cookies for her daughter's preschool class on her birthday. While these cookies were indeed lovely, the children would undoubtedly have enjoyed a quicker recipe just as much! Perfectionists may secretly be afraid to submit grant proposals or manuscripts for fear of rejection, but you can't win the lottery if you don't buy a ticket. Learn to recognize when additional time spent fine-tuning is no longer a good investment.

- **Be creative in your assignments.** Professors can be their own worst enemies. Every assignment that a student completes must be graded. By thinking creatively about learning goals, it may be possible to design exams, homework assignments, and laboratory reports that are less time consuming to grade. For example, lab reports that are written as short "communications" not only require students to develop concise scientific writing skills but also require significantly less time to grade than a lab notebook. Using a mixed format for exams, including multiple choice and short answer problems in addition to longer problems, prepares students for standardized tests such as the MCAT and GRE while also decreasing grading time.

- **Leave the "one more thing" until tomorrow.** How many times have you been ready to leave for an appointment but then realized that you had 5 or 10 minutes to spare? While that seems like long enough to send just one more email or look up a reference, you often end up rushing off to your appointment and being late anyway. Don't try to squeeze in one more task on your way out. It is much less stressful, and more professional, to be on time than to be late.

- **Leave time for yourself.** Most of us feel that we don't have time to schedule exercise, doctor's appointments, or even haircuts during the semester. However, in order to perform our best, we need to feel our best. When was the last time you saw a college administrator who needed a haircut? Put personal time on your calendar! You deserve it.

Conclusions

Carving personal time out of a busy workday is a constant battle for science faculty, but senior women face even greater challenges to do so. Nonetheless, the creative freedom of an academic career makes it possible to set one's own priorities more so than in many other professions. Overcoming the guilt of dividing your energy between multiple life roles is an excellent first step in achieving balance. Ultimately, the most sustainable lifestyles are those that set sufficient boundaries to incorporate your own personal needs into the equation.

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Improving Professional Development and Morale for Senior Women Faculty
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Problem:

Although a sense of isolation and lack of time may be common complaints for all faculty members at primarily undergraduate institutions (PUI) these issues appear to be magnified for senior women faculty in science, technology, engineering and math (STEM) fields. There are data which show that there are fewer female full professors in STEM fields and that, at each stage of promotion, the number of women decreases ("leaky pipeline"). As a result, the role that mid-to-late-career women play in these disciplines is underestimated or ignored, since there are few (if any) role models. As senior women faculty, we have successfully navigated previous hurdles to achieve success through tenure and promotion committees, and frequently have achieved career satisfaction outside our institution (for example, through professional societies), but we do not feel as valued and respected members of *our* institutions. Since most of us have been at the same institution since starting our academic careers, these issues can frequently create stress, anxiety and apprehension. We also recognize that increasingly data show that gender discrimination often exhibits itself in subtle ways that are difficult to identify. This paper addresses these concerns by seeking answers to the following questions: Are there inequities in salary and promotion between male and female faculty members? Are there any institutional and cultural factors that contribute to these effects? Is faculty time used and abused by increasing administrative or college service responsibilities? Can our institutions help us in overcoming these mid to late career crises in job satisfaction? This document lists some existing faculty development resources and suggests ways that institutions and individuals might formulate solutions that address these concerns; implementing some of these suggestions frequently can assist all mid to late career faculty.

What is in place? Faculty development resources at PUI Institutions.
Quite simply, most of the programs in place address issues facing new faculty members.

What is not being done at most PUI institutions?
- There are no or few faculty development resources for mid-career and senior faculty.
- PUIs tend to hire single individuals in a research program; few professional, informal conversations with faculty colleagues occur; there is little time for casual conversations, and frequently no good space for casual meetings. These lead to isolation. Many times, departments that teach required introductory courses for pre-medical programs are over-subscribed and their faculty members overworked with large introductory lecture and sections. Our lives are overrun by our students and although many of us enjoy this interaction and is a major reason why we are at PUIs in the first place, conversation among one's peers is also important in setting a civilizing tone to departmental affairs.
- In some cases, our home departments have not been supportive of the women on the faculty. In all cases, our ascent to full professor was not straightforward.
- Senior Administration and public relations staff members are selective in who gets featured in alumni magazines, web site narratives and who are chosen for alumni trips or fundraising

events.   At a humanities oriented PUI, the physical sciences sometimes are treated differently than other disciplines. Some of us have found our already small departments merging with others or disappearing.

- The cultural perception of older women is not the same as for our male colleagues who were/are seen as "wise" academics and are taken seriously; as they get older, they are rewarded and respected. Meanwhile, the younger faculty members have a newer set of professional skills and get featured for their "extraordinary" accomplishments, when compared to their more senior colleagues. Senior women are usually neither celebrated for their wisdom or for professional skills. Therefore, although we all have achieved some professional, college or university wide recognition (endowed chairs, teaching awards, research awards), we feel *undervalued* for our contributions to our institutions and department.

    Our generation of women seems to be caught "in-between" the older, mostly male, faculty that came before us and the younger, more assertive, faculty who expect (and get) more advantages (lower teaching loads, mentoring and teaching workshops for new faculty) and who promote themselves in a manner that we do not do very well.

- As a result of the length of our careers (20+ years) at the same institution and with many of the same department members, we may experience anxiety and feelings of isolation within our departments and in our institution. We therefore accepted our NSF ADVANCE supported mentoring activities with enthusiasm and, in the process, we created a close bond amongst ourselves.

- When the administration does not promote values that reward unity and equity, the workplace can result in a competitive atmosphere complete with feelings of dread and uneasiness; it fosters the formation of exclusive groups and general division. In an academic environment, not "being in the know" can lead to lack of confidence.

Effects of Good Administration vs. Effects of Bad Administration

A visual representation of the impact these issues have on senior faculty can be seen in frescoes that cover the walls of the 700-year old city council meeting room (the *Sala dei Nove* in the *Palazzo Pubblico*) in Siena, Italy. These frescoes painted by Ambrogio Lorenzetti in the early 1300s, illustrate and contrast the "*Effects of Good Government*" and "*Effects of Bad Government*". These outcomes are similar to those emanating from a good administration/workplace and a bad administration/workplace.

In the *Good Government* panel, the leaders foster a sense of justice and equality; everyone is striving towards a common goal, and all are appreciated for the work they contribute. The results are evident: buildings are taken care of; people are dressed well; there is time for work and for enjoyment. In one scene, the ruler is "tied" by a long rope to the citizens.

Effects of Good Government, Ambrogio Lorenzetti, 1330's. Siena, Palazzo Pubblico. Sala dei Nove**.** Image from *http://www.wga.hu/frames-e.html?/html/l/lorenzet/ambrogio/governme/index.html*

In the Bad Government panel, greed, pride and personal achievement drive the leaders; this type of leadership results in divisions and factions. A woman saws herself in half to symbolize division; buildings are falling apart and people look desperate and unhappy; there is discontent and violence.

Effects of Bad Government, Ambrogio Lorenzetti, 1330's. Siena, Palazzo Pubblico. Sala dei Nove. Image from *http://www.wga.hu/frames-e.html?/html/l/lorenzet/ambrogio/governme/index.html*

Peer Mentoring - Our Solution:

Our first Mellon grant initiated by Kerry Karukstis, and followed by our NSF Advance grant has sought to remedy these deficiencies by creating a network of female full professors in chemistry and extending our "community" to similar women at PUIs. Our peer mentoring system provides the validation we need for job satisfaction but that we do not receive from our own department or institution.

As a result of this, we have
(1) conference calls two or three times a month where besides talking about grant-related material, we listen to each other's life experiences ; we ask questions, and learn from our own career trajectories and experiences.
(2) exchanged each other's institutional practices and this has helped us to see different ways of potentially changing stagnant workplace practices.

(3) acted as an "advisory board" to some important career decisions that we needed to make   (a) applying for some senior administrative positions (b) asking for salary increase when hired as industrial consultant (c) advice on promotion and tenure decisions (d) teaching tips, etc. (e) discussions of how to deal with difficult colleagues, etc.

(4) collectively seen each other through life events; some were happy, while others were more challenging moments in our lives dealing with close relationships, medical, family issues.

Remedies – individual responsibility: speak out!

- "… there should be <u>less silence in the face of discrimination</u>. Academic leadership has a particular responsibility to speak out, but we all share this responsibility. *It takes minimal effort to send a brief message to the relevant authority when you note a lack of diversity in an organization or an act of discrimination. I don't know why more women don't speak out about sexism at their institutions, but I do know that they are often reluctant, even when they have the security of a tenured faculty position."* From **Does gender matter? Ben Barres, Nature v. 442, 13 July 2006, p133-136.**

- *Suggested Reading: **Challenges of the Faculty Career for Women: Success and Sacrifice*** by Maike Ingrid Philipsen. Jossey-Bass: San Francisco, 2008. 368 pp. ISBN 978-0470257005 (cloth); reviewed by Cheryl Baldwin Frech in *J. Chem Ed.* Vol. 87 No. 4 April 2010, p370, DOI: 10.1021/ed8001418. In the book review, the author describes different academic institutions (PUI, Research institutions, historically black institutions, etc.) and suggests that every institution should have an "Office of Family Issues" to assist and support people in diverse life situations and stages.

Remedies - Institutional appreciation for senior faculty; increase faculty morale; boost confidence and respect of senior faculty members. *<u>Senior faculty members have more of a stake in the institution than most of the senior officers, who increasingly leave an institution within 10 years.</u>*

- *Suggested Reading:* "Furthermore, we must devise strategies that consider faculty needs over an entire academic career and that are based on the synergetic interrelationship between faculty and an institution. The dual commitment of both faculty and an institution to the goal of excellence through the pursuit of high-quality, sustained undergraduate research will ultimately produce the most successful results." In "**Sustaining Research Productivity throughout an Academic Career: Recommendations for An Integrated and Comprehensive Approach"** Kerry K. Karukstis, Professor of Chemistry, Harvey Mudd College

- *Suggested Reading: **Keeping senior women at your college"*** http://aaup.org/AAUP/pubsres/academe/2009/SO/Feat/Hurt.htm
  Summary: When senior women are satisfied with relationships with senior administrators and other faculty members at their institutions, they are happier and consider leaving the institution less.
  Remedy: Keep morale high. Foster relationships between senior administrators and senior women; also foster relationships among senior women faculty. Foster shared decision making; for example, cuts in academic courses need to be done in consultation. Health, retirement

benefits and faculty office and lab space are important. Increase administrative or clerical help. Equity in teaching loads, course assignments.

- *Suggested Reading:* **Why so Few? Women in Science, Technology, Engineering, and Mathematics**.   http://www.aauw.org/learn/research/whysofew.cfm
  Summary: The climate of science and engineering departments at colleges and universities is especially important for women—both students and faculty. Bias, often unconscious, limits women's progress in scientific and engineering fields. Simple steps such as learning more about female scientists and engineers, and having positive images of women in science in your office and classrooms can help "reset" your biases. (http://www.aauw.org/learn/research/whysofew.cfm)
- Host a series of faculty research seminars; intersperse junior and senior faculty members.
- Since Faculty development workshops are aimed primarily at new faculty, host a series of faculty development workshops for senior faculty with special events for senior women faculty. Recognizing that frequently as a mid-to-late-career faculty member, one is asked to participate in leadership roles, the administration could initiate leadership seminars where faculty are taught how to lead groups and departments. This should include highlighting different leadership styles, how to have difficult conversations and how to promote oneself. Other topics might include how to teach an interdisciplinary course; how to deal with/improve course teaching evaluations; how to deal with changing student expectations; how to move into administrative roles; effective practices for administrators.
- Institutional officers need to clarify expectations of faculty performance for promotion, salary reviews. Make contributions to "life" of college important component of performance reviews.
- Increase opportunities for senior faculty to be involved with administrative decision-making.
- Senior officers should make an effort to get to know senior faculty. (example: Dean Of Faculty has been at Vassar two years, the President for 3 years. No effort on part of "senior officers" to systematically get to know all the senior faculty has occurred.)
- Our PUIs should remember what Honolulu Community College states:

Honolulu Community College considers the faculty to be one of its greatest assets. A program of faculty development is therefore dedicated to aggressively supporting the ongoing personal and professional growth of all faculty. By providing information, training, forums, connections, and other support services and activities, the program vitalizes the faculty, strengthens the college, improves the quality of instruction, and helps the college better serve the community. 😊

Bibliography and Resources:

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http://honolulu.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/teachtip.htm
http://teachingtips.fullerton.edu/
http://fod.msu.edu/

2. Women in Cell Biology Committee Newsletter
http://www.ascb.org/index.php?option=com_content&view=article&id=86&Itemid=12
They have hundreds of topics on diverse aspects that women in science face at a variety of career stages. Among these are:
"Sustaining Women through Critical Career Transitions (Nov 2008);

"Female Behavior Is Often Unrecognized As Leader Behavior "(June 2007);
"Owning Your Own Career" (June 2009).
http://www.ascb.org/index.php?option=com_content&view=article&id=177&Itemid=296

3. *Sustaining Research Productivity throughout an Academic Career: Recommendations for An Integrated and Comprehensive Approach.* **Kerry K. Karukstis, Professor of Chemistry, Harvey Mudd College.** White Papers written in support of the Undergraduate Research Summit (August 2-4, 2003), Bates College http://www.bates.edu/x50818.xml

4. *Does gender matter?* **Ben Barres,** *Nature* **v. 442, 13 July 2006, p133-136.**
http://www.nature.com/nature/journal/v442/n7099/pdf/442133a.pdf

5. *Challenges of the Faculty Career for Women: Success and Sacrifice* by Maike Ingrid Philipsen. Jossey-Bass: San Francisco, 2008. 368 pp. ISBN 978-0470257005 (cloth)

6. *Why So Few? Women in Science, Technology, Engineering, and Mathematics.*
http://www.aauw.org/learn/research/whysofew.cfm

Leadership Support for Women Faculty Members in Science, Technology, Engineering and Mathematics (STEM) Disciplines at Liberal Arts Colleges (LAC): Perspectives on Practices, Policies and Infrastructure Related to the Position of Department Chair

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Overview

One of the most logical and straightforward ways to provide leadership opportunities for women in STEM disciplines at liberal arts colleges is to consider them for the position of department chair. On many campuses the department chair position has a fixed term and is reviewed on a periodic cycle providing regular opportunities for the administrative leadership to consider senior women faculty members as chairs of their departments. Appointing women scientists to these important positions provides women faculty with new challenges and gives them visibility and credibility among peers and students. Additionally, these senior women then serve as a more prominent role model for junior colleagues, staff and students.

However, women may be reluctant to accept such positions if they feel a support structure to succeed in these positions is lacking or they struggle to find balance among the three aspects of a faculty career (teaching, research and service) and their personal life. If administrations are serious about increasing the diversity of perspectives at the table then advancing women and minorities is something administrators should take seriously. Potential concerns about the skill set needed for the position are easily remedied given the preponderance of workshops for department chairs and academic leaders offered.

Additionally, if senior women are interested in new challenges and in further facilitating the advancement of women scientists, then the chair's position provides opportunities that senior women scientists should consider.

This white paper highlights practices, policies and infrastructure that helps women scientists as leaders, particularly with regard to the role of department chair, and suggests ways that department chairs can perform their duties with an eye to supporting the leadership of women scientists.

Support Structures for Potential Chairs

Training

What has been said about female friendly pedagogy[i] can also be said about the position of chair, e.g., what's good for women chairs is good for all chairs. Institutions should put chair training in place, training that not only covers the nuts and bolts aspect of the position but also covers more difficult managerial challenges.

The nuts and bolts aspects of the position can be covered in a workshop ranging from half-day to two full days in length. Most institutions with such programs tend to organize these workshops in those extremely busy, meeting filled days just before the start of the semester. While there is no perfect time, the workshop would be more effective with significant lead-time before the semester begins, ideally before next year's entering class begins calling with questions. Earlier timing allows new chairs the opportunity to process the impact of the position on their other professional activities and put plans in place that will allow them to maintain balance on a daily basis.

In these workshops, the academic calendar from the perspective of activities of the chair should be emphasized. Important topics include everything from when the chair needs to submit the schedule of classes and annual budget, to when staff performance evaluations are conducted. Particular attention should be paid to those items that an individual faculty member without these managerial and administrative obligations may not have noticed in the past. Certainly, no introductory chair training would be complete without an overview that as a chair, an individual represents the institution in an official capacity. Accompanying this beginning of the term training should be a Chair's Handbook specific to the institution, with summary schedules, templates for various types of reporting, and a "whom to contact about what" relevant to department chair responsibilities. Templates for various reporting tasks are huge time savers both to department chairs and to the administrators that receive the resulting report.

During the school year, on-going leadership development workshops focused toward the needs of a chair and other academic leaders can provide important on-going support. In addition to imparting specific skills, these workshops provide a forum for chairs to regularly get together and discuss issues and strategies to address them. Because time is a premium, any more than once a month would be too often, and perhaps just twice a semester is more realistic. Topics could include the obvious: dealing with difficult colleagues or how to keep vision and forward momentum in the department when everyone feels they are barely treading water. Less obvious topics but equally valuable ones include: the University budget process from multiple perspectives and creating a professional community among department peers. Deans and provosts probably get more realistic budgets from departments when chairs understand the bigger pressures on university budgets. For example, depending on the institution, potential department chairs may not be aware of the fact that most university budgets are more than 50% salary and benefits, or that budgets derive from specific formulas related to the performance of the endowment.

Institutions with established programs for getting department chairs up to speed on the new set of skills required of them, give these individuals confidence to accept roles having greater responsibility, knowing they aren't on their own to learn the job and deal with its challenges.

In addition to providing on-campus opportunities that are typically heavily tailored to the specifics of the campus, administrations should offer chairs the opportunity to attend

chair workshops or other leadership institutes appropriate for the chair's role. These professional development workshops should come out of the dean's or provost's budget and not out of the chair's discretionary or travel funds. Project Kaleidoscope (www.pkal.org) has a particularly effective Leadership Institute for STEM faculty. Higher Education Resource Services (HERS) has an institute for Women in Higher Education Administration (hersnet.org/index.asp). The American Conference of Academic Deans (ACAD) also regularly organizes workshops for department chairs. Institutional associations such as the Great Lakes College Association (GLCA) also have leadership institutions particularly focused on liberal arts colleges.

Resources
Institutions should make sure that the chair role comes with the resources to do the job effectively. Most obviously, this means professional time. Typically, this time comes by reducing the teaching load for the department chair. Department chairs should not have to choose between maintaining a scholarly focus and providing this important service need to the department and institution. Neither should chairs' personal lives have to inordinately suffer because of the chair role. Certainly, there will be the occasional university function outside traditional business hours that requires the chair and takes them away from friends and family but the chair shouldn't feel an impossible tension between the leadership position and their personal time. A simple solution is allowing chairs to distribute some of those necessary events to other department members.

If teaching load reduction simply isn't possible given institutional constraints, then negotiation between the prospective chair and administration should take place to outline what other duties can be off-loaded. Some have negotiated with their administrations to reduce their research expectations or other service obligations. After a potential chair is satisfied with the administrations' position it would be valuable to have a discussion with department members, particularly, if the agreed upon reallocation of labor would conflict with the departmental culture in some way. For example, perhaps someone negotiated reduced research expectations but the department had a strong research culture. Or perhaps, the department took pride in their commitment to service on university wide committees and the potential chair negotiated not to serve on major committees. By discussing the approved reallocation of responsibilities, explaining to department members the reallocation is temporary and needed for smooth functioning of the department helps department members understand the potential chair's reordering of priorities and reduces future friction.

In addition to appropriate professional time, chairs need appropriate administrative and technical support. First and foremost the departmental or division secretary must be an effective member of the administrative team. Competent administrative assistants are extremely valuable to chairs, particularly new chairs. Additionally, science departments often have technical support needs. Administrations that are serious about supporting their department chairs will work collaboratively and creatively with departments to help provide adequate support given institutional resources. If it is not feasible to have technical support for every department individually, institutions should think about

whether there are effective ways to provide support by creating positions that serve multiple departments. An instrument technician might reasonably serve both physics and chemistry. One of the institution's IT specialists focusing on all the sciences might provide a reasonable compromise that simplifies this aspect of the chair role for these science department chairs.

Deans or provosts should regularly provide department chairs developmental reading materials. Those materials might be specific to the role of being department chair but might also provide chairs with resources about best practices related to the many functions, like assessment or broadening participation that chairs must facilitate. In addition the institution should have a place for faculty development resources with more titles on each topic that chairs might peruse and borrow as needed. A chair whose department is undergoing a self-study might have different resource needs than a chair whose department has several hires in the coming year. The biggest challenge to any chair is finding good reference material outside their area of professional expertise, largely because time is of the essence and many academics have not been trained as managers or team leaders.

Of course, it goes without saying that appropriate budgetary support is critical to a department chair's success, particularly, in the sciences. Unfortunately, science is expensive and the expendable costs are non-trivial. Department chairs that must spend significant time stretching available resources at the pennies level will have less time to cultivate their departments in more esoteric but often visionary ways.

Other practical resources that are often overlooked include access to university counsel if needed and open communication between the dean or provost and department chairs. Also in many institutions resources that support the chair working closely with development offices to identify donors or granting agencies can pay off by providing funding for expensive equipment.

Policies
Institutions with clear written policies spanning obvious personnel topics, family leave, harassment, conflict of interest, etc., to those that define the institution's values provide support structures that help all campus leaders, particularly women. Unfortunately, it is well documented that individuals challenge women in a position of authority more often than men.[ii,iii] Having clear institutional policies that women can turn to when challenged, make it easier for women to accept positions where their decisions may regularly be challenged by anyone whose request a chair did not or may not be able to accommodate.

Also, the existence of these policies sets a tone about what the institution values and allows women considering accepting leadership positions to decide whether they are comfortable upholding and representing the institution's values or perhaps current initiatives. This is particularly true for new initiatives that evolve and change. For example, currently, many institutions are reexamining their level of commitment to environmentally sustaining practices, disaster preparedness or even global citizenship.

Having written reference reports on these topics (foci) helps department chairs support these initiatives with their constituencies, e.g., students, support staff and faculty.

Feedback
Just as faculty members need periodic feedback about the quality of their work and their effectiveness in their role, so do department chairs. As mentioned earlier, many institutions have a term length for the department chairs, and can provide a regular checkpoint on how things are going. It is important that institutions have well-defined mechanisms for acquiring feedback about the chair's effectiveness and processes for sharing that feedback that protects both the chair and those the chair manages. An untenured faculty member feeling abused by a chair is unlikely to speak up if they fear their concerns will come back to haunt them. Additionally, chair can often be a thankless job, so chair reviews that simply provide a chair with a list of all the decisions someone disliked is unlikely to help a chair improve or endear individuals to agree to serve.

One particular effective system is having the promotion and tenure committee or similarly constructed elected committee, complete individual interviews with department members, then discuss the feedback, and provides summary recommendations for the dean or provost to share with the chair. These summaries are constructed to protect the identities of those who commented and have considered the context in which the chair must operate.

Ways in which Chairs Provide Support
On the other side of things, one reason women scientists should consider accepting the leadership role of a chair is the ability to facilitate a department that is female friendly to both colleagues and students. Surprisingly, this may not be as easy as it sounds. Women whose careers have been in less friendly departments may have a list of things not to do but do not yet feel confident in things they ought to do.

Communication
The single most important factor in being a successful chair is communication. This includes really listening to department members and understanding individually what each faculty member needs (within reason) to be successful and understanding what creates professional stress for colleagues.

Communication takes many forms. Chairs need to be open about how decisions are made and what resources exist. Other aspects of communication include making sure departmental policies are well documented. It speaks volumes about what the department values and provides a fall back when information is not well received. Assuming that everyone knows or remembers what was decided in the past doesn't take into account individuals who arrived in the department after a decision was made, were on sabbatical when the issue was discussed or simply forgot because the issue didn't affect them at the time of the decision.

Listening to department members isn't sufficient. Acting is also important. The chair's role is to advocate for resources that department and the members of the department need to be successful. Being sympathetic about the need to have the -80°C freezer on back-up power isn't nearly as effective as working with physical plant to make that happen. Thinking creatively to achieve solutions to stresses reported can also make a more personal and friendly department. While it is tempting to schedule meetings just for the chair's convenience, listening to challenges of department members is critical. If the local environment, makes late afternoon childcare difficult then avoiding late afternoon meetings is an easy solution that can make a surprising difference.

Working with department members regarding their teaching schedules is not necessarily difficult and can make department members increasingly productive and willing to be cooperative on other issues. Simply asking what teaching schedules individuals prefer, asking them to prioritize individual details and agreeing, within the constraints of departmental needs, to try to accommodate those preferences is the first step. Then as the semester teaching schedule is put together, trying to accommodate at least one preference for everyone. It is important not to judge reasons for preferences. One individual may have family care issues that impact preference and someone else may have a major professional project that causes them to prefer a particular assignment. A chair committed to a person friendly department recognizes that both are important and difficult to the rank the importance of one need versus the other. Person friendly may be a term that more colleagues value because it recognizes the needs of every individual whereas to some family friendly may imply the only focus is on meeting the needs of those individuals with children.

Flexibility
Beyond flexibility with regard to teaching schedules and meetings, chairs that remember to be open to new ideas and approaches, are likely to be more successful. Without intending to, scientists, who often value structure and organization, can forget to be creative. While it is a chair's responsibility to think through the what ifs and why something might not be possible, it is important not to voice those thought processes so early as to sound discouraging. Before saying why something may not be possible chairs should try to get excited about the benefits of what if it could happen.

Mentoring
Another important role chairs' play is that of mentor, particularly, but not exclusively, to junior colleagues. Entire white papers, articles and books describe the importance of mentoring and how to be an effective mentor.[iv] In short, mentoring is about providing advice or perspective and that requires being honest with colleagues. Most of the time mentoring is fun. One can help colleagues learn about opportunities and resources. One can help colleagues avoid pitfalls. Sometimes it requires hard conversations, diplomatically and developmentally helping colleagues learn why their activities are not measuring up to the standard required of a faculty member.

Organization

An important way chairs are successful is by being organized and tackling chair tasks well in advance of deadlines; administrative assistants can be particularly helpful in this regard. Often many aspects of chair tasks can be delegated to support staff. For example, an administrative assistant can be acquire data for departmental reports, draft possible schedules of classes that meet a list of criteria provided by the chair, keep departmental records current, etc.

It is important to remember that many chair tasks require input from a variety of constituencies and administrative offices. Therefore starting on these tasks early provides an opportunity to get necessary records and materials. Additionally, it gives department chairs the opportunity to make requests of others and give them a reasonable time line for task completion. It is important to give individuals a deadline and have them understand why the deadline is necessary.

The other managerial task where organization and planning is essential is the departmental budget. There are as many approaches to allocation of resources as there are resources, the key lies in documentation. When creating the budget calculations that justify particular needs must be easily reconstructed or documented in department files. Promises need to be recorded in writing. Planning to make sure resources last throughout the year is critical. During the year, monitor spending and make sure no budget category is out of line with resources. Unfortunately, with some University accounting systems, this may require keeping a second set of books that are organized based on departmental spending needs rather than university wide categories. Depending on the lag in institutional accounting systems this may also provide more up to date information critical in the last months of the fiscal year. Again, administrative support staff can be helpful in maintaining these records and alerting chairs when categories hit critical levels.

Seeking Resources
Just as administrators should regularly provide chairs with faculty development resources, chairs shouldn't hesitate to seek those resources out on their own. Just as a scientist seeks references and educates themselves about new topics as they engage their research and teaching, so should they be in such an important service role. A great place to start is the American Council on Education and their resources for department chairs (www.acenet.edu/resources/chairs). Publisher Jossey-Bass has an extensive list of higher education publications. ACE/Oryz Press' *Chairing the Academic Department* by Allan Tucker is practical book worth considering.

Given that student-faculty collaborative research is part of the culture in STEM disciplines, the Council on Undergraduate Research (CUR, www.cur.org) is another useful organization of particular value to science department chairs.

Leading Ethically
As individuals put together their personal style and approach to the chair's role, it is important that leading ethically remains forefront in their mind. If chairs decisions can

be explained ethically, the ways in which negative individuals can sabotage their leadership will be minimized.

Overarching suggestions
First, keep in mind, senior administrators change, sometimes unexpectedly. Make sure all promises from the administration are documented in writing. After a meeting/negotiation with the dean or provost follow-up with an email outlining your understanding of the resources promised or decisions made, whether specific to your personal role as chair or something for the department. Ask for confirmation from the provost or dean and be sure to keep track of that correspondence.

Second, remember that generally when chairs turn situations into win-win scenarios, they are likely to be viewed as successful administrators.

Closing thoughts
The role of department chair is critical and central to the health of a department and the institution. While often considered a thankless task, individuals may find the position rewarding because the impact of decisions made by the chair can result in a positive experience for our students and colleagues. Additionally, it provides an opportunity to lead the department in directions individuals value and find important.

However, no one should have to undertake challenging administrative roles without appropriate support. Universities can do much to provide on-going support. As mentioned earlier, many of the policies and strategies that make the chair position more attractive to senior women scientists positively serve all department chairs. Institutions that make faculty members who serve as chair feel respected and valued for their contributions are positive places to work.

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THE CHRONICLE OF HIGHER EDUCATION

Commentary

Women in Science, Beyond the Research University: Overlooked and Undervalued

By KERRY K. KARUKSTIS

The underrepresentation of women in almost all science and engineering fields is a well-documented statistic. The National Academies have issued four significant reports since 2001 examining the status and challenges of women in academic science and engineering and offering recommendations to broaden the participation and advancement of women in those fields. It released its most recent report, "Gender Differences at Critical Transitions in the Careers of Science, Engineering, and Mathematics Faculty," last month following a study mandated by Congress.

While those prominent studies focus attention and resources on an important issue, much of the emphasis is on those institutions described as Research I universities, using the former designations of the Carnegie classification system of institutions of higher education. Universities with less-extensive levels of research support, such as master's (comprehensive) universities and undergraduate liberal-arts colleges, are widely overlooked.

The primary consideration of Research I campuses might initially appear logical. The importance of basic research science to the American economy as well as the substantial amount of federal support for research on Research I campuses are compelling reasons for gender-equity studies focused on those institutions. The large student enrollments and faculty sizes of Ph.D.-granting institutions further justify making those campuses the focal point of efforts to improve the status of female scientists and engineers. Certainly any issues associated with a given institutional type are also best dealt with through analyses that concentrate on similar populations.

But overlooking other institutions of higher education is shortsighted and potentially harmful to the American scientific enterprise.

The belief that gender disparities are most likely to occur at research universities is itself questionable. The quantitative analysis provided by the American Association of University Professors in the "AAUP Faculty Gender Equity Indicators 2006" report demonstrates conclusively that, even using only a basic assessment of equity in terms of employment, salary, and rank, academic women face gender inequities and challenges at all career stages and at all types of institutions, including non-research-intensive campuses. In fact, seemingly exclusive attention to the challenges of one type of institution may serve to minimize the critical situation at other institution types and even suggest the existence of gender equality.

For example, data in a 2008 report of the National Science Foundation, "Thirty-Three Years of Women in S&E Faculty Positions," indicate that women with science backgrounds at research-intensive institutions have reached percentages at the full-professor level comparable to female scientists at liberal-arts colleges. But such parity was achieved only as the percentage of female scientists at the full-professor level at liberal-arts colleges stagnated (16.9 percent, 16.2 percent, and 15.8 percent in 1999, 2001, and 2003, respectively) while the percentage of female full professors at research institutions rose significantly (11.2 percent in 1999, 13.4 percent in 2001, and 15.6 percent in 2003). Those trends will need to be further examined when more current data are available.

Three immediate suggestions come to mind to better balance the assessment of the status of female scientists and engineers in academe. A key first step is for the programs, professional societies, and organizations that deal with aspects of academic culture and institutional structure that may affect female science and engineering professors to continue and expand their financial support. The Advance program of the National Science Foundation is an outstanding example of a vital program that seeks to develop systemic approaches to increase the representation and advancement of women in academic science, technology, engineering, and mathematics careers. A second suggestion is to commission separate studies of gender-equity issues for each type of postsecondary institution. Finally, as research studies, panels, conferences, and other committees of experts are assembled to examine the challenges and successes of academic women in science and engineering, organizing bodies should seek inclusion of people from all institutional types.

Additional mechanisms for determining potential experts to analyze the status of academic women in science and engineering, especially in liberal-arts colleges, should be pursued, including surveying college and university administrators for suggestions of leading female faculty members in science and engineering, and tapping the database of Advance grant recipients. For example, the female full professors in chemistry and physics at 20 distinct liberal-arts colleges who participate in the project "Collaborative Research for Horizontal Mentoring Alliances" are one group with experience in promoting the leadership and visibility of women in science and engineering. That project, for which I am principal investigator, involves the formation of five-member alliances of senior female faculty

members at different liberal-arts institutions to test a mentorship strategy that tries to enhance the advancement of academic women in science and engineering careers. Many other talented and extraordinary female scientists and engineers beyond the research university are also available to contribute.

Let's use all of our resources to improve the future of the scientific and technological enterprise and enhance America's global competitiveness.

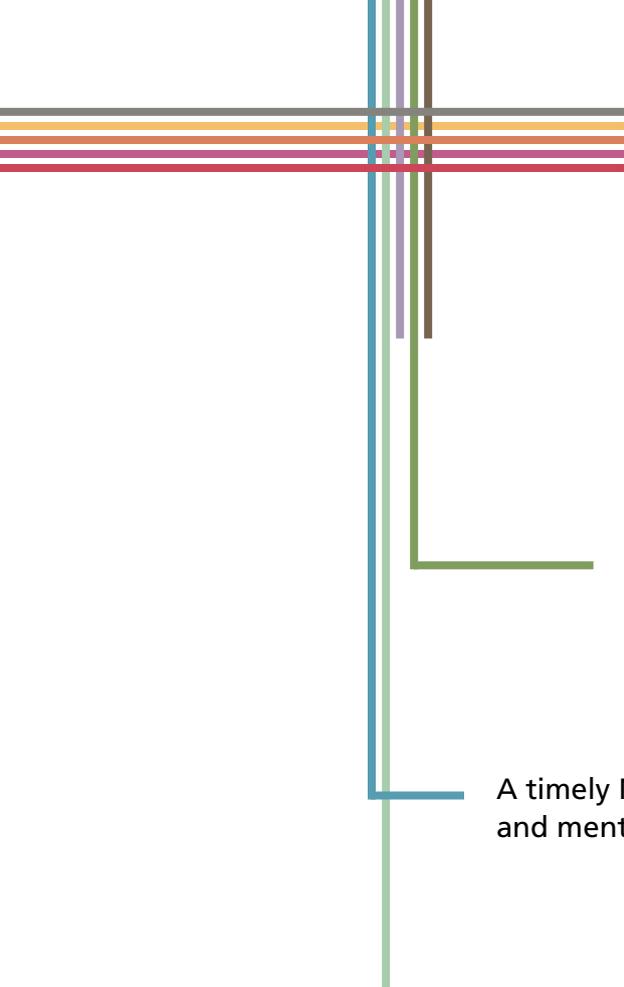*Kerry K. Karukstis is a professor of chemistry at Harvey Mudd College.*

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Strength in Numbers

A timely NSF grant helps women scientists discover the value of networking and mentoring to their careers — and their lives.

AT VARIOUS POINTS IN YOUR CAREER YOU may find that you need to ask someone how best to proceed. The questions may be about job expectations, project management, personnel problems, or how to obtain necessary resources.

When you start a new job you face many unknowns, and having someone to provide guidance or advice is critical to success. In many instances a formal mentoring system can help, but often informal interactions between colleagues provide even greater insights into how an organization works and how to progress in that organization.

As your career advances, if you are fortunate, you find colleagues with whom you can talk freely about any topic — people who have similar backgrounds and interests and talk the same language that you do.

In my case those colleagues turned out to be a group of four other women chemists scattered across the country.

In 2004 Kerry Karukstis, a chemist from Harvey Mudd College in California, asked if I would like to be part of a career development initiative to be sponsored by the Andrew W. Mellon Foundation. The project would focus on providing opportunities and resources for women chemists at liberal arts institutions to explore the next phase of their careers

and determine how they could contribute the most to their institutions.

Surprisingly, only five of us in the targeted Mellon cluster of eight colleges had achieved the rank of professor, and several of us were still the only woman ever in a tenured or tenure track position in our departments. In most cases we were the first women faculty hired at our institutions in departments with few, if any, female role models.

I agreed to participate. But I could hardly have anticipated that suddenly I would have access to the most amazing resources of my academic life.

As the members of our group became acquainted, we began to reflect on our careers — past, present and future. Working with a career counselor, we began to develop goals based on our individual strengths, and to establish steps to achieve these goals.

One of the most valuable aspects of the Mellon project has been the opportunity to sit and talk with women chemists about issues that each of us have faced in our professional and personal lives, such as sexism, equal pay, and balancing work and family. Having a group with whom to share opinions and ideas has made our professional lives more rewarding.

BY LAURA WRIGHT

Because we now know each other so well, we can recognize when someone is about to pass up an opportunity that is a perfect match for her abilities — or commit to a project that does not fit her career aspirations or personal interests. We serve as an informal check and balance system for each other.

It didn't take long for us to realize that women scientists at other liberal arts colleges could benefit from similar opportunities. Four of us decided to submit a proposal to the National Science Foundation's ADVANCE Program that would allow us to further explore how our mentoring project could be adapted for others. When word came that we had received $500,000 to support our proposal, we were ecstatic — and a bit awed by the responsibility to investigate whether our model would work with other women at similar stages in their careers.

THE UNDERLYING GOAL OF OUR ONGOING
project is to promote the advancement of senior women science faculty at liberal arts institutions to the highest ranks of academic leadership. Five-member mentoring alliances, representing institutions across the country, engage in discussions and workshops about career and leadership development.

While there have been many studies of the needs of women scientists at research institutions, no studies have focused on the environment they face in the liberal arts setting. The NSF was interested in evaluating our group's strategy, as well as in seeing whether it would be of value in disciplines other than chemistry. With this in mind, we established three new alliances, two comprised of chemists and one of physicists. These alliances are working to enhance the leadership, visibility and recognition of the participating faculty members.

We are now completing the third year of the NSF project, and its impact is evident.

One woman, seeking an opportunity to use her leadership and administrative skills, accepted her colleagues' nomination and subsequent invitation from her institution to serve as department chair. A second gained the confidence to write a research proposal that was funded by the NSF. Another raised the intensity, scope and visibility of her contributions to a national professional organization to the point that she was elected the group's president.

Two participants recently were appointed to endowed chairs in their departments; one was the first woman to be awarded an endowed chair in her institution's science division. Another woman received a prestigious endowed research chair at her university, and yet another was named Professor of the Year for her state.

These women used the professional skills they had identified during our project's workshops to increase their visibility on their home campuses. They had always been worthy of these types of awards, but they had just assumed people would know it. Taken individually, each is a major accomplishment in a career. As a group, they show that a network of horizontal mentors who provide support and encouragement can produce positive results.

I presented some of our initial findings at the 2008 Southeast Regional meeting of the American Chemical Society. Many women dropped by to hear about the project and to ask how we had gotten started — and how they could become involved.

The first part of their question was easy to answer; the second, more difficult. The NSF grant supports only the initial group of 20 participants. Judging by the number of women who expressed interest, it is clear that many need guidance on how to advance their careers. And it isn't just women at liberal arts schools. I spoke with women at large state universities and at technical colleges, all of whom would benefit from access to an alliance.

The most unexpected encounter I had came toward the end of my presentation. A man had been standing in the background listening as I talked with two women. When we finished, he stepped forward and began to describe his own informal alliance.

A number of years earlier, he said, he had developed health problems that precluded him from continuing to direct a traditional graduate research lab at his university. He had looked around for a new way to contribute to the discipline and realized that he could do research in chemical education pedagogy. Although no one on his campus focused on the same area, he was able to find a group of four chemists doing similar work at other institutions who were also looking for a peer group with which to share ideas and concerns.

As he talked, I realized that any time an individual, man or woman, is working in isolation, there is a need for some type of support network. This man from a major research institution was so excited about our project that he was considering adding a new monthly column to a journal about chemical education to showcase strategies for career development.

Our project has provided a lifeline for senior women scientists at liberal arts colleges. But others, in different disciplines and professions, are seeking the same thing. Our project can perhaps serve as a model for them to emulate.

Being part of a mentoring alliance can become an amazing resource to help you find a better way forward in your career. And you might just end up with some of the best friends of your life!

The author has taught chemistry at Furman since 1983. She received the 2008-09 Alester G. Furman, Jr., and Janie Earle Furman Award for Meritorious Teaching.

On the following pages, four alumnae/academics offer their perspectives on mentoring in their professional journeys.

Finding the right path

I COMMEND THE EFFORTS OF LAURA WRIGHT and her colleagues in establishing the NSF ADVANCE mentoring alliance. Clearly, they recognize the challenges facing women academicians and the need to build avenues of support.

As a fellow woman academician and administrator in higher education, I find considerable relevance in the ongoing, urgent need for guidance for women in general in advancing their careers.

After graduating from Emory University with a Ph.D. in clinical psychology, I initially plotted a career path that would focus primarily on establishing a clinical practice. As fate would have it, my first job offer was as an assistant professor of psychiatry in a small medical school. Although I had not initially planned to pursue a career in academe, I welcomed the opportunity to teach and build a practice through the medical school faculty practice plan.

One advantage of being in a small institution was the ability to quickly demonstrate competence. Without any plan, or clear guidance, I advanced in my career, but often felt "led" and "defined" by circumstance. I did not have a road map and, to some extent, was simply riding the train wherever it took me.

Looking back, however, I realize I never really planned a particular career path. Perhaps I was lucky and happened to land in the right place at the right time.

Throughout my career, I have found that many women struggle to find a clear plan or path. They tend to allow others — or circumstances — to "define" what the next step may be.

I was able to take full advantage of all the opportunities presented to me, and the "train" actually led me to a place that I believe I was destined to arrive. Now, as a full professor and executive vice president and provost at Meharry Medical College in Nashville, Tenn., I can truly say that I am headed in the right direction.

My path has been a bit unique, given the type of institutions I have served, and I still sometimes reflect on a phrase I often used with my children: "Mama doesn't know what she wants to be when she grows up."

The NSF ADVANCE program resonates with me in that I rarely had the benefit of like-minded, similarly destined individuals with whom to share stories.

There were often times that I longed to consult with someone who would understand my frustrations, my challenges and my desire to find purpose. At all levels there is a need for camaraderie, and we should all do more to help, advise, support and push each other forward.

Whereas there are many workshops, fellowships and academies to "train" and direct individuals toward a particular career direction, these opportunities sometimes fall short in providing follow-up and guidance. A well-defined mentoring alliance clearly provides a targeted effort to assist and guide for the long term.

Given my own experiences, I now wish to help other women who are looking for guidance and purpose. Perhaps it is my training as a psychologist, or my genuine desire to give back. Regardless, there is a need for building alliances, identifying and selecting advisors and mentors, and sharing stories that may help another person find purpose.

Everyone faces challenges in advancing their careers, but it surely can make the walk more pleasant if there is someone to join you along the way. Therefore, I fully support the idea of a mentoring alliance and applaud the

JEREMY FLEMING

efforts of Laura Wright and her colleagues in providing a resource for women in the sciences.

We should all learn from this and strive to create opportunities for women in other disciplines, emulating the model that has now been established.

— ANGELA WALKER FRANKLIN

The author, a member of Furman's board of trustees, earned her degree in psychology in 1981. She was for many years a professor and administrator at Morehouse School of Medicine in Atlanta before moving to Meharry.

Staying on track

ONE OF THE MOST TRANSFORMATIVE experiences of my career came during three workshops that I attended in the spring of 2005, while I was pursuing my postdoctoral fellowship at Rockefeller University in New York City.

The workshops were titled "Making Sure That Academia Includes You: A Career-Building Workshop for Women in Science." For three Saturday mornings, women from multiple academic ranks — graduate students to junior faculty members — and from diverse scientific disciplines gathered to learn about coping and advancing within male-dominated academia. The workshops, sponsored by the Gender Equity Project at Hunter College of the City University of New York and by the New York Academy of Sciences' Women Investigator Network, were intended to help increase productivity and the likelihood of women receiving tenure and promotion.

The first session, "Gender and Basic Foundations," uncovered one of the defining lessons that I took from the program: the need to build and maintain a circle of advisors.

During this session, we did an exercise where we listed areas in which we needed mentoring and advice. As a postdoctoral fellow, I listed such things as scientific direction, writing papers and grants, technical help in the laboratory, and networking in my field. After developing our lists, we then identified individuals who could help us in these areas. I included a few of my postdoctoral colleagues, my husband (who is also a scientist), and my current postdoctoral advisor, each beside a different need.

Through this exercise, I immediately realized that one single person could not — and cannot — provide advice for every aspect of my career. Each person on my list had certain abilities (and time) to advise me in specific areas.

During my days as a biology major at Furman, I had one advisor, Joe Pollard, who helped me develop my class schedule and assisted me in choosing a graduate school. When I began as a graduate student at Emory University in cell and developmental biology, I joined the laboratory of Grace Pavlath to study muscle development.

The graduate student-mentor relationship resembles your relationship with your parents, where you learn about multiple aspects of scientific training and career development. A scientific committee directed my progress in the laboratory, and I garnished additional career advice through interactions with other faculty members. However, these relationships tended to be casual and informal, as opposed to the ongoing, organized relationships that the Women Investigator Network workshops promoted.

When I joined the faculty of Yale University earlier this year as an assistant professor, the lessons from those workshops suddenly came flooding back to me.

Faced with many new decisions and responsibilities — teaching undergraduates, hiring and managing technicians, students and postdoctoral fellows, organizing a laboratory — I remembered the list of mentors I had generated during the workshop. I immediately began writing down the aspects of my new job where I needed advice.

Once I began to make my list, I realized that I had a network of individuals who could help me work through these new responsibilities. Some of them were a part of my formal mentoring committee in my department, but others were colleagues from outside the department and from other institutions.

Each week, one of my former postdoctoral colleagues and I have an informal video conference where we discuss what we do — science — and how we do it — managing our new jobs as assistant professors. It is these kinds of interactions that will help keep me on track in academia, in keeping with the focus and the intent of the NSF ADVANCE project.

— VALERIE HORSLEY

A 1998 Furman graduate, the author earned her Ph.D. from Emory University. Her specialties are molecular, cell and developmental biology.

Building on mutual respect

WHEN I WAS A CHEMISTRY MAJOR AT Furman, Laura Wright was the only woman professor in the department. I never thought much about being a woman in chemistry, perhaps because Laura was there or perhaps because the faculty in the department seemed to care only about whether you loved chemistry, not about your gender.

I did not realize how rare it was for her to be the sole tenured woman until I was in graduate school. But knowing that there was at least one female chemistry professor out there provided proof that it was possible for me to be a chemist, too.

Laura was my first mentor and first role model, the first female working chemist that I knew. At the time, in the early 1990s, it was insignificant that she was a faculty member. She was a woman in chemistry.

I met other women in graduate school, but they were mostly graduate students, not chemistry professors. Soon I began to understand the rarity of women in the academic ranks in chemistry.

My mentors in graduate school were men and women. My advisor and my colleagues provided me with job training. My colleagues offered much needed support. They were also friends. We respected each other as we worked toward the same goal — enough research to allow us to move to the next phases of our careers.

Graduate school was a heady time for a self-professed geek. Every day was a new opportunity to learn. When things would go well, my fellow graduate students would offer praise; when things went south, they provided much needed commiseration. And I did the same for them.

When I left graduate school, I realized how valuable a support group my lab mates had been. My first academic job was at a brand new college — Harriet L. Wilkes Honors College of Florida Atlantic University — which did not have most of the infrastructure you take for granted at an established institution like Furman. I yearned for the collegiality, the solidarity and the joy of being surrounded by people who understand where you are going and what you need to do to get there.

At the time, I did not have anyone close by to offer the support I desperately needed. Laura Wright helped me make a valuable contact — her sister Amy, who is currently the director of the Center for Marine Biomedical and Biotechnology Research at the Harbor Branch Oceanographic Institute of Florida Atlantic University. In subsequent years, Laura has provided me with much needed advice on how to handle sticky issues. Her support has been invaluable.

Now, as a tenured professor at Butler University, I still have mentors. Some are colleagues and some are former associates. Some are men, some women. They all supply a much needed support network. But, in some ways, the women offer an additional level of support. They understand the challenge of childbearing (especially as a synthetic chemist), the difficult balance of family and work, and the isolation of women in science in academia.

When I think about the cohort that Laura has joined as part of her NSF grant, I realize she has found a group of people much like my friends from graduate school. This cohort is built upon mutual respect. They are friends, cheerleaders, critics and sounding boards. Her group provides the truthfulness needed from a mentor, with a healthy dose of good will to keep everyone going. Most importantly, her group is cooperative. They mentor each other.

I do not know how my career will continue to evolve. But I would like to believe that I will have help along the way. If it is possible for Laura and her group to find each other, then it should be possible for others, including myself.

— LUANNE McNULTY

Having earned her degree from Furman in 1993, the author has taught at Butler since 2003. She holds a Ph.D. from the University of Virginia.

R. BRENT SMITH

Empowering others

JUST IMAGINE! IMAGINE WHAT AN undergraduate can achieve! Imagine what an undergraduate can become!

Just imagine! Amanda, a biology major, using statistics and databases, analyzed the relationship between diet and birth defects during a summer internship at a genetics center and presented her research at a national conference. After a year-long fellowship at the National Institutes of Health, she pursued doctoral studies of genetic associations with obesity.

Just imagine! David, a double major in computer science and mathematics, helped develop software for the science operations interface of Mars Rovers at the Jet Propulsion Laboratory in California. In part because of this research, he was awarded a National Science Foundation Fellowship to study computer graphics in a doctoral program at Columbia University.

Just imagine! Diana, a double major in computer science and Spanish, was an intern at Lawrence Livermore and Los Alamos National Laboratories. After completing a master's degree, she returned to Los Alamos to work in the International Space and Response Division — and to run her own Web design company.

Just imagine! Lena, a biology major, interned with the Cardiac Mechanics Research Group at the University of California-San Diego. Her work on optimization of large-scale computations in electrophysiology helped to change the direction of the group's research. She is now attending medical school.

Just imagine! Frank, a double major in physics and mathematics, completed two internships at the Jet Propulsion Laboratory (JPL). He developed software to access images of specific moving objects from JPL's extensive observational archive. The breakthrough resulted in the naming of an asteroid in his honor. Since completing his Ph.D., Frank has done research at the Johns Hopkins University Applied Physics Laboratory.

These stories of undergraduates I have taught and mentored bring a rush of memories: encouraging, reassuring and sometimes prodding those who do not know their own capabilities; contacting scientists to ask that they mentor the students; sharing their joy at obtaining positions; helping them gain funding; arranging presentations on their research; encouraging them to network with others; celebrating their acceptances for post-graduate opportunities; and hearing stories of exciting work that would not have been possible without their internships and their education.

Small liberal arts colleges such as Furman and my institution, Wofford College, foster this kind of mentoring between faculty and students. The education that Wofford has provided these students is in a revolutionary new academic discipline, computational science, which is at the intersection of computer science, mathematics and the traditional sciences.

Much important scientific research today involves computation as well as theory and experiment. Realizing this, I have had the joy of being present at the formation of one of the first undergraduate programs in this field (Wofford's Emphasis in Computational Science). I have helped others develop programs, written educational materials for such programs, and collaborated with others to advance education in this new area.

Collaboration has been most rewarding with my husband, George Shiflet, chair of the biology department at Wofford. Little did we know when we sat together in calculus class at Furman that we were forming a career path as well as a close relationship!

Sharing a passion for learning and for helping others to learn, George and I wrote the first textbook designed specifically for an introductory course in computational science and engineering.

Introduction to Computational Science: Modeling and Simulation for the Sciences was published in 2006 by Princeton University Press.

As partners and colleagues, we have experienced the excitement of learning new things, making connections among disciplines that have often been too isolated, helping others develop their own computational science programs and, in particular, empowering undergraduates to participate in a revolutionary new field — and imagining what they can achieve.

— ANGELA BUZZETT SHIFLET

The author earned her doctorate from Vanderbilt University. She is the Larry H. McCalla Professor of Mathematics and Computer Science at Wofford.

Commentary —————————————

Mentoring Strategies To Recruit and Advance Women in Science and Engineering

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The underrepresentation of women in almost all science and engineering fields is a well-documented statistic. One strategic effort to broaden the participation of women in the technical workforce is to increase the advancement of women faculty in science and engineering fields at academic institutions of higher learning. The presence of senior women faculty in the highest ranks of academic leadership enables female students to self-identify as potential scientists and engineers, thus, having a powerful influence on their choice of major and career.

Effective Mentoring Approaches

Numerous strategies have been considered to achieve a greater presence of senior women scientists and engineers at colleges and universities. For example, compelling evidence exists to support the hypothesis that both formal and informal mentoring practices that provide access to information and resources are effective in promoting career advancement, especially for women *(1, 2)*. Mentoring relationships provide opportunities to improve the status, effectiveness, and visibility of a faculty member via introductions to new colleagues, knowledge of information about the organizational system, and awareness of innovative projects and new challenges *(1, 3—5)*. The changing responsibilities of faculty members as they advance in the professoriate suggest that mentoring relationships could continue to facilitate career advancement for senior faculty seeking new challenges and leadership roles and desiring greater professional visibility and recognition. An investment by an institution in the continuous development of a faculty member's career will have a broad impact not only on the faculty member, but also on his or her colleagues and students and on the ability of the institution to attract and retain excellent faculty and students. However, while institutions generally place substantial focus and resources on junior faculty *(6, 7)*, significant investment in faculty members throughout the whole of their career is not as common.

On March 24th, 2010, at the 239th National Meeting of the American Chemical Society in San Francisco, the symposium "Successful Mentoring Strategies To Facilitate the Advancement of Women Faculty" will feature an array of successful mechanisms for enhancing the leadership, visibility, and recognition of faculty members using various mentoring strategies. In particular, the organizers will share the results of their NSF-ADVANCE-PAID project *(8)* that focuses on the distinctive environments of undergraduate liberal arts institutions and tests a "horizontal mentoring strategy" involving the formation of five-member alliances of senior women faculty members in chemistry and in physics at different institutions. Alliance members participate in discussions, workshops, and activities focused on career and leadership development through periodic gatherings of alliance members and the use of various collaboration and communication mechanisms. Results of an ethnographic study using qualitative research methods will be presented that show this form of peer mentoring to be particularly effective. In particular, the varied career experiences and achievements of a cohort of women faculty who have reached the senior ranks at their institutions have provided a rich resource to use for guidance and recommendations. Numerous other mentoring programs for women faculty at all career stages and at a range of institutions will also be showcased at the symposium to demonstrate a range of successful strategies to broaden the participation and advancement of women in all fields, particularly in science and engineering.

Acknowledgment

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