Report from Study Group Meetings to Develop a Research and Action Agenda on STEM Career and Workforce Mentoring

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I. Introduction

Mentoring is often identified as one of many factors that help to increase the participation of groups traditionally underrepresented in science, technology, engineering and mathematics (STEM) fields. These underrepresented groups in STEM include women; African American, Hispanic American, and Native American men; and people with disabilities. However, little is known about the research base on STEM mentoring and the structure and function of mentoring in the STEM educational and workforce sector.

In October 2003, AAAS convened a study group to examine what we know about mentoring in STEM fields and what we should be doing to foster high quality mentoring in STEM fields. The study group was particularly interested in STEM mentoring of groups traditionally underrepresented in the sciences, including women; African American, Hispanic American, and Native American men; and people with disabilities.

This meeting was co-sponsored by the National Science Foundation (NSF) Committee on Equal Opportunities in the Science and Engineering (CEOSE) and the American Association for the Advancement of Science (AAAS) Committee on Equal Opportunities in Science (COOS). The goals of the meeting and overall project were to:

- Develop a common definition of mentoring.

- Identify research questions on STEM career mentoring, primarily with regard to workforce preparation.

- Develop guidelines as to what students should know and learn about work-based skills needed in STEM (In this case we are making a distinction between the STEM content knowledge needed for STEM careers and the skills needed in the STEM workforce).

- Identify ways to assess whether students are gaining workforce skills along the education continuum in order for them to be productive and successful in the STEM workforce.

- Identify strategies for disseminating information and scaling-up high quality STEM mentoring through NSF or professional societies.

Methods for carrying out this work included:

- Conducting a literature search using the following electronic databases: Education Resources Information Center (ERIC); the American Psychological Association's PsychLIT; and Dissertation Abstracts. Our database searches were centered on mentoring in STEM and not on research on general mentoring.

- Conducting focus groups on mentoring at meetings of Women in Engineering Program Advocates Network (WEPAN), the Georgia Institute of Technology EMERGE meeting, and the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS). Many of the participants in the EMERGE meeting were awardees or participants in NSF's Alliance for Graduate Education and the Professoriate (AGEP) Program. Focus groups included students, educators and administrators, and questions centered on definitions of mentoring; what students expect from a mentor; and skills and resources needed by mentors. All three focus groups included about 100 participants.

- Conducting a study group meeting with STEM educators and administrators from the K-12, college and university, business, foundation, and government sectors. Seventy participants attended this meeting.

- Commissioning short papers on mentoring from researchers, including *A Definition of Mentoring to Guide Research*, Becky Wai-Ling Packard, Mount Holyoke College; *What a Difference a Mentor Makes*, Catherine Millet, Educational Testing Service (ETS) (a special analysis of questions about STEM mentoring from a graduate student database); *Mentoring: Lessons Learned and Research Questions*, Suzanne Gage Brainard, University of Washington; and *Graduate Student Mentoring Blueprint*, Charlena Seymour, Provost, University of Massachusetts, Amherst (See Appendix for papers).

Also, in 2005, AAAS convened a second meeting of professional societies and selected recipients of the White House's Presidential Awards for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM). This meeting focused on clarifying workforce-based skills that students should know and learn from the high school years and beyond; identifying mentoring strategies and practices that work; and identifying strategies that professional societies and foundations could use to foster workforce mentoring. Twenty eight participants attended this meeting.

Findings from this work include:

- Summarizing definitions and types of mentoring (Section II).

- Identifying mentoring research articles related to STEM, gaps in the research, and possible research questions (Section III and Appendix A).

- Identifying workforce-based skills that student should know and learn (Section IV).

- Recommendations for fostering career and workforce-based mentoring for professional societies, foundations, and departments (Section V).

II. Definitions and Types of Mentoring Strategies

Findings from the focus groups with STEM faculty, students, and others indicated that definitions and perceptions of mentoring varied widely. In general, students and faculty indicated that they made a distinction between academic advising and mentoring. Students viewed the mentor relationship as a personal one. In the focus group, participants generally agreed with the definition developed by Marilyn Suiter, NSF Program Director, PAESMEM that:

Mentoring is an interaction between a more-experienced person and a less-experienced person; it provides guidance that motivates the mentored person to take action.

Becky Wai-Ling Packard from Mount Holyoke College, whose primary research centers on mentoring, provided us with a similar definition for mentoring:

Mentoring is a term generally used to describe a relationship between a less-experienced individual, called a mentee or protégé, and a more-experienced individual known as a mentor. It is important to acknowledge that the term "mentor" is borrowed from the male guide, Mentor, in Greek mythology, and this historical context has informed traditional manifestations of mentoring.

More current definitions of mentoring suggest that mentoring is a *two-way, mutually beneficial relationship,* particularly in the employment sector. http://www.coachingandmentoring.com/mentsurvey.htm

Mentoring can be formal or informal; short or long term; and may vary in time. The function of mentoring generally includes:

- Psychosocial mentoring.
- Role modeling, which can be viewed as psychosocial mentoring.
- Career-related mentoring.

Mentoring is structured in a variety of ways, including:

- One-to-one relationships.
- Peer group mentoring.
- Electronic mentoring.

In addition, mentoring structures include:

- A network of multiple mentors.
- Cascade mentoring, which is often used in STEM research laboratories, where a professor may supervise graduate students or advanced undergraduates in research, who in turn supervise lower division undergraduates.

Other types of mentoring include:

- Informal mentoring, which occurs when two people establish a developmental alliance without the assistance or guidance from the organization. www.mentorcanada.ca/en/en_keynote/dclutterbuck2.doc

- Enhanced informal mentoring, which falls somewhere between formal and informal mentoring. Mentors and mentees typically find each other on their own (rather than become matched by a coordinator or committee), and the pair follows a somewhat structured process. At least one of the pair has learned mentoring structure, protocol, and skills and gently manages the process. http://www.mentoringgroup.com/html/idea_25.htm

- Reverse mentoring is peer mentoring usually centered around gaining technical expertise and understanding different perspectives. http://www.coachingandmentoring.com/reversementoringresults.htm

III. What We Know and Gaps in Research on STEM Mentoring

As can be noted from Table 1, our literature search of the selected electronic databases on STEM mentoring yielded 96 abstracts related to STEM and mentoring, of which a little over 36% were dissertation abstracts (Appendix A). Only 21 articles were published in peer-reviewed science or science education journals.

Table 1 – Distribution of STEM Mentoring Abstracts by Types of Sources**

Dissertations	35/96 (36.5%)	
Meeting Abstracts	8/96 (8.3%)	AERA
Science or Ed Journals	21/96 (21.9%)	
Books/Book Chapter	7/96 (7.3%)	
Organizational/Institutional Research or Reports	25/96 (26%)	NAS, AWIS, NACME, Catalyst, Universities, MentorNet, AAAS

***All of the above are about science-related mentoring in the U.S.*
***Articles were published between 1980 and 2006.*
***Articles were found by doing a search of ERIC, PsychLIT, and Dissertation Abstracts electronic databases.*
***Articles examine science-related mentoring throughout the "pipeline," i.e., K-12, undergraduate, graduate, postdoc, and industry.*
***Many articles examined how race and gender affected the mentoring experience, but the search process used to produce the articles did not use race and gender as criteria to limit the results.*

In general, the quality of the research based on STEM mentoring is limited, particularly in regards to studies on career and workforce skills. However, the STEM mentoring research base indicates the following:

- STEM career mentoring appears to be more prevalent in after-school programs for middle and high school students.

- The level of systematic STEM career and workforce mentoring is not high in undergraduate research programs/internship programs, or during the undergraduate, graduate school doctoral year, or in postdoctoral fellowship programs.

- Support networks for women (including students) in STEM areas in academia, industry, and government are useful in helping family/career balance, negotiating organizational or departmental challenges, and in career advancement.

- More research is needed on cross-gender and cross-racial STEM mentoring and mentoring of disabled persons in STEM disciplines.

- More STEM mentoring research linked to outcome measures is needed, such as entry into STEM college majors, time-to-degrees at all degree levels, types of college and university degrees earned, entry into STEM graduate majors, entry into STEM careers by sectors, and advancements in the STEM workforce.

- More STEM mentoring studies that follow cohorts of students or scientists and engineers are needed.

Participants in our focus groups identified some possible research questions that fall into four categories:

1. Type, Structure, and Process of STEM Mentoring

- What is successful STEM mentoring and how do we measure it? What happens when mentoring goes wrong?

- Are there significant differences in various mentoring strategies, including one-to-one, network mentoring, peer mentoring, cascade mentoring, and informal mentoring?

- What external variables influence effective mentoring at different educational levels, including the K-12 years, the undergraduate years, the graduate years, and the early career years?

- What are the interpersonal dynamics and related variables that characterize “successful” mentoring?

- How do different types of institutions recognize or reward mentoring, particularly in the STEM area?

2. STEM Mentoring in the Business and Government Sectors

- What is the structure and function of a mentoring program within a company that is *successful*?

- In what ways does structured mentoring propel underrepresented groups through the glass ceiling?

- Where there is structured mentoring does it make a difference in career advancement; for example, length of time to move to a new level?

- We need longitudinal data of mentoring from the early years (K-12) to a job in industry, with particular emphasis on cultural factors including disability and language.

- Investigate connection between effectiveness of mentoring in the postdoc years and career advancement once they are at the company.

- Create a detailed study of STEM (including women, underrepresented minorities, and people with disabilities) and study early mentoring relationships, and their impact on the final career choice. We would need to have a control group.

- Is informal mentoring in a project team environment different from hierarchical mentoring, and is it more effective?

3. STEM Mentoring in Academia

- What is the structure and function of effective junior faculty mentoring programs?

- Are structured faculty mentoring programs as effective as informal mentoring programs?

- Are there differences in STEM faculty mentoring by types and sizes of academic institution?

- Are there gender, race, class, sexual orientation, or disability differences in the extent to which STEM tenured faculty mentor students or untenured faculty?

- What incentives or rewards are needed to foster effective mentoring in STEM departments?

- Are there gender, race, class, sexual orientation, or disability differences in mentoring?

- Is there STEM faculty for leadership positions in academia?

4. Students in Higher Education

- How does STEM faculty mentoring affect undergraduate persistence, degree attainment, and entry into STEM Master's or doctoral programs?

- With STEM faculty, how does their understanding, knowledge and their skill in and practice of diversity, affect persistence, degree attainment and entry into STEM Master's or doctoral programs of underrepresented groups?

- How does mentoring of community college students affect their transition to STEM majors in four-year institutions?

IV. Work-Based Skills that STEM Students Should Know and Learn

In most instances there are defined learning objectives in content and research/techniques skills that STEM students should know and learn, but less attention is given to learning objectives related to building workforce skills. Both the focus groups at professional meetings and the study group meeting were used to identify work-based skills that students should know and learn, beginning in the high school years. Findings from these meetings indicate that students want to know how to:

- Prepare abstracts and posters for professional meetings.
- Make oral presentations at professional meetings.
- Review scientific papers.
- Conduct literature reviews.
- Formulate scientific research questions.
- Use statistical and computational skills, particularly related to informatics.
- Prepare a paper for publication in a journal.

In addition students should begin to understand:

- The importance of scientific paper citations.
- The patent process.
- Science journal publication guidelines.
- Best practices in teaching, learning, and educational assessment.
- Setting up and managing a laboratory, including safety issues and guidelines for the use of human subjects and animals in research.
- Understanding Internal Review Boards (IRBs) and research ethics.
- Grant-writing, including being familiar with grant guidelines.
- The peer review and the grant process.
- National and global science policy issues (funding, ethics, intellectual property rights).

- Post graduation placement opportunities in all sectors.

Also, mentors should encourage students to enter science competitions and other awards-based programs, beginning in elementary school.

In terms of assessment of mentoring programs, the focus group recommends developing a research and career plan and annual progress reviews or assessments at all academic levels and at the professional level.

In addition, the National Academy of Sciences, Committee on Science and Engineering, has developed a set of *Skills and Attributes that Contribute to a Successful Career as a Scientist, Engineer, Scholar, or Professional*.
http://www.nap.edu/readingroom/books/careers/contents.html

V. Recommendations for Fostering STEM Mentoring that Builds Knowledge about Careers and Workforce Skills

For Professional Societies

Many professional societies already include a number of activities that build knowledge about STEM careers and workforce skills, including student poster and essay competitions; travel grants for attending the annual meeting; career materials and websites; special issues of the scientific journal devoted to careers; and career workshops.

However, science society representatives who have participated in focus groups indicated that a more coordinated approach could be developed for bringing increased attention to STEM mentoring, including:

- Declaring a decade, year or particular week for STEM mentoring.
- Providing mentor and mentee training at annual meetings and in special forums.
- Encouraging journals to publish editorials, mentoring research, essays, columns, or special issues on STEM mentoring. This might include a coordinated effort, where journals publish a special issue during the same month.
- Creating a Code for Mentoring, incorporating mentoring into existing Codes of Ethics or creating guidelines that foster high quality career and workforce mentoring.
- Creating board statements about the importance of mentoring that build knowledge about STEM careers and workforce skills.
- Establishing mentor awards, particularly departmental mentoring awards.
- Conducting research on STEM mentoring.
- Incorporating mentoring in the accreditation process.

Recommendations to foundations included:

- Provide funding for research on STEM career and workforce mentoring. A single-focus program can be developed, or this topic may be incorporated into an existing grants program.

- Include grant review criteria that require applicants to present a plan for STEM career and workforce mentoring.

- Write a "Dear Colleague" letter to encourage awardees to pay more attention to developing STEM career and workforce skills. See example from the NSF Geosciences Directorate. http://www.nsf.gov/pubs/2006/nsf06038/nsf06038.jsp

Recommendations to STEM departments include:

- Appoint a departmental mentoring committee to develop and implement a departmental mentoring plan with a particular emphasis on providing students with career information and opportunities to develop workforce skills;

- Provide mentor training for faculty.

- Provide mentee training for students.

- Provide online mentoring resources or links to resources for faculty and students, and

- Assess and provide incentives for high quality faculty mentoring.

Appendix A -- Bibliography of Journal Articles, Books, Book Chapters, Organization Reports, Annual Meeting Reports and Dissertations on STEM Career and Workforce Mentoring

Journal Articles

1. Anderson, Melissa S. and Karen Seashore Louis. The Graduate Student Experience and Subscription to the Norms of Science. Research in Higher Education. Volume 35, Number 3, May 1994. This paper examines the normative orientations of doctoral students with respect to academic research. In particular, it analyzes the effects of graduate department structure, department climate, and students' mentoring experiences on students' subscription to the traditional norms of science and to alternative counter-norms. Findings are based on data from a nationwide survey of students in chemistry, civil engineering, microbiology, and sociology. The analysis demonstrates substantial ambivalence among graduate students about the traditional norms of academic research. It also reveals significant differences in the normative orientations of U.S. and international students.

2. Bird, Stephanie J. Overlooked Aspects in the Education of Science Professionals: Mentoring, Ethics, and Professional Responsibility. Journal of Science Education and Technology. Volume 3, Number 1, March 1994. Science as profession is generally defined narrowly as research. Science education as preparation for a profession in research is usually perceived as course work and laboratory training, even though the necessary knowledge and skills to pursue a research career are more extensive and diverse and are learned in one-on-one interaction with mentors. A complete education of science professionals includes the values, ethical standards and conventions of the discipline, because they are fundamental to the profession. Mentoring and education in the responsible conduct and reporting of research and in the ethical dimensions of science are among the professional responsibilities of scientists and need to be discussed as part of science education. Moreover, science as an enterprise is much more than research and includes a number of other components, including science teaching, science journalism, and science policy. Each of these contributes to the nature of science and its role in society.

3. Chesler, Naomi C. and Mark A. Chesler. Gender Informed Mentoring Strategies for Women Engineering Scholars: On Establishing a Caring Community. Journal of Engineering Education. 2002. This paper explores the sociological literature on interpersonal- and institutional-generated gender roles and dynamics and mentoring strategies that are likely to be more successful for mentoring women. http://vtb.bme.wisc.edu/images/Chesler_JEE_2002.pdf

4. Davis, Kathleen S. 2001. "Peripheral and subversive: Women making connections and challenging the boundaries of the science community." *Science Education*; v85 n4 p368-409 Jul 2001. This article draws upon the findings of a qualitative study that examined the valued social capital, ways, and practices of a support group for women working in the sciences at an academic research institution. Findings from this study indicate how women (1) were given little access to powerful networks in science that would provide them with opportunities to acquire the knowledge, skills and resources necessary to be legitimate in the traditional sense, and (2) encountered many obstacles in their attempts to develop networks and make such connections between themselves and other women. Findings also indicate that, despite these impediments, the support group provided a meaningful and useful network through which they developed a critical perspective of legitimacy as they sought to make explicit the "culture of science."

5. Ferreira, Maria M. 2001. “The effect of an after-school program addressing the gender and minority achievement gaps in science, mathematics, and engineering.” *ERS Spectrum*; v19 n2 p11-18 Spr 2001. Examines effects of an after-school science program on minority female students' attitudes toward science, engineering, and mathematics. The program, which incorporated cooperative learning, hands-on activities, mentoring, and role models, positively influenced participants' attitudes to (and subsequent participation in) these subject areas.

6. Ferreira, Maria M. Gender Differences in Graduate Students’ Perspectives on the Culture of Science. Journal of Women and Minorities in Science and Engineering. Volume 9 (2003). In this study, gender differences in graduate students’ perspectives on the culture of science were examined in two graduate departments (biology and chemistry) at a large research university. Data from a survey questionnaire from 170 students and interviews with 32 of them indicated that the culture of science as experienced by the participants in this study was characterized by competition, a narrow focus and a belief in objectivity. These perspectives were particularly common among the female students, who also perceived a role conflict between a successful career in science and having a family. The study shows that although women have greater access to careers in science, the culture of the scientific enterprise continues to be based on the masculine ideals of 17th-century England. Results indicate that the level of mentoring in each department was not very high. This view was particularly common among female students in chemistry.

7. Ferreira, Maria M . The Research Lab: A Chilly Place for Graduate Women. Journal of Women and Minorities in Science and Engineering, Volume 8 (2002) PhDs in most graduate science programs require that graduate students spend large amounts of time conducting research in science laboratories. As a result, the environment in the research lab is key to the success or failure of graduate students, particularly women. This article is a case study of two graduate women in a chemistry department at a large research university. In-depth interviews, field notes from a support group for graduate women in science and departmental records were used to examine the relationship between key factors of their work environment and the high attrition rate of graduate women in the department. Analyses of the data indicated that the social climate in the research lab, shaped by the attitudes and behaviors of the women’s male colleagues and/or research advisors, created a “chilly place” for the female graduate students.

8. Frierson, H. T., Hargrove, B. K., Lewis, N. R. (1994). Black summer research students’ perceptions related to research mentors’ race and gender. Journal of College Student Development, 35, 475-480.

9. Handelsman, Jo, Nancy Cantor, Molly Carnes, Denice Denton, Eve Fine, Barbara Grosz, Virginia Hinshaw, Cora Marrett, Sue Rosser, Donna Shalala, and Jennifer Sheridan. More Women in Science. Science, 19 August 2006, 309:1190-1191. Universities are failing to take advantage of an available resource: the brainpower of women scientists. In many fields of science, the proportion of women in faculty positions lags well behind the proportion of PhDs granted to women. The authors explore the reasons for the disparity and offer examples of strategies used at research universities to overcome the impediments to recruitment, retention and advancement of outstanding women scientists.

10. Johnson, W. Brad. The Intentional Mentor: Strategies and Guidelines for Practicing Mentoring. Professional Psychology: Research and Practice. Volume 33 No.1, 88-96, 2002. This article summarizes the nature of mentoring, the prevalence of mentoring in

psychology, primary obstacles to mentoring and some ethical concerns unique to mentoring. The article provides several strategies to enhance mentoring and guidelines for the profession, departments of psychology and individual psychologists who serve as mentors. http://users.utu.fi/juhtiur/jakelu/mentor.pdf

11. Kardash, Carol Anne. Evaluation of an Undergraduate Research Experience: Perceptions of Undergraduate Interns and Their Faculty Mentors. Journal of Educational Psychology. Volume. 92, No.1, 191-201, 2000. This study evaluated the extent to which 14 research skills were enhanced by science undergraduates' participation in an undergraduate research experience (URE). Fifty-seven undergraduates self-rated their ability to perform the skills at the beginning and end of the URE. Faculty mentors' ratings of their respective interns' skills served as an objective measure of intern skill level. Mentor and intern data revealed that the URE enhanced some skills better than others. At the end of the URE, female interns rated their ability to understand concepts in their field significantly lower than did male interns. Female interns also tended to perceive less of an increase in their ability to formulate research hypotheses than did male interns. http://aresty.rutgers.edu/SophRA/Karina_reading.pdf

12. McMillian, W. and M.E. Parker. Quality is bound up with Our Values: Evaluating the Quality of Mentoring Programmes. Quality in Higher Education. Volume 11. No. 2, 51-160, July, 2005. This paper discusses quality evaluation of health sciences mentoring programs. The discussion highlights the way in which perceptions of what constitutes quality shape evaluative purposes. Potential tensions between the evaluative purposes of various stakeholders are brought to the fore. To this end, the discussion explores the ways in which accountability shapes the evaluative purposes of funders and how the desire for program knowledge and development frames the evaluative purposes of academics. Various approaches to program evaluation are examined. The potential of reflective practice as a tool for examining quality for knowledge and development of programs is considered. The paper concludes by presenting a framework for evaluating various aspects of quality in mentoring programs.

13. Morahan, Page, Deborah F. Diserens, Rosalyn C. Richman, Aron Primack, Karen Hofman, and Sharon Hyrnkow. Women Health Scientists from Developing Countries: A Pilot Effort for Meeting Their Career and Leadership Aspirations and Needs. AWIS Magazine. Summer 2006. Volume 35(3), page 10-14. This paper describes a training program for preparing senior women faculty at schools of medicine and dentistry to move into positions of institutional leadership. http://awis.org/pubs/magazine/35-3/2006Summer.pdf

14. Shellito, Cindy, Kalyn Shea, Gary Weissmann, Anke Mueller-Solger, and William Davis. 2001. "Successful mentoring of undergraduate researchers: Tips for creating positive student research experiences." *Journal of College Science Teaching*; v30 n7 p460-64 May 2001. Presents the results of an undergraduate researcher survey which aims to determine the properties of a successful mentor. Includes a list of suggestions and tips for a successful undergraduate mentoring experience.

15. Singer, Maxine. *Science*, Volume 306, Issue 5694, 232, 8 October 2004. Although stipends and benefits have improved, there is continuing frustration at the lack of data on postdocs supported on research grants, data that can only be collected by federal agencies. However, the greatest continuing concern is the quality of mentoring from advisers, especially support and guidance in the transition to independent careers. This article views the postdoc situation as a systems problem that evolved over time. Strategies suggested for

improving the post doc experience include clarifying the goals of scientific training, including written appointment letters for with clearly outlined expectations and compensation; at least annual conversations between postdoc and PI to evaluate progress and provide career guidance; tracking of career outcomes by institutions; and tracking of grantees, including postdocs supported on investigator awards, by funding agencies.

16. Suiter, Marilyn J. Wisdom of mentoring-Sharing Methods of Exemplary Science and Engineering Mentors. AWIS Magazine. Volume 35 (1), p 17-25. This paper describes mentoring methods of selected recipients of the White House's Presidential Award for Science, Mathematics, and Engineering Mentoring (PAESMEM). http://awis.org/pubs/magazine/35-1/suiter.pdf

17. Waxman, Merle. 1992. "Mentoring, role modeling, and the career development of junior science faculty." *Journal of College Science Teaching*; v22 n2 p124-27 1992. This article describes problems of junior science faculty members and makes recommendations explaining how mentoring and role-modeling can be supplied to assist faculty members with ascending the "faculty ladder."

18. Packard, Becky-Wai-Ling. Mentoring and Retention in College Science: Reflections of the Sophomore Year. Journal of College Student Retention Research Theory and Practice. v6, n3, p289-300, 2005. Although mentoring has been linked to the retention of college students in science, it is still unclear whether students who persist in science majors (pursuers) have greater mentoring experiences than students who do not persist (switchers). In this study, 79 upper-level students who had enrolled as science majors at a research university were surveyed about the science mentoring they experienced during their sophomore year, a time when students were asked to make final decisions about their major. Pursuers reported greater science career mentoring than switchers, but there were no differences for psychosocial mentoring. In addition, students perceived similar barriers to, and need for, science mentoring, but pursuers initiated science mentoring more than switchers. Implications for future mentoring initiatives are discussed.

19. Pfund, Christine, Christine Maidl Pribbenow, Jane Branchaw, Farah Miller Lauffer, and Jo Handelsman. Science, 27 January 2006, 311:473-474. This guide developed by HHMI Professor, Jo Handelsman, and her colleagues and co-founders of the Wisconsin Program for Scientific Teaching at the University of Wisconsin, Madison, raises questions about teaching expectations, mentoring as a function of training new teachers, and dealing with diverse learning styles, personal styles, ethnicity, experience, gender and nationality. The guide can be located at http://www.hhmi.org/resources/labmanagement/downloads/entering_mentoring.pdf

20. Summers, Michael F. and Freeman A. Hrabowski III. Preparing Minority Scientists and Engineers. Science, 31 March 2006, 311:1870-1871. An undergraduate program involving mentorship, summer and other workshops, and targeting high-achieving high school students improves participation of underrepresented minorities in science.

21. Rodriguez, Jose Florencio, Levay Lehman, Angela Valeria Fleith, and Denise De Souza. Factors mediating the Interactions between Adviser and Advisee during the Master's Thesis Project: A Quantitative Approach. Quality in Higher Education, Volume 11, Number 2, July 2005, pp. 117-127. Building on previous studies centered on the interaction between adviser and advisee in master's thesis projects, in which a qualitative approach was used, this study uses factor analysis to identify the factors that determine either a successful or unsuccessful outcome for the master's thesis project. There were five

factors relating to the adviser, seven to the advisee and three relating to a combination of the adviser and advisee. The outcomes suggest elements to be taken into account by those in charge of the management of graduate programmes.

Books/ Book Chapters

22. Feldman, Gregory C. 2001. "Encouraging mentorship in young scientists." Pp. 61-71 in *Supportive Frameworks for Youth Engagement*, edited by Mimi Michaelson and Jeanne Nakamura. San Francisco, CA: Jossey-Bass. In this chapter, which focuses on a group of young adults (aged 24-36 years old) already committed to work in science, the author shows how mentorship affects young scientists. The Good Work study describes the impact of mentorship at two different moments in a scientific career. Certain kinds of mentoring fosters scientific engagement in one generation and may facilitate an ongoing cycle of mentorship; that is, those who were well-mentored may in turn go on to mentor others successfully.

23. Frierson, H.T. (ed.) Diversity in Higher Education: Vol. 1--Mentoring and Diversity in Higher Education. Greenwich, CT: JAI Press, Inc., 1997.

24. Frierson, H.T. (ed.) Diversity in Higher Education: Volume II--Examining Protégé-Mentor Experiences. Greenwich, CT: JAI Press, Inc. (1998).

25. Frierson, H.T. Comparing Perceptions of Mentoring Experience of African American Undergraduate Humanities/Social Science and Science Majors. In Frierson, H.T. (ed.) Diversity in Higher Education: Volume II -- Examining Protégé-Mentor Experiences. Greenwich, CT: JAI Press, Inc. (1998).

26. Frierson, H.T. and Riggins, T.A. Male and Female Minority Students' Perceptions and Satisfaction Concerning a Short-Term Research and Mentoring Program. In Frierson, H.T. (ed.) Diversity in Higher Education: Volume II -- Examining Protégé-Mentor Experiences. Greenwich, CT: JAI Press, Inc. (1998).

27. Frierson, H.T. Perceptions and Assessments of Faculty Preceptors in a Summer Research Program for Minority Undergraduate Students. In Frierson, H.T. (ed.) Diversity in Higher Education: Volume II -- Examining Protégé-Mentor Experiences. Greenwich, CT: JAI Press, Inc. (1998). In general, findings from these studies revealed that mentors' general perceptions about the students were positive, especially when related to a student's ability to conduct research. Mentors' perceptions of their own effort and involvement in the program were also positive. Results indicate that the students engaged in directed humanities and social science research had a higher proportion of positive responses.

28. Wadsworth, Emily M. Giving Much / Gaining More: Mentoring for Success. Purdue University Press (2002). This book contains several descriptions of a successful mentoring program, and how participants related to the program, to each other and to the program's lasting effects on their lives, both personal and professional. http://www.thepress.purdue.edu/Books%20Pages/Book%20Descriptions/GivingMuch-GainingMore.as

Organizational/Institutional Reports/Research

29. American Association for the Advancement of Science. New Career Paths for Students with Disabilities: Opportunities in Science, Technolgy, Engineering, and Mathematics (2002). This study profiles 34 college and university STEM students with disabilities who participated in summer internship programs, primarily at NASA and IBM. Findings indicate that entry and retention of these students into STEM majors and careers can be attributed to four critical factors: assistive technology, family and community support, mentors and role models and professional internships. http://ehrweb.aaas.org/entrypoint/paths/index.html

30. The Association of Women in Science Mentoring Project. A Hand Up (2005). Edited by Deborah Fort, this new edition of AWIS's classic mentor report has been thoroughly revised to reflect the realities women in science, mathematics, technology, and engineering face in the new millennium. Through interviews and essays, both veteran women in science and others new to the field offer specific and practical insights, advice, and assistance to females who would enter scientific fields and to those already there. Contact information accompanies all 37 interviews with women scientists, postdoctoral fellows, and students. A Hand Up concludes with a section guiding women scientists to organizations, electronic resources, and how-to practical recommendations in their searches for successful professional outcomes. Some barriers have been breached; others remain for women scientists in general and for Hispanic ones in particular. To investigate and mitigate such hurdles, AWIS describes the struggles and triumphs of the latter group in particular detail. http://awis.org/pubs/ahandup.html

31. Blake-Beard, S. D. CGO Insights No. 15 (2003) Critical Trends and Shifts in the Mentoring Experiences of Professional Women. Center for Gender in Organization, Simmons School of Management. Boston, MA. For women in this sample, mentoring was associated with positive career outcomes, including higher promotion rates and greater career satisfaction. These research findings highlight the importance of the role model function for women. Finally, we confirm that women are also acting as mentors to others in their organizations. The web-based survey, a collaboration between Simmons School of Management and Compaq Computer Corporation (now HP), explored these areas with women who attended Simmons's 2002 Annual Women's Leadership Conference. Responses were from 427 women. Many of the women (82%) reported that they had been involved in an informal mentoring relationship -- an indication of the prevalence and importance of this important developmental relationship. The women included in the survey work in a wide range of industries, including technology, finance, health care and manufacturing. They are mostly middle to senior level managers with a mean age of 42 years; 60% earn more than $75,000 annually; 45% have a graduate or professional degree; and, 39% are working in organizations with 20,000 or more employees. They have an average of 20 years of work experience, and 62% are in a committed relationship (including marriage or committed relationship with same or opposite sex partner). http://www.simmons.edu/som/docs/centers/insights15.pdf

32. Blake-Beard, S. D CGO Insights No. 10. (2001) Mentoring Relationships through the Lens of Race and Gender. Center for Gender in Organization, Simmons School of Management. Boston, MA. Until very recently, a common and unspoken assumption was held that if we learned about the mentoring experiences and outcomes for white women, we would be able to speak to the experiences of all women. But the nascent body of research by scholars examining the mentoring experiences of women of color clearly debunks this assumption.

We need to be far more proactive and thoughtful about how mentoring relationships may be differentially-accessed based on the intersection of race and gender. We must contemplate how our research paradigms and frameworks should be adjusted to accommodate hypotheses and samples that are inclusive of the mentoring experiences of women along the spectrum of ethnic diversity. The challenges of mentoring, particularly across lines of race and gender, are not insignificant. But the promise of mentoring, that women of all ethnicities are supported in reaching their fullest potential, is a goal for which it is worthy to strive. These findings are based on a review of the literature on mentoring of women of color in corporations, including studies by Catalyst. http://www.simmons.edu/som/docs/centers/insights_10.pdf

33. Blake-Beard, S.D. Audrey Murrell and David Thomas Unfinished Business: The Impact of Race on Understanding Mentoring Relationships. This working paper presents a revised model of racial dynamics in mentoring. http://www.hbs.edu/research/pdf/06-060.pdf

34. Catalyst. African American Women in the Work Place: What Mangers Need to Know? (2004) http://www.catalystwomen.org/knowledge/titles/title.php?page=woc_advafricanmngr_04 Quantitative findings come from 963 African American women survey respondents in F1000 companies. Qualitative findings are from 23 focus groups with entry- and mid-level African American women. These respondents participated in Catalyst's larger 1999 study, *Women of Color in Corporate Management: Opportunities and Barriers*. Survey data also come from a follow-up study, done in 2001, of 369 African American women participants from the earlier study. **Findings:** Barriers facing African American women in business include negative, race-based stereotypes; more frequent questioning of their credibility and authority; and a lack of institutional support. Experiencing a "double outsider" status -- unlike white women or African American men, who share gender or race in common with most colleagues or managers -- African American women report exclusion from informal networks, and conflicted relationships with white women, among the challenges they face. The historical legacy of slavery, legally enforced racial segregation, and discrimination based on skin color make race a particularly difficult topic for discussion in the workplace. Many women in the study report making discussions of race off limits. Many study respondents report that their diversity programs were ineffective. Thirty seven percent of African American women see their opportunities for advancement to senior management positions in their companies declining over time, in contrast to Latinas and Asian women who are more likely to see opportunities slightly increasing. Keys to success cited by African American women in business include exceeding performance expectations, communicating effectively, connecting with mentors, building positive relationships with managers and colleagues, and using their cultural backgrounds to enhance job performance.

35. Catalyst. African American Women in the Work Place: What Mangers Need to Know (2003) http://www.catalystwomen.org/knowledge/titles/title.php?page=woc_advlatinasmngr_03 Quantitative findings comes from 342 Latinas survey respondents in F1000 companies. Qualitative findings are from 13 focus groups with entry- and mid-level Latinas, and in-depth interviews with senior Latinas. These respondents participated in Catalyst's larger 1999 study, *Women of Color in Corporate Management: Opportunities and Barriers*. **Findings:** There is great diversity among Latinas, as to language facility, national origin, and education. About three out of four Latinas surveyed are bilingual. Many Latinas feel they lack access to role models, sponsors, mentors, and informal networks. They report that it is a challenge to build effective professional relationships and that negative

stereotypes are a hindrance in navigating the corporate work environment. In responding to their outsider status, some Latinas make a concerted effort to fit in while others maintain their unique styles. Diversity policies are generally not seen as creating inclusive work environments. Many Latinas place a great deal of emphasis on their relationships with extended family members, who serve as sources of support, but these close relationships are less than optimally supported by corporate policies.

36. Catalyst. Bit by Bit: Catalyst's Guide to Advancing Women in High Tech. (2003) http://www.catalystwomen.org/knowledge/titles/title.php?page=lead_bitbybit_03 Five half-day roundtables were conducted with about 15 participants each. Seventy three women and men leaders from 27 technology companies participated in the meetings. A focus group was conducted with nine women from one company who were identified as future leaders. Interviews were conducted with representatives from participating companies, as well as other companies in the field, on their programs and practices to recruit, retain, and advance women. **Findings:** We asked participants to identify the most important barriers to women's advancement in high tech. Their responses are categorized into four main barriers: the corporate culture at many high tech companies is exclusionary and does not support women's advancement; the demands of work and career are at odds with having a commitment to family and personal responsibilities; women feel isolated because they lack role models, networks, and mentors; and companies do not strategically and objectively identify and develop talent.

37. Catalyst. Leadership Careers in High Tech: Wired for Success (2001) http://www.catalystwomen.org/knowledge/titles/title.php?page=lead_carhitech_01 Catalyst conducted personal interviews with 30 men and women who are regarded as the tech industry's next generation of leaders. **Findings:** There is no one route to the top in high tech. Though there are some critical steps to success, there's no required starting point. Also, a technical degree is not necessary to make it to the top. Mentors and networking are vital to career advancement and mobility, especially for women in the industry. Although many believe that the high tech world is a strict meritocracy, the majority of study participants -- especially women -- say that the higher you go in the industry, the more important it is to get to know the key power players. Catalyst also found that work/life balance is important to both men and women in high tech; most feel they are not sacrificing their personal lives for their jobs.

38. Catalyst. Women Scientists in Industry: A Winning Formula for Companies (1999) http://www.catalystwomen.org/knowledge/titles/title.php?page=lead_womsci_99 In-depth interviews with 30 women scientists in corporations. **Findings:** More than one-half of the respondents reported that they were given little or no information about the corporate job market for industrial science careers. Nearly one-third of the women scientists in the study chose the business sector not because they were recruited into it, but because they did not feel welcomed into academia. The organizational barriers to advancement women scientists face include: absence of female role models; absence of mentors; lack of line experience; isolation; exclusion from informal networks; stereotypes and preconceptions; style differences; risk-averse supervisors; and, work/life balance. Most of the participants reported that they had to struggle against the perception that science was a male pursuit.

39. Committee on Science, Engineering, and Public Policy, National Academy of Sciences. 1997. Adviser, Teacher, Role Model, Friend On Being a Mentor to Students in Science and Engineering. Washington, D.C.: National Academy Press. This guide -- intended for faculty members, teachers, administrators, and others who advise and mentor students of

science and engineering -- attempts to summarize features that are common to successful mentoring relationships. Its goal is to encourage mentoring habits that are in the best interests of both parties to the relationship. While this guide is meant for mentoring students in science and engineering, the majority of it is widely applicable to mentoring in any field. http://www.nap.edu/readingroom/books/mentor/

40. Committee in Science and Engineering: A Student Planning Guide in Grad School and Beyond (1996). Washington, DC. National Academy Press. Skills and attributes that contribute to a successful career as a scientist, engineer, scholar and professional are defined and discussed. http://www.nap.edu/readingroom/books/careers/

41. Computing Reseach Association Committee on the Satus of Women in Computing Research. Career Mentoring Workshop. This publication is a culmination of a decade of information provided at workshops. http://www.cra.org/Activities/craw/projects/mentoring/mentorWrkshp/transcripts.pdfhttp://cct.edc.org/admin/publications/report/telement_bomhsg98.pdf

42. Davis, G. Doctors without Orders. American Scientists 93 (3). http://postdoc.sigmaxi.org/results/ http://www.sigmaxi.org/postdoc/highlights.pdf. A summary of national highlights from the Sigma Xi Postdoc Survey, based on information provided by 7,600 postdoctoral scientists at 46 American research institutions, appeared in a special 16-page insert called "Doctors Without Orders" in the May-June 2005 issue of *American Scientist*, the magazine of Sigma Xi, The Scientific Research Society.

43. Gwynne Peter. Success Factors for Postdocs: Ensuring A Fruitful Fellowship. Science, 2004. In an online survey sponsored by *Science* Careers, more than 900 present and past postdocs, the majority of them in life science departments, identified factors most critical to the success of their postdoc. Respondents generally assigned the most significance to five factors: mentoring (which 83 percent of participants viewed as very important or extremely important); a sense of direction and vision (81 percent); the ability to obtain funding and grants for postdoctoral work (79 percent); encouraging postdoctoral fellows to carry out and publish research that appeals to potential employers (78 percent); and helping postdocs to network with the scientific community (75 percent). The large majority of respondents expect to establish their permanent careers, including learning new research, expanding their skill sets, and publishing research papers.

44. Highsmith, Robert J., Ronni Denes, and Marie M. Pierre. 1998. "Mentoring matters." *NACME Research Letter*; v8 n1 1998. This paper examines the role of mentoring and the internship experience in this successful program. Each year, NACME surveys CSP scholars and supervisors to provide feedback regarding components of successful internship and mentoring experiences. In 1997, NACME distributed surveys to 87 NACME scholars with CSP internships and their supervisors. The surveys examined their satisfaction with the program. Results indicated that successful mentoring made a significant difference, contributing substantially to interns' interest in returning to their host companies and their overall evaluation of workplace experiences. Students and supervisors differed significantly in how they viewed and interpreted the experience. The investigation led to four recommendations: recognize the value of teaming; invest time in developing engineering talent; respect the ambition and abilities of interns; and engage interns in exploring future possibilities.

45. Howard Hughes Medical Institute. Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty. Collection of practical advice, experiences,

and opinions from seasoned biomedical investigators. http://www.hhmi.org/resources/labmanagement/moves.html

46. MentorNet. College and university student participants indicate that e-mentoring by STEM professionals is beneficial for both academic and personal mentoring. www.mentornet.net/

47. Ortolani, Alessis. Mentoring Graduate Studnets at UC Davis: Results of the 1998 Menotring Survey. Overall, 56% of graduate students were either "satisfied" or "very satisfied" with dissertation guidance. Overall, 71% of the students report being "satisfied" or "very satisfied" with financial support, but there are significant differences in the satisfaction level across disciplines. Engineering students are the most satisfied with financial support (77.1%), followed by Math and Physical Sciences students (76.8%) and then Biology students (73.1%). Students in the Arts and Humanities and in the Social Sciences report the lowest satisfaction ratings for financial support (44.9% and 54.5% respectively). Overall, 68% of students are satisfied with the interpersonal interaction with their mentors. Career help received the lowest satisfaction ratings of all mentoring areas: only 40% of the students are "satisfied" or "very satisfied" overall. On average, female students are less satisfied than males on a number of mentoring roles under interpersonal interaction (i.e. "Treats me as a colleague," "Is a personal friend" and "Does not abuse his/her power"), career help (i.e. "Is willing to discuss a variety of career options with me," "Makes me aware of current job opportunities in my field" and "Teaches me how to network") and financial support (i.e. "Helps me secure adequate space to do my research"). Females are also less satisfied than males with interpersonal interaction as a whole. Finally, female students meet on average less often with their major professor (i.e. less than twice a month) than male students do (i.e. more than twice a month). Two thousand, nine hundred and twenty two surveys were sent out in the spring of 1998, representing all graduate students enrolled in the Fall of 1998. Nine hundred and one graduate students completed surveys, representing a 30.8% response rate.

48. Riskin, Eve, Mari Ostendorf, Pamela Cosman, Michelle Effros, Jia Li, Sheila Hemami, Robert M. Gray. Mentoring for Academic Careers in Engineering: Proceedings of the PAESMEM/Stanford School of Engineering Workshops (2005). In late June 2004 a workshop was held at Stanford University on the subject of mentoring for academic careers in Engineering. The workshop provided a forum on the needs, goals, methods, and best practices for mentoring engineering students interested in an academic career, for young faculty beginning such a career, and for recently tenured faculty. http://paesmem.stanford.edu/html/proceedings.html

49. Rutter, Joni L., R. Sowmya Rao, Isabella Bouchelet, Graca Dores, Helen Green, James Gulley, Jennifer Koblinski, Martha Lundberg, Rachael Stolzenberg-Solomon, Robert Wheelock, Wendol Williams, Tyra Wolfsberg, Barry Graubard, Patricia Hartge, Sholom Wacholder, and Joan P. Schwartz. 2003. "Survey of mentoring experiences of NIH postdoctoral fellows." The Mentoring Subcommittee of the NIH Fellows Committee and their consultants, National Institutes of Health, DHHS, Bethesda, MD, available online at http://felcom.nih.gov/Mentoring/Mentor_revised_081403.pdf. The NIH Fellows Committee has identified key components of good mentoring and areas of concern through a representative survey. From 3,051 fellows who met the survey inclusion criteria, a random sample of 750 was drawn, and 72% responded. Although we found that over 70% of the fellows were satisfied with their overall mentoring, we found that there were a significant number of fellows who felt that they were too independent, suggesting that little effective mentoring is occurring. In addition, a significant number of fellows reported that

they did not discuss their training goals and/or career goals with their mentor. One interpretation of this finding is that it is not of interest to the mentors to ensure that training and career goals of their postdoctoral fellows are met. This is not to suggest that the onus falls completely on the mentor, as much as it is to point out that the supervisor-trainee relationship is one where the supervisor is meant to be a guide. Surprisingly, factors such as institution size, number of other fellows under the mentor, gender, or ethnicity did not significantly contribute to the three outcomes.

50. Seymour, Charlena, Tony Jno Baptiste, Susan Cocalis, Kathy Foley, Tanya Kachwaha, Ann Lewis, Shantikumar Nair, Klaus Nuesslein, Sarah Scarchilli, Julian Tyson, and Robert Wolff. 2001. "Report of the task force on graduate student mentoring." University of Massachusetts Amherst Graduate School. A survey conducted by the Task Force showed that although many programs have formal advising for graduate students, there was little systematic mentoring at the University of Massachusetts Amherst. A Task Force literature search showed that mentoring has multiple benefits for the academic community. Most importantly for the student, mentoring can increase retention rates and decrease time-to-degree. It can also assist students with taking responsibility for (or ownership of) their academic programs, help to build community, permit increased acculturation of the student and mentor, and improve awareness of diversity on the parts of both the student and the mentor. The Task Force believes that establishment of a systematic mentoring program at the University of Massachusetts Amherst would have benefits far beyond the immediate satisfaction of graduate students by extending to a wider and more tightly woven network of satisfied graduate alumni with all of the implied benefits of such a group.

51. Schultz, Jeffery R. The Transformational Process of Mentoring. Council on Undergraduate Research Quarterly. December 2001. This articles identifies strategies for assessment of undergraduate research and intership programs. http://www.cur.org/conferences/responsibility/ab_mentor.pdf

52. Starcevich, Matt. M. What is Unique about Reverse Mentoring, Survey Results? The Center for Coaching and Mentoring. http://www.coachingandmentoring.com/reversementoringresults.htm. Reverse mentoring relationships are developed to gain technical expertise and a different perspective. Mentors were not an older person mentoring a younger person for this group; it was more a peer-to-peer relationship in which both people have a lot to teach and lot to learn. In line with our earlier survey (http://coachingandmentoring.com/mentsurvey.htm) planning and management of the relationship are critical. A commitment of time, having a game plan/goal and rules of engagement, as well as listening, being open minded and patient seem to be central ingredients for any mentoring relationship, not just a reverse relationship. These results indicate that there is nothing unique about reverse mentoring. These same challenges need to be managed in any mentoring relationship. The operative word is “mentoring.” Fifty nine people responded to the on-line survey during the first quarter of 2001. Thirty seven were mentors (the person doing the mentoring) and twenty two were partners (the person being mentored). They were from such diverse organizations as government, consulting and financial services. Only 9% were Executives while 40% were Middle Managers, 25% First Level Managers and 26% Individual Contributors. The results are limited by the fact that this was a voluntary survey, with no attempt to obtain a representative sample. Although we did not control for gender or racial differences, no respondents chose as the biggest challenge in making a reverse mentoring relationship productive "getting over our gender differences," and only one chose "getting

over our racial differences." Subsequent inquires from journalists about the survey results suggests that there may be some challenges in these areas and worthy of further study.

53. Stern, Virginia and Michael Woods. Roadmaps and Rampways (2001). American Association for the Advancement of Science, Washington, DC. Roadmaps and Rampways chronicles the journeys of three dozen students from childhood to higher education in science, engineering, or mathematics, and on through their early career decisions. http://ehrweb.aaas.org/rr/index.html

Other Annual Meeting Reports

54. Frierson, Henry T., Jr. 1996. “Comparing science and non-science minority students' perceptions and satisfaction with a short-term research and mentoring program.” Paper presented at the Annual Meeting of the American Educational Research Association (New York, NY, April 9, 1996). This study is a follow-up to earlier studies that examined interview responses of students who participated in summer research programs. The objectives of those studies were to qualitatively compare the perceptions of mentoring-related experiences of African American college students in the sciences with those in the humanities and social sciences. The purpose of this study was to follow up the early studies and to examine students' responses from questionnaires that were given at the end of each program. Results indicate that the students engaged in directed humanities and social science research had a higher proportion of positive responses.

55. Frierson, Henry T., Jr. 1996. “Perceptions of faculty preceptors in a summer research program targeted at minority undergraduate students.” Paper presented at the Annual Meeting of the American Educational Research Association (New York, NY, April 8-13, 1996). This paper reports the perceptions about students and the personal experiences of 23 faculty who served as preceptors for 32 undergraduate African American and other students of color and minority ethnic groups who participated in a ten week, summer research program for high-achieving students. Each faculty member preselected the student whom they wished to direct before official offers for participation were made. Faculty covered a broad range of disciplines from the humanities to the physical sciences. Faculty were interviewed in the ninth and tenth weeks of the program to obtain their assessment of the program and their experiences, particularly their perceptions about the students and their relationships with them. Findings revealed that mentors' general perceptions about the students were positive, especially when related to a student's ability to conduct research. Mentors' perceptions of their own effort and involvement in the program were also positive.

56. Grant, Linda and Others. 1993. “Mentoring, gender, and careers of academic scientists.” Paper presented at the Annual Meeting of the American Educational Research Association (Atlanta, GA, April 12-16, 1993). This study explores the dynamics and effects of mentoring relationships, with particular emphasis on the experiences of women and minorities as proteges. It draws upon quantitative and qualitative data gathered from a survey of 587 academic scientists and interviews with 55 academic scientists, in three disciplinary areas: physics and astronomy, chemistry and biochemistry, and sociology. Results are analyzed in terms of effectiveness of mentors, access to eminent mentors, advantages and disadvantages of mentors, gender-neutral themes, gender-specific themes, problematic relationships, race/ethnicity-linked themes, collaboration, other mentors and consequences of the mentoring experience. The study concludes that women and minority

scientists, overall, appear to find the mentors they need for career success, have effective mentoring relationships with doctoral and postdoctoral advisers, and find other mentors when necessary. Problems in mentoring relationships include difficulty in gaining access to the eminent mentors whose sponsorship can help to jump start their careers and a series of gender-related and race-related difficulties in sustaining mentoring relationships within the academic system.

57. Grant, Linda, Kathyn Ward, and Fisher, Carrie. Mentoring Experiences of Women and Men in Academic Physics and Astronomy. Women at Work: A Meeting on the Status of Women in Astronomy (1992). The successful women and men scientists surveyed report positive mentoring experiences. Nevertheless, women's relationships at the doctoral level are slightly less effective than men's and women work less with the eminent mentors whose sponsorship might boost them into the inner circle of scientific disciplines. Women also face gender-specific disadvantages in some mentoring relationships, such as paternalism or diminished attention to their work that might keep them in the outer circle of scientific disciplines. The findings suggest that mentoring of women can be improved. Also, it is probable that less favorable mentoring experiences might have discouraged persistence of some capable women, or diminished the likelihood that they attained employment in doctoral-granting departments. This topic demands further study, most likely with a prospective research design. Although women physicists and astronomers have less access than men to the most influential and effective mentoring relationships, they do not appear to be disadvantaged in career productivity, once they attain positions in doctoral-granting programs. http://www.stsci.edu/stsci/meetings/WiA/grant.pdf

58. Carlsen, William S. and Peg Boyle Single. 2000. “Factors related to success in electronic mentoring of female college engineering students by mentors working in industry.” Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (New Orleans, LA, April 28-May 1, 2000). This paper reports findings from a comprehensive evaluation of the first national electronic mentoring program that matches female engineering students with mentors working in industry. The program being evaluated -- MentorNet -- uses a combination of on-line tools, computer databases, mentoring specialists, and campus and industrial contacts to recruit, match, train, coach, and monitor bimonthly e-mail exchanges between women studying science and engineering fields and mentors working in engineering fields. The paper examines the effects of student-mentor matching algorithms, coaching, engineering field, and mentor and student attributes on a variety of outcome measures, including participant reports, the frequency and substance of communication, and students' interest in persisting in science and engineering.

59. McGinnis, Robert and J. Scott Long. 1980. “Mentors have consequences and reap returns in academic biochemistry.” Paper presented at the Annual Meeting of the American Educational Research Association (Boston, MA, April 7-11, 1980). This paper explores the possible measurable effects of mentors (major professors) on the subsequent productivity of the mentor's students. Also asked is whether there are benefits to the productive scientist who acts as a mentor. Analysis is based on a population of male biochemists who obtained their doctorates in 1957, 1958, 1962 and 1963. Various measures of departmental, mentor and/or student productivity and prestige were obtained. Sources included biographic information from American Men (and Women) of Science and productivity indications from the Science Citation Index and Chemical Abstracts. Results indicate no visible mentor effects, unless the postdoctoral context is one in which research

productivity is encouraged. Other results indicate that the productivity of former students positively influences the research visibility of the mentor.

60. Packard, Becky Wai-Ling and E. David Wong. 1999. “Future images and women's career decisions in science.” Paper presented at the Annual Meeting of the American Educational Research Association (Montreal, Canada, April 19-23, 1999). This report presents a working model of how future images influence women's career decisions in science. Based on interviews with college women who invested at least two years in college science, the nature and source of women's conflicting future images, or clash of future selves, when considering science careers is described. Women identified three kinds of clashes: (1) type of person; (2) lifestyle choices; and (3) purpose of science work. The source of these clashes was the discord between the images projected by people in the field and students' desired future images. Students questioned whether they were in the right field, because they were unable to identify images that were consonant with their desired future images. Specifically, the students' positive image of being "collaborative" clashed with the field's negative projected image of being "competitive," the positive image of "combining family and career" clashed with the negative projected image of "being childless and unbalanced," the positive image of scientific work as "contributing to society" clashed with the negative projected image of scientific work as done "for the money or sake of science." In order to help them work through these conflicts, the students turned to others for mentoring. As a consequence, some students pursued other fields while others shifted to different careers within the field, and a few took steps to redefine the field through creative uses of mentoring.

61. Shore, Cecilia and John Hughes: Training doctoral students for mentoring undergraduate research. Presented at Council on Undergraduate Research, June 2004 in La Crosse, WI. An assessment of the Doctoral-Undergraduate Opportunities for Scholarship (DUOS) program seeks to increase the synergy between graduate and undergraduate programs at Miami University. Each year, ten undergraduates have intellectual ownership of research guided by a doctoral student mentor. The program is intended to: add a distinctive experience to undergraduate education, increase availability of graduate students as role models for undergraduates, enable doctoral students to enhance their skills as research mentors and reflect on the role they play in undergraduate education, and document doctoral students’ achievements as research mentors for later job applications. http://www.users.muohio.edu/shorec/DUOS/final_reports_2003-4/CURposter.htm

STEM Mentoring Dissertation

62. Aittola, Sisko Helena. 1995. "Mentoring in postgraduate education." Dr.Ed. dissertation, Jyvaskylan Yliopisto, Finland. The aim of this study was to analyze the study processes, supervision and mentoring relationships in postgraduate education from the point of view of students. The data of the study were collected in 1988 by a comprehensive questionnaire posted to 700 postgraduate students representing a variety of disciplines at different universities in Finland. The questionnaire was returned by 326 students. The results show that different disciplinary norms and organizational structures influence research processes in postgraduate education. The nature of postgraduate studies varied greatly between the social and the natural sciences. However, the way in which research projects were supervised varied not only across disciplines but also according to the degree (licentiate/PhD) and the stage of research. In some cases supervision failed to support

students' research projects. Analyses of mentoring relationships need to be based on a developmental perspective. The main functions of mentoring were academic, psychosocial and career-related functions. The results imply the need for a more clearly defined conception of the postgraduate programme as research training. This would require a deeper understanding of the nature of research in different disciplines, a clarification of supervisory responsibilities and a redefinition of the intellectual and developmental tasks of mentoring in postgraduate education.

63. Baker, Meecee Mary Martha. 1994. "Mentoring activities and the career paths of women earning B.S. degrees in agricultural education at the Pennsylvania State University (Bachelor of Science)." PhD dissertation, The Pennsylvania State University. The purpose of this study was to describe the mentoring activities and career paths among women with B.S. degrees earned in agricultural education from The Pennsylvania State University who entered and remained in the profession of teaching agriculture, those who entered and left, and those who never entered. The population for the study was the 80 living female graduates. Sixty three (79.9%) women responded. Data was collected via telephone interviews. Descriptive statistics were used in the analysis. The research questions dealt with the career paths, demographic, and educational activities of the graduates, as well as the characteristics of the graduates' mentors, their mentoring activities and relationships. Women entered agricultural education because of their desire to teach and their interest in agriculture; but, many left the field because they couldn't get hired. Nevertheless, the graduates tended to follow a teaching career path. The current agriculture teachers reported having more mentors before and after graduation. Before graduation, career guidance, role modeling, and cheerleading were the most frequently reported mentoring activities. Help in job searches, introductions to key people, and encouragement to join professional organizations were the most frequently cited post-graduation mentoring activities. Evidence indicates that women who graduated from Penn State need assistance in career guidance and securing permanent positions. Moreover, the lack of female role models has made it difficult for women to enter and advance in the field of agricultural education.

64. Belknap, Kathy A. 1998. "The relationship between assigned peer mentors and the retention and GPA of female and male engineering students." PhD dissertation, University of Idaho. The objective of this dissertation study was to examine if there was a significant relationship between assigned peer mentors and the retention and GPA of female and male engineering students. This study investigated engineering students at the University of Pittsburgh (Pitt) in Pittsburgh, Pennsylvania. GPA and retention information was gathered for students without a peer mentor and for students with a peer mentor. The results of the analysis showed no difference in retention or GPA for mentored and non-mentored male and female engineering students. There was a significant difference in the GPA of the women and men engineering students, with the women having higher GPA's at the end of the freshman year. Finally, in this study, there was not a significant difference in the retention of female and male engineering students.

65. Buckingham, Gregg A. 2002. "An evaluation of face-to-face mentoring vs. electronic mentoring." Ed.D. dissertation, University of Central Florida. The purpose of this study was to investigate the impact of a variety of mentoring methods on students' attitudes toward science, academic performance and retention of classroom science material. Subjects for the research were seventy one biology students at Brevard Community College located in Cocoa, Florida. Two NASA mentors provided real world applications of academic concepts being learned in an introductory biology class. The mentors worked

with one class via videoconferencing and with another class face-to-face. A third class served as a control group. The study took place in fall 2001. Results indicated students' attitudes toward science changed over time, with the mentored classes having the higher interest scores on four of five interest subscales. The electronically- mentored class had the highest mean on three of the five interest subscales. Student performance was also positively affected in the mentored classes. No significant increased retention of assigned science material was found.

66. Campbell, Ashley McDowell. 2002. "The influences and factors of an undergraduate research program in preparing women for science careers." Ed.D. dissertation, Texas Tech University. This study employed mixed methods, utilizing both a questionnaire involving all past female fellows in the Texas Tech University Howard Hughes Medical Institute (TTU/HHMI) Undergraduate Biological Sciences Education Program, and in-depth interviews with seven fellows who chose a career as a professional scientist. According to the quantitative data, research experience, the relationship with mentors and opportunities to present at state or national meetings were program factors that fellows identified as contributing to their career success. The TTU/HHMI program experiences positively influenced the fellows' level of interest in science, confidence in science, and motivation to pursue a science-related career. Qualitatively, six themes were identified for coding, which included: (1) research experience; (2) the mentor; (3) support and interactions; (4) self-confidence; (5) career decisions; and (6) time demands related to a science career. The themes identified were important factors in preparing these past female fellows for a career in science by initiating a change in their attitudes, knowledge and skills. With over 90% of past fellows currently pursuing a science career, the program, through research experience and encouraging mentors, made a significant impact on the career paths of fellows. Data from this study support the premise that the TTU/HHMI program, and similar programs, that provide undergraduate women with research experiences and mentoring, have the potential to increase the number of women pursuing and continuing in science careers.

67. Cohoon, Joanne and Louise McGrath. 2000. "Non-parallel processing: Gendered attrition in academic computer science." PhD dissertation, University of Virginia. This dissertation addresses the issue of disproportionate female attrition from computer science as an instance of gender segregation in higher education. By adopting a theoretical framework from organizational sociology, it demonstrates that the characteristics and processes of computer science departments strongly influence female retention. The empirical data identifies conditions under which women are retained in the computer science major at comparable rates to men. The research for this dissertation began with interviews of students, faculty and chairpersons from five computer science departments. These exploratory interviews led to a survey of faculty and chairpersons at computer science and biology departments in Virginia. The data from these surveys are used in comparisons of the computer science and biology disciplines, and for statistical analyses that identify which departmental characteristics promote equal attrition for male and female undergraduates in computer science. This three-pronged methodological approach of interviews, discipline comparisons and statistical analyses shows that departmental variation in gendered attrition rates can be explained largely by access to opportunity, relative numbers, and other characteristics of the learning environment. Using these concepts, this research identifies nine factors that affect the differential attrition of women from CS departments. These factors are: (1) the gender composition of enrolled students and faculty; (2) faculty turnover; (3) institutional support for the department; (4) preferential attitudes toward female students; (5) mentoring and supervising by faculty; (6)

the local job market, starting salaries, and competitiveness of graduates; (7) emphasis on teaching; and (8) joint efforts for student success.

68. Dagenais, Raymond John. 1990. “A study of selected ability, physical and psychological variables and the achievement of a successful mentoring experience (physical matching, affective matching, technical matching).” Ed.D. dissertation, Northern Illinois University. The goal of this study was to identify characteristics which were positively correlated with the achievement of a successful mentoring experience. A review of the literature suggested selected ability, physical and psychological variables as potential candidates. The sample population consisted of 67 students, aged 14-18, who were identified as gifted or talented and interested in the fields of science and/or mathematics. These students were formally matched with mentors in the fields of science, mathematics and technology for a period of four weeks. Questionnaires which gave measures of the cognitive flexibility of the protege, the affective, physical and technical dimensions of the match, and the success level of the mentoring experience were administered to this sample population. Analysis of the data revealed that the cognitive flexibility, as well as the verbal and quantitative abilities, of the mentees were not correlated to a successful mentoring experience. However, the degree to which the mentees were matched to their mentoring experiences was shown to be positively related to the achievement of a successful mentoring experience. Evidence for this relationship was derived from the fact that the affective, physical and technical dimensions of the match all exhibited positive correlations with the achievement of a successful mentoring experience.

69. Davis, Barbara Jeane J. 1989. “The mentor-mentee relationship between doctoral advisers and advisees at an historically black university.” Ed.D. dissertation, Texas Southern University. The purpose of this study will be to investigate the existence and magnitude of mentor-mentee relationships between doctoral degree advisors and advisees at Texas Southern University, an historically black institution. The population for this study was doctoral students who were enrolled at the university during the 1988-1989 school year, those who have graduated from the doctoral program and those faculty members of the School of Education and Behavioral Science who were designated as doctoral advisors. The advisor-advisee questionnaire was administered to determine the existence and magnitude of the mentoring behaviors of trust, befriending and awareness of personal attributes between doctoral advisors and advisees as affected by the gender of the participants, the age of the participants, the full- or part-time enrollment status of the advisee, the advisee's acquisition of advisor by assignment or by choice or the length of the advisor-advisee relationship. The independent t-test and the one-way analysis of variance were employed for the statistical data analysis. Of the 18 null hypotheses tested, significance was found in the level of befriending and the awareness of personal attributes between advisors and advisees. This significance was affected by gender, full- or part-time enrollment status of the advisee, and by method of acquisition of the advisor by the advisee. One hundred percent of the advisors considered themselves to be mentors, and 76.2% of the advisees considered advisors to be mentors.

70. Dimasi, Gabriel J. 1992. "The effects of mentoring on technical personnel of an engineering organization of the United States Government." Ed.D. dissertation, Temple University. The purposes of this study were: (1) to measure the professional success and personal growth and development of individuals involved in a mentor relationship, as part of a formal program or as an informal development; (2) to determine the effects of cross-gender and cross-race mentoring on the protege; (3) to determine the effects of mentoring on the

professional success of minorities and women; and (4) to assess the benefits accrued to the mentor in an informal relationship and in a formal program. The sample was limited to civilian technical members of an engineering organization of the United States Government. These included 75 white men, 75 minority men and 75 white women as well as all of the 35 minority women who qualified as subjects. The minority participants were Asian, Black and Hispanic. Of the 198 participants, 55.6 percent reported that they had received mentoring during their career. The professional success of three groups, those who developed informal mentor dyads, those who participated in formal organization sponsored programs, and those who were not mentored, were compared. Significant differences in success were found between the informal and nonmentored groups. In cross-gender relationships the comparison of female-male and male-female protege-mentor relationships were not found significantly different in professional success. The same-gender and cross-gender relationships were also tested for significance, but differences were not determined. The professional success of mentored cross-race, same-race minorities, and same-race non-minorities were compared. Significance was found between the same-race non-minorities, white-white dyads, and the nonmentored.

71. Febbraro, Angela Rosa. 1998. "Gender, mentoring, and research practices: Social psychologists trained at the University of Michigan." PhD dissertation, University of Guelph, Canada. This thesis investigates the effects of gender and mentoring on the research practices of a sample of female and male social psychologists who received their PhDs from the University of Michigan between 1949 and 1974. During this period 338 social psychology PhDs were awarded (53 to women, 285 to men). This study focuses on all 53 women PhDs and a matched sample of 53 men PhDs who shared a similar graduate training background. Based on the identity of the thesis advisor (or “mentor”), each social psychologist was categorized into one of three mentoring groups, distinguished by certain theoretical and methodological affinities. A sample of 564 first-authored journal articles (374 empirical and 186 nonempirical), contributed by 77 of these 106 Michigan graduates, was examined for the use of particular research practices. Three 2 (gender) x 3 (mentoring group) multivariate analyses of variance were conducted to assess those research practices found in: (1) empirical articles only; (2) nonempirical articles only; and (3) both empirical and nonempirical articles. Results showed a main effect for gender in all three multivariate analyses, and a main effect for mentoring group in the empirical multivariate analysis. Univariate analyses demonstrated that men were more likely than women to use quantitative methods in their empirical research and to express proexperimental views in their nonempirical work. Women were more likely than men to publish articles on gender roles and feminine topics or that included feminist perspectives. This study demonstrates the importance of extra-scientific influences in shaping science, and provides mixed support for feminist theories regarding gender differences in the conduct of science (e.g., the agentic/communal distinction).

72. Filippelli, Laura Ann. 1997. "The mentoring of male and female scientists during their doctoral studies." PhD dissertation, University of Illinois at Chicago, Chicago, IL. The mentoring relationships of male and female scientists during their doctoral studies were examined. A reliable instrument, “The Survey of Accomplished Scientists’ Doctoral Experiences,” was developed to assess career enhancing and psychosocial mentoring of doctoral chairpersons and student colleagues based on the review of literature, interviews with scientists and two pilot studies. Surveys were mailed to a total of 400 men and women scientists with earned doctorates, of which 209 were completed and returned. The findings reveal that female scientists considered the doctoral chairperson furnishing career

enhancing mentoring more important than did the men, while both were in accordance with the importance of them providing psychosocial mentoring. For doctoral student colleagues, female scientists, when compared to men, indicated that they considered student colleagues more important in providing career enhancing and psychosocial mentoring. However, male and female scientists were equally satisfied with their colleagues as providers of these mentoring functions. Lastly, the majority of male scientists indicated that professors served as a positive influencer, while women revealed that spouses and friends positively influenced their professional development as scientists. Several recommended changes in science departments are provided.

73. Gakuba, Alla Petrovna. 1985. "A study and analysis of the factors influencing professional women engineers' attitudes and motivation." D.B.A. dissertation, The George Washington University. The subject of this study is women engineers in the United States with at least a bachelor's degree in engineering and one or more years of professional experience. An exploratory model of utilization of women engineers was developed to serve as a framework for the study. The objective of the study was to determine whether differences in perceptions exist between pioneer and young women engineers and what internal/external factors most and least influence motivation and attitudes of women engineers. Statistically significant differences were found between the means of pioneer and young women engineers, mean scores for the young group being considerably higher for all variables. Attitudes were assessed by measuring five possible sources of discrimination in organizations -- from secretaries, peers, immediate supervisors, middle management and outside clients. Significant differences were found in mean scores between the two groups for all sources except outside clients. The highest degree of discrimination comes from middle management with both groups of participants. Least discrimination comes from outside clients to the pioneer group and from secretaries to the young group. Internal factors consist of women engineers' personal background, bachelor's degree field, employment status, responsibility, continuing education, age group, professional experience, marital status, number of children, salary range, professional registration, and patents, publications and papers. The study found that all internal factors greatly influence women engineers, motivation and attitudes and contribute to significant differences in mean scores of participants. External factors consist of the organizational environment, type of employer, size of organization, number of women engineers in an organization and existence of a mentor. All external factors except type of employer were found to be a great influence on participants' motivation and attitudes and contributed to significant differences in mean scores between the pioneer and the young groups.

74. Garner-Williams, Elizabeth. 1998. "The Office of Naval Research support underrepresented ethnic groups mentoring model redirecting science education: An "investigative" case study." PhD dissertation, The Florida State University. This is a cultural study of African American students in a mentoring program. The purpose of this dissertation is to investigate the efforts of the Office of Naval Research (ONR) program which mentors African Americans by redirecting and encouraging them to pursue careers in scientific fields. The study investigates whether African American students at Florida State University (FSU), a historically white university, and a participant in the ONR program, significantly benefits African American students by providing a mentor with the same cultural background. The research is significant, because it highlights an understanding of underrepresentation of African Americans and the African American students understanding of those who are charged with the responsibility of educating them on historically white university campuses.

75. Haggray, Mildred Annette. 1992. "An interpretive case study of perceptions and experiences of undergraduate women in engineering majors at Iowa State University (women engineering majors)." PhD dissertation, Iowa State University. The purpose of this study was to describe and analyze the perceptions and experiences of selected undergraduate women in engineering majors at Iowa State University. Using qualitative research methods, the researcher described and analyzed the effects of selected educational environment factors on the persistence of women in engineering majors. Primary data sources included semi-structured individual interviews with nine undergraduate women representing each undergraduate classification level and two focus group discussions with six to eight undergraduate women in engineering majors. Supplementary data was obtained from a related survey of undergraduate women in engineering majors sponsored by the Program for Women in Science and Engineering. A discussion and analysis of the actual experiences and perceptions of the research participants are included. Findings from the study identified negative academic environment concerns (e.g. sexism, harassment, sex role stereotyping), inadequate and ineffective internal support systems (e.g. poor and inadequate advising, lack of consistent mentoring and research opportunities, inadequate academic preparation in practical knowledge of scientific concepts), and lack of sufficient peer support, as some of the problems female students are experiencing in engineering. Several strategies were identified that faculty and administrators may use to raise awareness of the issues and concerns of female students in male-dominated disciplines.

76. Hawkins, Elizabeth Jemison. 1997. "Faculty perceptions of the research environment at four Mississippi institutions of higher learning." PhD dissertation, The University of Mississippi. This research compared the perceptions of the environment for research of three groups of faculty at the four institutions of the Mississippi Research Consortium (MRC): Jackson State University, Mississippi State University, The University of Mississippi and The University of Southern Mississippi. The groups were the faculty funded by the National Science Foundation (NSF) EPSCoR program, the faculty in the same disciplines as the EPSCoR faculty and the remaining faculty in disciplines fundable by the NSF. Data were collected through a survey of the full faculties in the spring of 1997. The study compared perceptions in the broad areas of physical resources, personnel assistance and professional opportunities, institutional administrative support, and policies and practices. Results reveal that faculty members with the consistent funding, mentoring, and team research of the EPSCoR program had the greatest degree of satisfaction with their research environment. Faculty members with the most success in obtaining external funding had more positive perceptions of institutional environment than faculty less successful in obtaining external funding. Responding faculty members, despite their external funding, viewed institutional support for personnel assistance, professional development, and certain policies and practices less favorably than support for physical resources and administrative support mechanisms.

77. Johnson, Bettina Ann. 2001. "Mentoring in academia: An exploration of mentoring relationships between graduate students and faculty members." PhD dissertation, University of Illinois at Urbana-Champaign. An interview study and a web survey study were conducted to investigate the mentoring relationships between graduate students and faculty members. Participants in the interview study were 32 (16 female, 16 male) graduate students registered in one of seven randomly selected academic departments at a large Midwestern university. Participants in the web survey were an independent sample of 278 graduate students (150 female, 128 male) enrolled in one of 18 academic departments at the same university. The results of the interview and survey studies,

together, suggest several conclusions about the mentoring of graduate students by faculty members. First, students' experiences in their mentoring relationships were very positive, and students who had not established such relationships did not fare as well as those who had. Furthermore, women were less likely to have a mentor but were very successful if their mentor was also female. Not having a mentor was especially detrimental to students in humanities and social science departments but not for those in physical/natural science departments. Second, students wanted and seemed to benefit from having more than one mentor. Third, students thought almost all positive traits are important in a mentor, but there was some disagreement over whether the sex of a mentor was important. And fourth, though there were some differences by sex composition of departments, these differences did not strongly support the predictions made by expectation states theory or proportionality theory for mentoring relationships. These differences were much clearer when examined in terms of the differences in the content areas across departments.

78. Kahn, Sharon Rae. 1990. “Male graduate students' evaluations of their dissertation advisory relationships: A comparison of same-sex versus cross-sex mentoring experiences.” PhD dissertation, City University of New York. Research on both male protege/female mentor dyadic relationships and mentoring techniques have been neglected topics in empirical investigations. In this study at an urban commuter graduate school, 86 male dissertation candidates, in various disciplines, completed an extensive survey of their graduate school advisory and mentoring experiences. Programs studied were selected on the basis of their having faculty compositions that were at least 15% female. Seventy three percent of students reported their dissertation advisor was also their mentor. Dichotomous questions were analyzed through the use of chi squares. Scale means were analyzed for significant differences through the use of t-tests, and analyses of variance. Open-ended questions were content-analyzed. Overall, the results suggested that groups were more similar than they were different. Most participants met their dissertation advisors in graduate courses taught by their advisor. Participants usually reported their dissertation advisors shared their research interests. Participants did not differ on their attitudes toward professional women. Finally, on the Bem Sex Role Inventory (BSRI) both groups rated themselves significantly higher on the feminine dimension when compared to their ratings for their advisor on this dimension. However, several significant differences were found between groups. Overall, males with female mentors rated their mentors more favorably on a mentoring scale. Furthermore, males with female mentors were significantly more likely to rate their mentoring experiences as having been both more intense and more nurturant than were males with male mentors. In addition, males with female mentors were more likely to report that they were included in their mentor's professional network than were males with male mentors. Finally, significant differences were found between personal gender-role traits and having a working mother. Male-advised males with working mothers rated themselves lowest on the masculine dimension of the BSRI, while male-advised males who did not have working mothers rated themselves highest on this dimension.

79. Kelly, Jill Elizabeth. 2001. "A comparison of females in levels I, II and III as per the influence of mentorship on their attitudes towards science and their career aspirations." PhD dissertation, Memorial University of Newfoundland, Canada. The purposes of this study were to examine the influence of mentoring, the attitudes towards science and the occupational plans of adolescent females in Levels I, II and III in an urban high school in Newfoundland and Labrador. Individual questionnaires were administered to 121 students attending one urban high school. The data from 75 returned questionnaires were analyzed using the statistical program, SPSS. Descriptive statistics, including percentages and

frequencies, along with chi-squared analysis were used to analyze the data. The findings indicated that 75% of the young women in the study could identify one or more mentors in their lives. There were no significant differences between those who identified mentors and those who did not on variables of attitudes towards self in the present or future, self-esteem, occupational plans, attitudes towards science or beliefs regarding women in science occupations. Some of the findings on young women's self-esteem and attitudes towards science and science-related occupations were not consistent with findings reported in earlier studies. Most of the young women in the study believed that significant adults in their lives had influenced their career-related decisions and supported the notion that schools should encourage mentoring. The majority reported having good self-esteem and felt confident when voicing their opinions. Most of the women surveyed were confident in their abilities in the sciences and believed they would be successful in school. It is recommended that parents become informed of the impact they and other significant adults have on the career decisions of their daughters. It is also recommended that schools attempt to promote mentoring for young women and to guide young women in their career planning, ensuring that occupations in science are presented as viable and possible options.

80. Laing, Delia J. 1991. "Technology management: The relationship between the career stages of engineers and scientists and innovation in research and development units." PhD dissertation, The University of Michigan. The purpose of this study was to examine what relationship, if any, exists between career stages of engineers and scientists and innovation in research and development (R&D) units. Data was collected by survey questionnaires (demographic data, work description, work climate, perceived innovativeness, organizational records data), selected on-site interviews, and organizational records from ten R&D units in two industries, four in automotive and six in computer. The 287 member sample of R&D professionals crossed three job levels: 13 Vice presidents, 24 senior Managers and 250 engineers/scientists. Using a descriptive analysis of four career stages -- apprentice, independent contributor, mentor, sponsor (Dalton, Thompson and Price, 1977), questionnaire and organizational data and a content analysis of the interview data -- the findings confirmed a relationship suggesting the more advanced the career stage of the professional, the higher the incidence of perceived and actual innovation. The study data uncovered organizational policies and practices attributed to the fostering of professional career development, innovation and the development of human resource talent for the organization.

81. Marotz, Lynn R. 1996. "The changing nature of the graduate faculty mentor: Causes and consequences." PhD dissertation, University of Kansas. This two-part, single-case study was designed to examine the perceived: (1) role of the graduate faculty mentor; (2) factors that could produce role changes; and (3) consequences that such changes might cause in the traditional graduate faculty mentor/student-aspirant model at a major public research-intensive institution in the midwest. The University of Kansas was selected as the study institution because it had characteristics typical of comprehensive, research intensive PhD-granting institutions in the U.S. A questionnaire was distributed to two hundred sixty tenured faculty members at the Associate and Full Professor levels in four selected schools: College of Liberal Arts and Sciences, Business, Education, and Engineering. In-depth interviews were later conducted with fourteen faculty members, yielding qualitative data that aided in the interpretation of quantitative findings. Analyses of survey and interview data netted several important findings. Increasingly, students are pursuing advanced degrees on a part-time basis and often for reasons that differ from those associated with the traditional model of graduate education. Typically, they are not interested in seeking a

mentoring relationship with faculty members, are often employed, want to complete degree requirements as quickly as possible and have little long-term desire to join the academic community. In turn, departments are attempting to respond to external pressures and student demands by modifying existing programs and requirements, offering programs off-campus and on varying schedules, and hiring contract faculty, thus altering the typical mentoring relationship, especially in the professionals schools. Such changes in departmental goals and objectives have contributed to a sense of personal and professional conflict among faculty.

82. Medley, Mary Dee. 2001. "How gender-specific listservs contribute to the professional development of faculty women in computer science." PhD dissertation, University of Georgia. The purpose of this study was to understand how women in computer science learn and benefit from using job-related, unmoderated, all-women listservs for professional development. The study was a qualitative study that included in-person interviews of ten female faculty members in computer science. The participants in the study are faculty in computer science departments at two-year colleges, small four-year institutions, city universities and large research institutions. Their teaching experience in the field ranges from five to more than twenty years. Three sets of interrelated categories were inductively derived through the constant comparative analysis of the data. The content of learning on the lists includes women's issues, professional opportunities, technical issues and pedagogy. The participants in the study all related instances in which they had teamed information that was important to their professional lives. For some of the content areas the listserv was the only place where the information was available. The methods by which learning took place include incidental learning and learning by direct inquiry. Each learning experience reported by the participants fell into one of the content areas and occurred through either incidental or direct means. One or more of the characteristics of the listserv provided an environment for each learning experience. Three conclusions were reached as a result of the study. First, women-only listservs provide opportunities for continuing professional education for faculty in computer science. Second, women-only listservs foster women's professional learning through a supportive environment, mentoring and, networking. And third, the content and methods of learning and the environment of the listservs are interrelated.

83. Mencucci, Joanne Marie. 1996. "Mentoring of women science and engineering doctoral students." PhD dissertation, The University of Connecticut. This study examined the nature and extent of mentoring of women science and engineering (S&E) doctoral students in American colleges and universities. This study attempted to ascertain: (1) how faculty mentoring is performed; (2) administrator perceptions of the most important mentoring elements; and (3) the relationship of mentoring to women S&E doctorate production. The National Research Council rank-ordered U.S. doctorate-granting institutions according to productivity indexes, i.e., the ratio of women S&E doctorates to total S&E doctorates awarded for 1994 women S&E doctorates. Graduate school deans in U.S. doctorate-granting institutions were asked to complete the Science and Engineering Mentoring Inventory (SEMI), an instrument designed to ascertain the nature and extent of mentoring among women S&E doctoral students. Usable returns totaled 233, a 75% response rate. Rank-ordered means and standard deviations revealed that same gender and cross-gender mentoring, mentoring assistance from women's centers on campuses and the removal of gender-related obstacles were the most prevalent mentoring practices on these campuses. Analysis of variance revealed significant differences according to Carnegie ratings and institutional size. Large Research I universities had the strongest mentoring programs.

Theme analysis of dean's perceptions revealed the following as paramount in the mentoring of women S&E doctoral students: (1) the presence of role models, i.e., critical masses of women on tenure tracks in the S&E departments; (2) early initiation of student mentoring; (3) mentoring workshops; and (4) faculty development seminars. The regression of Productivity Indexes on SEMI items of mentoring institutions accounted for only five percent of the variance. Regression exercises with the top ten schools revealed that over 61% of the Productivity Index variance was explained by mentoring.

84. Miller, Catherine Biros. 2002. "To be or not to be an expert: Academic advising and mentoring and the construction of academic identity among students in two information technology programs." PhD dissertation, University of Colorado at Boulder, Boulder, CO. This exploratory study addresses the gaps in the literature by focusing on how the advising and mentoring experiences of undergraduate students in two information technology programs at a large public research university might influence, positively or negatively, their construction of academic identities as computer scientists or technology experts, and ultimately their educational choices (i.e., persistence or attrition). The Technology, Arts, and Media (TAM) certificate program is a multidisciplinary program enrolling approximately two-thirds women, and thus represents a nontraditional program. The Computer Science program is a narrowly focused program enrolling approximately 85% men, and thus represents a traditional program. The researcher used three measurement tools to collect data: (1) documentary evidence related to the two programs; (2) primary and secondary observations of ten courses in the two programs; and (3) forty one student and advisor (thirty-one student and ten advisor) face-to-face semi-structured interviews. Analysis of the data revealed that advising and mentoring were rarely cited as factors directly related to the underrepresentation of women in information technology programs. Nonetheless, three themes emerged. First, advising experiences might indirectly and in very limited ways influence the construction of academic identity among women. However this influence becomes apparent primarily in terms of the absence, rather than presence, of advising experiences that encourage and support the development of women as legitimate computer scientists or technology experts. Second, mentoring relationships, which were not common, were not highly valued by most students in the sample. And third, learning environments supportive for the students in the sample were more evident in the nontraditional TAM program than in the traditional computer science program.

85. Mitchell, Judith Marie. 1987. “The association of the oldboy network with productivity and career satisfaction of women academicians, and antecedents to the oldboy network.” PhD dissertation, University of California, Los Angeles, CA. This study investigated the influence of the “old boy network” upon career success of women academics and explored potential predictors to network inclusion. Secondly, a career model was developed that suggested the old boy network is a mediator between early career experiences and opportunity structures on one hand, and career attainment outcomes on the other. A sample of 193 assistant and associate women professors in the social, biological and physical sciences were surveyed from eight doctoral-granting California universities. Career success was measured by publication counts, citation counts and career satisfaction. The old boy network was assessed by three measures of Finkelstein's Collegial Relations Instrument, the participant's perception of network inclusion and colleague support in the current working environment. Regression analysis indicated that network involvement and colleague support are significant predictors of publication counts along with rank and science field. All three network measures were significant predictors of career satisfaction. The old boy network measures did not significantly predict citation counts, although rank

and science field did. Antecedent variables that significantly predicted the old boy network were rank for network involvement, and having had a mentor and choosing highly visible research topics for collegial relations. Path analyses were significant for the path model of career satisfaction with collegial relations operating as a mediator between mentor and research topics, and career satisfaction. Findings suggest that academic women who are included in the informal old boy network activities tend to publish more and are more satisfied with their careers than women who are excluded from such activities. Women most likely to be included in networks were associate professors, and women who had past mentor experiences and did research on highly visible topics in their discipline. In-depth interpretation of these findings are discussed.

86. Montgomery, Donna Lynn. 1993. "Critical success factors in matching formal mentoring pairs in organizations (personal chemistry)." PhD dissertation, California School of Professional Psychology - Berkeley/Alameda. This qualitative study examines in depth the role of "personal chemistry" in the success of 11 formal mentoring pairs. Interviews were conducted in a division of a Fortune 100 Industrial company located in the northeastern United States that develops, produces and markets a broad spectrum of high-technology products. Participants volunteered to participate, and each pair member was interviewed separately. Pairs were ranked according to their success, which was a combined measure of goals compared to outcomes, strength of secondary outcomes and satisfaction. Findings indicate that the critical success factors were ability to engage in a relationship of temporary inequality, shared values regarding work, complementary and flexible mentoring styles and difference in age. An important additional finding was that the formal mentoring program had an impact on the organizational culture, moving it from one that validated "promotional mentoring" to one that values mentoring for the sake of development. Although not all pairs met their primary goals, all of those who participated were strongly in favor of the program's continuance.

87. Moore, Ellen. 1999. "Ideal and received mentoring of male and female graduate students in mathematics, the physical sciences, and engineering: Career development mentoring and psychosocial mentoring." PhD dissertation, Texas A&M University - Commerce. The current study: (1) explored graduate students, conceptualizations of the ideal mentor in order to formulate a definition of mentoring from the viewpoint of the mentee; (2) characterized their received-mentoring experiences; (3) predicted possible gender differences in mentees' ideal and experienced-mentoring using a portion of Deaux and Major's (1987, 1990) interactive theory of gender-related behaviors; and (4) explored gender differences in participants, conceptualizations of the ideal mentor and in their actual mentoring experiences. Participants for the study were a matched sample of 78 males and females enrolled in graduate programs in mathematics, the physical sciences, and engineering. A modified Delphi study format was used, with three rounds of data collection. Data from rounds one and two were subsequently examined for possible gender differences. The participants' definition of mentoring emphasized that an ideal mentor would teach the mentee to be a scientist and would serve as a role model. Both components of the definition included professional (career development) as well as personal (psychosocial) aspects. Participants indicated that they considered at least one professor to be a mentor, and that, with the exception of emotional support, they had received to some degree the mentoring behaviors specified in the two components of the definition. Throughout the study, males' and females' responses were more similar than dissimilar. Gender differences were found, however, in conceptualizations of the ideal mentor and in expectations versus actual mentoring experiences. One of the more

important findings of the study was that both males and females agreed that an ideal mentor would provide encouragement and support, but that they had seldom received such support from their professors.

88. Nicholson, Anita Lucindy Connelly. 1997. "Hispanic females, forty plus years of age, returning to six South Texas universities to study science and/or math: Biases, sources, effects, and the barriers imposed." M.Ed. dissertation, Texas A&M University - Kingsville. The purpose of this study was to investigate the historic and present day bias that female Hispanics, age forty-plus, must hurdle as barriers, in order to became self-actualized and able to obtain their education. Historically, culture, religion, society, government, education and family have shown prejudices toward Hispanic females. Currently, a female Hispanic, struggling to attain a professional identity, especially in an historically male field, must cope with prejudice in the roots of ethnicity and culture, while also contending with gender and age bias which are common to all females. The age forty-plus female Hispanic, because of the time-frame of her birth, has possibly had to endure even stricter family roles and more bias than younger female Hispanics.

89. Nye, Gloria Tara. 1997. "Academic discipline, mentoring, and the career commitment of women faculty." PhD dissertation, The Louisiana State University and Agricultural and Mechanical College. This study of women faculty investigates how female career commitment is influenced by academic discipline and mentoring. The survey responses of sixty six tenure-track women faculty were used to obtain data for both science or engineering and non-science or engineering academic disciplines at three public PhD-granting research universities. The women faculty in science or engineering departments, where women are in the minority, scored higher on a measure of career commitment than women employed in departments which already have a critical mass of women faculty. Women reported that mentoring was important to their advancement in non-traditional academic careers. Women who had been mentored by women did not have higher career commitment scores than women who had been mentored by men. In some instances, women who had been mentored by men had higher career commitment scores. Interviews revealed that the concept of mentoring is problematic for female and male academics. Being supportive, and helping with skill development, promotion and guidance were aspects of mentoring that were identified as being useful to female academic career advancement. Women faculty in science or engineering reported wanting more acceptance, more respect, and more women faculty colleagues. Women faculty in non-science or engineering disciplines reported wanting more compensation and more support for travel and research.

90. Packard, Becky Wai-Ling. 2000. "To construct a 'composite mentor': College women's conceptions of mentoring, future images, and motivation in science." Dissertation, Michigan State University. This project investigated whether college science women's conceptions of mentoring could be expanded in the direction of the "composite mentor" and the influence of this redefinition of mentoring on their future career concerns and motivation in science. Thirty college women in science and engineering participated in a 12-week "future career concerns" workshop series designed to introduce the "composite mentor" strategy. Pre-assessments provided evidence that clash of future-selves was a salient concern and that students were searching for one mentor who represented their desired future image. Post-surveys indicated several important findings linking conceptions of future mentoring, clash of future-selves, and motivation in the field. First, students' conceptions of mentoring moved in the direction of a "composite mentor";

students expanded their mentor selection criteria to include men and people out of their fields and saw a pro-active role for themselves. Second, this redefinition of mentoring influenced their actions, because students reported new mentoring and career-related experiences. Third, although students' experiences of clash of future-selves remained at the end of the program, students were now motivated rather than discouraged by their concerns. And fourth, students reported a renewed motivation to stay in the field, both at the conclusion of the program and 16 weeks later.

91. Pierce, Carole Ann. 1983. "Mentoring, gender, and attainment: The professional development of academic psychologists." PhD dissertation, The University of Texas at Austin, Austin, TX. The main purposes of this study were to identify key aspects of the mentoring process and to relate them to the attainments of female and male psychologists employed in academia. Participants were 244 females and 241 males (59% response rate) who completed a questionnaire sent to members of the American Psychological Association who met the following criteria: (1) residence within the United States; (2) completion of the doctoral degree between 1966 and 1976; and (3) current employment by a university. Participants were asked whether they could identify a mentor and, if so, to complete a scale assessing six aspects of the mentoring process. They also completed a multidimensional measure of achievement motivation (Work and Family Orientation Questionnaire, Spence & Helmreich, 1978) and provided information used in ranking their graduate and current institutions. Number of publications and citations for each respondent were obtained independently from the Social Science Citation Index for the period 1978 to 1981. Of the 485 participants, 78% identified a mentor. As hypothesized, significantly higher publication and citation rates were found for men than for women, and for those identifying mentors than for those not identifying mentors. Regarding achievement motivation, women scored higher than men on the Work and Mastery scales of the Work and Family Orientation Questionnaire and lower than men on the Competitiveness scale. Men scored higher than women on one of the mentoring scales, but women scored higher than men on four of the five remaining mentoring scales.

92. Ryan, Lynnette J. 2000. "Building and encouraging confidence and creativity in science." Master's thesis, St. Martin's College. The focus of this study is an eight week science enrichment mentorship program for elementary and middle school girls (ages 8 to 13) at Coleson Village, a public housing community in an urban area of western Washington. Data collection instruments included a "draw a scientist" test, interviews, questionnaires, journals and ongoing observation. The girls developed science fair projects with their mentors and presented them at a community science fair held at their community center. This study provided insight into how girls prefer to approach learning situations in a cooperative manner, as well as how girls tend to look for a relationship between themselves and the content. The enrichment program was successful in helping the girls develop a voice in their study of science. Most girls went from having negative or neutral feelings about science to exchanging stories about the activities and projects in which they engaged in this program, and to building relationships with strong female mentors pursuing science careers.

93. Sibley, Joyce Gregory. 1995. "The relationship of self-others understanding to social and academic adjustment of African American college students, as related to retention (social adjustment)." PhD dissertation, The University of Alabama. This study dealt with the relationship between self-others understanding and social and academic adjustment of African American science, engineering, and mathematics college students, as related to

retention. Programs to develop excellent, technically-trained minority students have focused on academic preparedness, study clusters, mentoring, the responsibility of universities, social integration, family dynamics and self-concept. However, there appears to have been little concentration on self-understanding and developing skills for more effective interpersonal relations as ways of facilitating academic and social adjustment. That is the target of this study. The Bi/Polar personality theory and its application were presented in a seminar to a group of African American science, engineering and math college students. Its effectiveness was tested with a pre- and post-test Attitude Toward Others assessment and relationship problem-solving. The Tennessee Self-Concept Scale was administered as a pre- and post-test to evaluate change in self-concept related to the summer intervention (counseling, classes, mentoring, and research projects). At one site students were counseled about personality interactions with mentors, and mentors were consulted about their students. The use of the Bi/Polar seminar to students' understanding of themselves and others was found to be statistically and practically related in the pilot and main studies. Self-concept change registered statistical and practical significance, although whether that is related to the intervention or some other variable is unknown. Data related to mentor attitudes toward students were inconclusive. In the experimental group, students' attitudes toward mentors registered statistical and practical significance in a positive direction. Strong positive significance was registered in African American students' attitudes toward White mentors in the experimental group.

94. Turner, Elizabeth Ann. 2000. "The role of mentoring relationships for Asian-Americans in High tech corporations." PhD dissertation, University of California, Santa Cruz, CA. This study examined the role that mentoring plays for Asian Americans who work in the high technology industry. One hundred sixty one individuals employed in the technology group of a Silicon Valley high tech company responded to a survey asking about their mentoring relationships at the company. The survey was designed to provide information on mentee and mentor demographics, access to mentors, quality and quantity of mentoring, and satisfaction with mentors and with work outcomes, such as promotions, recognition, and work climate. Results indicated that Asian American and White employees have equal access to mentors, but Asian Americans are more likely to be involved in cross-race mentoring relationships. Compared to White mentees, Asian American mentees receive less mentoring, but it does not depend on the ethnicity of their mentor. Measures of mentoring quality were obtained from a factor analysis, which resulted in the following three mentoring functions: instrumental help, psychosocial support, and help with advancement. Asian American mentees reported less satisfaction than did White mentees with the quality of instrumental mentoring help they receive. Both Asian American and White mentees reported receiving more psychosocial support and help with advancement from Asian American mentors, but when only data from male mentees was considered, an interaction was obtained such that mentees receive more psychosocial support from same-race mentors. White employees and employees with mentors reported more satisfaction with work outcomes, but mentoring provides a greater increase in work satisfaction for Asian American than for White employees. Only instrumental help was found to predict satisfaction with work outcomes.

95. Wallace, Jill Y. 1998. "Mentoring in a computational problem-solving environment." PhD dissertation, The University of New Mexico. One hundred seventy four high school students, engaged in computational science project work, were the subjects in this study of academic mentoring in a computational problem-solving environment. The major purpose of this study was to compare the computational science project scores of those students

who worked with a mentor to the project scores of those students who did not work with a mentor. The results of the study suggest that mentored students did receive significantly higher computational science project scores than non-mentored students. Several mentoring and student variables were also considered. There was insufficient evidence to suggest a significant difference in project scores due to differences in the “degree” of mentor assistance or in the type or frequency of communication between student and mentor. There was insufficient evidence to conclude that there is a significant difference in the project scores of students due to differences in: math experience, programming experience, or whether the student did their project as an individual or as part of a team. With respect to the time that the student began work on his/her project, there was evidence to suggest that the students in the “early” group have significantly higher project scores than students in the “on time” or ”late” group. There was also sufficient evidence to conclude that students with previous project experience received significantly higher project scores than students with no previous project experience.

96. Walters, Nancy Bannister. 1997. "Retaining aspiring scholars (retention, students of color)." PhD dissertation, University of Minnesota. Tinto's retention model provided the theoretical framework for this research study of the academic and social integration of academically talented students of color into the graduate and professional science degree pipeline. The site for this study was the Life Sciences Summer Undergraduate Research Program of the University of Minnesota. This program recruits academically talented undergraduates from throughout the nation for participation in two months of research, academic study and orientation to science graduate and professional programs. The quantitative data source consisted of survey responses by 108 alumni of the Summer Undergraduate Research Program to the Institutional Integration Scale developed by Ernest Pascarella and Patrick Terenzini. The scale measures academic integration, social integration and institutional and goal commitment of students. The qualitative data source consisted of one-on-one interviews of 14 summer program alumni of White, Latino and African American background. The quantitative results were not significant, while the qualitative results demonstrated the importance to alumni interviewed of the challenging academic research work, personally confirming peer group socialization, and supportive student faculty interactions. The study showed the importance of programs like these for helping students of color plan upper level college study and graduate/professional school enrollment. Program characteristics that influenced decision-making regarding school and career choices by study participants and specifically by students of color were: (1) involvement of faculty in recruiting and mentoring students; (2) socialization to the graduate student role through peer group relations; and (3) student maturation and empowerment through participation in a high level academic program. Study findings indicated that supportive and empowering faculty contact was considered most important by students of color who continued on to graduate and professional programs.

Appendix B -- Definition of Mentoring

Becky Wai-Packard

Mentoring is a term generally used to describe a relationship between a less-experienced individual, called a mentee or protégé, and a more-experienced individual known as a mentor. Traditionally, mentoring is viewed as a dyadic, face-to-face, long-term relationship between a supervisory adult and a novice student that fosters the mentee's professional, academic or personal development (Donaldson, Ensher, & Grant-Vallone, 2000). It is important to acknowledge that the term "mentor" is borrowed from the male guide, Mentor, in Greek mythology, and this historical context has informed traditional manifestations of mentoring.

The traditional model is but one configuration of mentoring within a wide range of possible models that vary in their structure and function. As for structure, mentoring can involve a one-on-one relationship or a network of multiple mentors (Bird & Didion, 1992). A network may vary in timing of access to multiple mentors as well as in its content. In terms of timing, multiple mentors may be enlisted concurrently (Burlew, 1991; Packard, 2003a) or sequentially (Baugh & Scandura, 1999; Nolinske, 1995). In terms of content, the network can contain peers, "step-ahead" peers, or supervisors (Ensher, Thomas, & Murphy, 2001). For example, mentoring may involve a peer group, such as when women scientists convene to talk about the science community (Davis, 2001). A network can also refer to "cascade mentoring," a popular group form in science education circles, where a professor may supervise graduate students or advanced undergraduates in research, who in turn supervise lower-division undergraduates (e.g., Davis, Ginorio, Hollenshead, Lazarus, & Rayman, 1996). Furthermore, mentoring relationships can be informally or formally assigned, long-term or short-term in nature, and convened electronically or face-to-face (Kasprisin, Boyle Single, Single, & Muller, 2003; Packard, 2003b).

As for function, two categories are usually used to describe mentor roles: psychosocial and career-related. Psychosocial mentoring involves mentor roles such as counselor or friend, and career-related mentoring involves mentor roles such as coach or sponsor (Noe, 1988; Ragins and McFarlin, 1990). Some prefer to view role-modeling as a third category, rather than as embedded within psychosocial mentoring (Donaldson et al., 2000; Scandura & Williams, 2001). Mentoring is not considered an all-or-nothing enterprise; a mentor may fulfill only one role or take on many roles (Kram, 1985; Ragins, Cotton, & Miller, 2000). An effective mentor may differ from the mentee in terms of gender, field of study, ethnic background, socioeconomic status, or disability status (Blake-Beard, 1999), although students may prefer a mentor who is a close match along many demographic variables (Frierson, Hargrove, & Lewis, 1994). In the case of science mentoring, from high school through post-doctoral studies, additional mentoring roles may need to be examined, including the provision of research training and academic support.

Each structure of mentoring may be better suited to support particular mentoring functions or desired outcomes. For example, the structure of peer mentoring may advance psychosocial functions, while supervisory mentoring may advance career functions (Ensher et al., 2001). Also, a structure that uses multiple mentors may more likely yield a broader set of mentoring functions and strengthen training than a one-mentor structure (Baugh & Scandura, 1999; Burlew, 1991; Nolinske, 1995; Packard, 2003a). Overall, alternatives to the traditional model may be crucial to support underrepresented groups, whether in or out of science fields (Dreher & Dougherty, 1997; Packard, 2003b). An awareness of the complex mentoring typology, including the various structures and roles associated with mentoring, should assist with innovative and effective research planning.

References

Baugh, S. G., & Scandura, T. A. (1999). The effect of multiple mentors on protégé attitudes toward the work setting. Journal of Social Behavior and Personality, 14(4), 503-521.

Bird, S. J., & Didion, C. J. (1992). Retaining women science students: A mentoring project of the association for women in science. Initiatives, 55, 3-12.

Blake-Beard, S. D. (1999). The costs of living as an outsider within: An analysis of the mentoring relationships and career success of Black and White women in the corporate sector. Journal of Career Development, 26, 21-36.

Burlew, L. D. (1991). Multiple mentor model: A conceptual framework. Journal of Career Development, 17(3), 213-221.

Davis, C. S., Ginorio, A. B., Hollenshead, C. S., Lazarus, B. B., & Rayman, P. M. (1996). The Equity Equation: Fostering the Advancement of Women in the Sciences, Mathematics, and Engineering. San Francisco: Jossey-Bass.

Davis, K. S. (2001). "Peripheral and subversive": Women making connections and challenging the boundaries of the science community. Science Education, 85, 368-409.

Donaldson, S. I., Ensher, E. A., & Grant-Vallone, E. J. (2000). Longitudinal examination of mentoring relationships on organizational commitment and citizenship behavior. Journal of Career Development, 26, 233-249.

Dreher, G. F., & Dougherty, T. W. (1997). Substitutes for career mentoring: Promoting equal opportunity through career management and assessment systems. Journal of Vocational Behavior, 51, 110-124.

Ensher, E. A., Thomas, C., & Murphy, S. E. (2001). Comparison of traditional, step-ahead, and peer mentoring on protégés' support, satisfaction, and perceptions of career success: A social exchange perspective. Journal of Business and Psychology, 15, 419-438.

Frierson, H. T., Hargrove, B. K., Lewis, N. R. (1994). Black summer research students' perceptions related to research mentors' race and gender. Journal of College Student Development, 35, 475-480.

Kasprisin, C. A., Boyle Single, P., Single, R. M., & Muller, C. B. (2003). Building a better bridge: Testing e-training to improve e-mentoring programs for diversity in higher education. Mentoring & Tutoring, 11 (1), 67-78.

Kram, K. E. (1985). Mentoring at work. Maryland: University Press of America.

Noe, R. A. (1988). Women and mentoring: A review and research agenda. Academy of Management Review, 13(1), 65-78.

Nolinske, T. (1995). Multiple mentoring relationships facilitate learning during fieldwork. The American Journal of Occupational Therapy, 49(1), 39-43.

Packard, B. W. (2003a). Student training promotes mentoring awareness and action. Career Development Quarterly, 51, 335-345.

Packard, B. W. (2003b). Web-based mentoring: Challenging traditional models to increase women's access. Mentoring & Tutoring, 11 (1), 53-65.

Ragins, B. R. & McFarlin, D. B. (1990). Perceptions of mentor roles in cross-gender mentoring relationships. Journal of Vocational Behavior, 37, 321-339.

Ragins, B. R., Cotton, J. L., & Miller, J. S. (2000). Marginal mentoring: The effects of type of mentor, quality of relationship, and program design on work and career attitudes. Academy of Management Journal, 43(6), 1177-1194.

Scandura, T. A., & Williams, E. A. (2001). An investigation of the moderating effects of gender on the relationships between mentorship initiation and protégé perceptions of mentoring functions. Journal of Vocational Behavior, 59, 342-363.

Appendix C -- Mentoring: Lessons Learned and Research Questions

Suzanne Gage Brainard

16 December 2003

Mentoring has become the popular national "cure-all" for recruitment, retention and advancement of people from underrepresented groups in science and engineering in both the academic and corporate sectors. Until recently, the literature did not provide concrete guidelines on how to train people to be mentors or mentees, on how to transfer training across different disciplines or environments or on how to deal with special issues of concern in mentoring relationships. Perhaps more importantly, there is very little research on the effectiveness of mentoring and on its impact on graduation and career outcomes. Finally, the literature has a limited number of evaluation studies measuring the effectiveness of specific types of mentoring programs and mentoring relationships.

The purpose of this paper is to describe general lessons learned about implementing mentoring programs, the challenges in measuring the effectiveness of mentoring programs as well as other retention programs, and research questions about mentoring that need to be addressed.

General Lessons Learned

1. A large body of literature exists on theories of mentoring. Even so, there is no accepted definition of mentoring. Further, there is a great deal of "magical thinking" about what happens when mentors and mentees do come together (Wunsch, 1994). Mentoring skills are thought by many to be intrinsic and natural; yet, in many cases what passes for mentoring is not mentoring at all.

2. Past experience has revealed a lack of, and a definitive need for, extensive training of mentors, mentees and administrators of mentoring programs in order to have an effective mentoring program (Bird, 1993; Brainard, 1994, Faddis, 1988; Gaskill, 1993; Henry, 1994). Simply matching a mentor and mentee is not enough. The mentor and mentee need to understand their goals and responsibilities and have an awareness of the climate issues at their institution. Further, mentors and mentees need to have a way to measure the relationship's success.

3. Multiple mentors can assist students. Advisors serve as the professional and institutional authority that students will first depend upon for navigating their academic career. A student's research, publications, and entry into a field may be linked with the advisor for years, continuing even after the student graduates. As such, the advisor is an immediate and powerful authority figure. Choosing the right advisor is critically important to a successful graduate school experience (Feibelman, 1993; Zuccarelli, 1993; Walbot, 1993). Even if the advisor can offer some mentoring, it is rare for him/her to have all the qualities and characteristics that a graduate student expects. Choosing advisors is particularly difficult for individuals from underrepresented groups as they often lack the confidence not to be intimidated.

4. Anecdotal studies of cross-gender and cross-racial mentoring exist, but little if any research exists on the effectiveness of cross-gender and cross-racial mentoring.

Challenges of Evaluating Mentoring

1. Evaluations of mentoring programs tend to assess student perceptions of the effectiveness of a program or student satisfaction with a mentor. Very few studies examine the impact of a mentoring program or the mentoring relationship on graduation and career outcomes (Brainard, 1998, 1995).

2. Surveys of student perceptions of climate provide some information, but without multiple levels of analyses (faculty, staff, department chairs, and administrators), many unanswered questions remain (Brainard, 2002; Huang, 2002).

3. Surveys alone reveal the need for more in-depth analyses; focused interviews would be particularly helpful when small sample sizes of different ethnic groups are all that can be obtained (Brainard, 1999, 2002; Huang, 2002).

4. The quality of items on different survey instruments often proves disappointing during analyses, even when validity and reliability tests are administered (Brainard, 2002; Huang, 2002).

5. Longitudinal tracking is labor-intensive and time-consuming. Retention rates are rarely collected by institutions, which is the only "full-proof" method (Brainard, 1998) of measuring retention. Most often institutions report cohort data as retention, which does not provide the same information as individual tracking.

6. Human Subjects Clearance processes at each institution are slightly different. For example, the University of Washington uses the Medical School Model of Patient Risk for all research, which is not totally adaptable to social science research. Hence, the process of clearance is time consuming, unpredictable, and requires an inordinate amount of scrutiny.

Research Questions on Mentoring

1. Are there definitions of mentoring that are commonly accepted? Most faculty appear to believe that mentoring and advising are synonymous.

2. Can mentoring be taught? What are the personality types of individuals who are successful mentors? Who are not successful mentors? How do we identify successful and unsuccessful characteristics of mentors?

3. Is cross-gender mentoring effective? Is cross-racial mentoring effective? Does each have an impact (positive or negative) on academic retention and career outcomes?

4. Is mentoring more effective for majority groups than for underrepresented groups? Are different types of mentoring more appropriate for specific levels (e.g., undergraduate, graduate or post-docs)?

5. What types of mentoring or mentoring programs have an impact on academic retention and career outcomes of students?

Lessons Learned References

Bird, S. and Didion, C. (1993). A Hand Up: Women Mentoring Women in Science. Washington, DC: Association for Women in Science.

Brainard, S.G. & Ailes-Sengers, L. (1994). Mentoring female engineering students: A model program at the University of Washington, *Journal of Women and Minorities in Science and Engineering.* 1, no.2: 126.

Brainard, S.G., Laurich-McIntyre, S. and Carlin, L. (1995). Retaining Female Undergraduate Students in Engineering and Science: 1995 Annual Report to the Alfred P. Sloan Foundation. *Journal of Women and Minorities in Science & Engineering,* 2, (4), 255-267.

Brainard, S.G. and Carlin, L. (1998, October). A Six-Year Longitudinal Study of Undergraduate Women in Engineering and Science. *Journal of Engineering Education,* 87 (4) 369-375.

Brainard, S.G., Metz, S.S., and Gillmore, G. (1999). WEPAN Pilot Climate Survey: Exploring the Environment for Undergraduate Engineering Students. *Proceedings of the 1999 IEEE/ISTAS Conference on Women and Technology: Historical and Professional Perspectives.*

Brainard, S.G. and Huang, P. (unpublished 2002 October). University of Washington Climate Survey: Exploring the Environment for Undergraduate Engineering Students, 2002.

Faddis, B., Ruzicka, P., Berard, B.K. & Huppertz, N. (1988). Guide for Planning, Implementing, and Evaluating a Mentoring Program. (Newton, MA: Women's Educational Equity Act Publishing Center), 15-17.

Feibelman, P. (1993). A PhD is Not Enough. Reading, MA: Addison-Wesley Publishing Company.

Gaskill, L.R. (1993, Winter). A Conceptual Framework for the Development, Implementation and Evaluation of Formal Mentoring Programs. *Journal of Career Development*, 20, 2 (147-60).

Henry, J.S. (1994). A Formal Mentoring Program for Junior Female Faculty: Description and Evaluation. *Initiatives*, 56, 2 (37-45).

Huang, P. and Brainard, S.G. (unpublished 2002), University of Washington Climate Survey: Exploring the Environment for Graduate Engineering and Science Students.

Walbot, V. (1993) Keys to success in graduate school and beyond. In S. Bird and C. Didion (eds.), A Hand Up: Women Mentoring Women in Science (pp. 205-8). Washington, DC: Association for Women in Science.

Wunsch, M.. A. (1994). Mentoring revisited: making an impact on individuals and institutions. Jossey-Bass: San Francisco.

Zuccarelli, L. (1993) Thriving in graduate school. In S. Bird and C. Didion (eds.), A Hand Up: Women Mentoring Women in Science (pp. 209-13). Washington, DC: Association for Women in Science.

Appendix D -- What a Difference a Mentor Makes[1]

Catherine M. Millett

In the Understanding for Improvement (UFI) study[2], my colleague Michael Nettles and I set out to learn how students navigate the doctoral program experience. Our initial interests centered upon how students financed their education, but we quickly broadened the scope of our inquiry after talking with students, faculty, deans and administrators and foundation program officers. Despite the conception of the doctoral experience as the induction to the solitary life of scholarship, one of the questions that all constituents in the doctoral enterprise raised was who helps students over the course of their doctoral studies? Mentors were a common refrain, typically followed by a discussion of how to pair students with mentors. Reflecting back on my own educational experience, I argued with Michael that advisors could be assigned, but assigning mentors might be difficult. I could clearly distinguish between my advisors and my mentors. For me, the difference was "chemistry." By "chemistry" I refer to the non-scientific definition -- a strong mutual attraction, attachment, or sympathy. Chemistry occurs in a mentoring relationship but not necessarily in an advising relationship.

In the Survey of Doctoral Student Finances, Experiences and Achievements, we asked students a question about having a faculty advisor and separate questions about having a faculty mentor.

> (Question B-6) A faculty or research advisor is a person assigned by your department/program to act in an official capacity in such ways as discussing and approving your coursework, or signing registration forms. Please note that your faculty or research advisor may not be your mentor. Do you have a faculty member who serves as your advisor?
>
> (Question B-9) Many doctoral students have someone on the faculty to whom they turn for advice, to review a paper or for general support and encouragement. This person may be thought of as a mentor. If you have more than one mentor, please comment on the one with whom you work most closely. Do you have a faculty member who serves as your mentor?

Overall, 69% of the doctoral students in the sample had a mentor. In both engineering, and science and mathematics, 71% of students reported having mentors. Within each field, we examined gender and racial/ethnic differences in the doctoral student experience. We uncovered no gender differences in engineering (see Figure 1), while in science and mathematics, women had a slightly higher rate of having a mentor compared to men (74% vs. 69%). When we compared African Americans and Hispanic Americans each to Whites, we found no significant racial differences in doctoral students' mentoring experiences in engineering. In science and mathematics, African Americans reported a lower rate of having a mentor than Whites, while Hispanic Americans had similar mentoring opportunities as Whites (see Figure 2). For the

[1] This material is based upon work supported in part by the Spencer Foundation and the National Science Foundation under Grant No. REC 9903080. Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the Spencer Foundation or the National Science Foundation.

[2] In "The Understanding for Improvement study" more than 9,000 students from 11 disciplines at 21 universities completed the 28-page Survey of Doctoral Student Finances, Experiences and Achievements. For analysis purposes the disciplines were aggregated into five fields: education (27%), engineering (10%), humanities (15%), science and mathematics (21%), and social sciences (27%). Science and mathematics includes the biological sciences (biochemistry, biophysics, and molecular biology), the physical sciences (chemistry and physics), and mathematics.

majority of students, one person serves the role of both advisor and mentor.

Figure 1:
Having a Mentor by Sex and Field

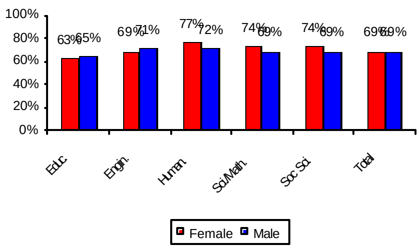
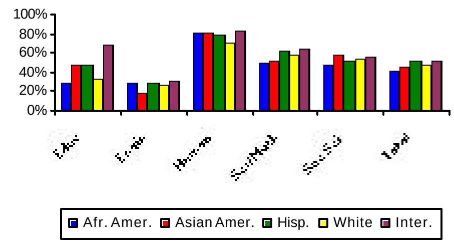


Figure 2:
Having a Mentor by Race/Ethnicity and Field



The majority of students (70%) found their mentor within the first year of doctoral study and half of those within the first few months of starting their doctoral program.

What predicts having a mentor? Because so many students found their mentor early in their doctoral career, we looked at personal attributes (sex, race, parents' socioeconomic status [SES][3]) and admissions characteristics (GRE® scores and enrollment at a private or public graduate school) that might determine who has a mentor. Controlling for other factors, in engineering, Asian Americans and international students were each less likely than White doctoral students to have a mentor, with Asian American students being two times less likely and international students being one and half times less likely. Higher parental SES was associated with students having greater opportunity to have a mentor while higher GRE verbal scores were associated with lowering students' opportunity to have a mentor. In science and mathematics, African Americans were two and a half times less likely to have a mentor than their White peers. As we saw in engineering, higher parental SES was positively associated with the opportunity to have a mentor. In contrast to engineering, higher GRE quantitative scores were associated with a decrease in science and mathematics students' opportunity to have a mentor. Science and mathematics students at private graduate schools were less likely than their peers at public graduate schools to have a mentor.

A question that follows once you know if students have a mentor is "Does mentoring make a difference in other areas of doctoral students' lives?" The answer is "yes." Using regression analysis, we explored the influence of mentoring on three different areas: their social experiences, their research productivity and their degree completion.

The first two social experiences refer to interactions with department faculty while the third refers specifically to their faculty advisor. After controlling for other factors, in engineering, and in science and mathematics, students with mentors had higher student-faculty social interactions than their peers without a mentor. The same positive relationship occurred between having a mentor and having higher perceptions of academic interactions with faculty in both fields. Having one person as both an advisor and a mentor positively contributed to student perceptions of their interactions with their faculty advisor in both engineering, and science and mathematics. This suggests a benefit of having one person fill both roles.

[3] This measure combines parents' highest level of education and occupational attainment.

We next turned our attention to doctoral students' involvement in the research enterprise at their institutions. Student received credit for both sole or joint authorship. We adopted a scaffolding approach to examine research productivity and looked at presenting a paper at a national conference, publishing a journal article, publishing a chapter in an edited book or publishing a book. An aggregate measure of research productivity was created to incorporate students having said "yes" to any of the four individual measures. In engineering, having a mentor positively contributed to students presenting a paper at a national conference. However, in science and mathematics, having a mentor was a not an important contributor. Mentors positively contributed to students publishing an article in both engineering, and science and mathematics. Given the influence of mentoring on the component parts, it was not surprising that mentoring was positively associated with engineering and science and mathematics students having research productivity.

The UFI sample included students who had completed at least one year of their doctoral program. Using several sources of information, we determined degree-completion rates as of 2001. Having a mentor was positively associated with degree-completion in engineering but not in science and mathematics. Since degree-completion is often linked with time-to-degree, the relationship between mentoring and time-to-degree also was examined. Having a mentor was not a significant predictor in either engineering, or in science and mathematics.

In the UFI study, we found several areas of the doctoral experience in which mentors may play a critical role. These findings have raised many questions about the mentoring experience. In our next study, we hope to take a closer look at the student-faculty mentoring relationship. Our aim will be to unpack the elements of the relationship to learn what mentors and mentees do that contributes positively to social interactions, research productivity, and degree completion.

Appendix E -- Graduate Student Mentoring Blueprint

Charlena Seymour, PhD

From the pipe line to the professoriate, mentoring is an important networking process, and necessary for the successful recruitment and retention of underrepresented minorities into STEM disciplines.[i] Because of the recognized serious impact mentoring has on graduate education,[ii] and because of ongoing initiatives to recruit and retain underrepresented minorities in STEM fields at the University of Massachusetts Amherst, a Task Force on Mentoring was organized and charged with reviewing the current procedures for mentoring graduate students on campus and developing recommendations for coordinating, supplementing and initiating these efforts.[iii] The Task Force surveyed graduate program directors and found that the mentoring activities in graduate programs campus-wide were not being offered systematically. Therefore, in order to assist academic graduate programs with mentoring efforts, the Task Force recommended that the Graduate School implement a systematic plan that would serve as a Blueprint for Graduate Student Mentoring.

The Blueprint was based upon certain assumptions that were taken from an unpublished manuscript on mentoring written by two graduate student interns working in the Graduate School. Because the article was written by graduate students for the purpose of improving mentoring conditions for graduate students, the Task Force felt that the graduate students' direct involvement in mentoring arrangements and their data collected from several focus groups was sufficient to substantiate the authors' observations and conclusions, and consequently, a credible source for extrapolation. In the article, "The Graduate Student Mentoring Network: A Model Developed for a Culturally Diverse University Environment," Ashiagbor and Suner propose the following guiding principles for effective mentoring:[iv]

1) Mentoring is critical for individuals who are women and minorities.

2) Mentoring should be voluntary, based on mutual respect and interest, not limited and exclusive to age or gender, culture, race, or disability status. Graduate student mentoring involves networking between graduate students and available people: faculty, graduate students, undergraduates, staff, alumni, and administrators. Anyone can mentor for anyone as long as they are willing to accept the responsibility.

3) Mentoring relationships will vary across disciplines and vary in style. Whatever works best at the time is best for the mentoring relationship to succeed. Each graduate program has unique conditions and dynamics arising from different academic and research interests in the discipline, different teaching circumstances and different graduate student profiles. Mentoring should include activities related to research, teaching and academic activities on the campus.

4) Mentoring should not be an isolated activity. It should be a network of academic faculty, students and staff working collaboratively. It is not a static phenomenon, rather a system of various dynamic relationships and processes that interconnect with relevant research, teaching and outreach activities on the campus.

5) Mentoring at its best is part of a networking process that serves to help graduate students cope with complex conditions of the academic environment. While many of the best mentoring relationships can evolve from informal methods, sometimes it is necessary to provide a formal mechanism to initiate mentoring relationships especially for visiting and new students.

6) Mentoring activities should be mass-marketed across campus to increase awareness and help educate the campus community.

With these six principles in mind, and the directive of the Task Force, the University of Massachusetts Amherst administration designed a mentoring weekend as part of the Blueprint program to initiate and cultivate mentoring relationships between underrepresented minority students and their respective STEM graduate programs as part of recruitment and retention goals. The mentoring weekend was set up to encourage dialogue, provide information, and to allow participants to interact socially in a relaxed atmosphere. Campus support groups and relevant student social groups also participate in the mentoring weekend to acclimate the minority students to campus.

At the University of Massachusetts Amherst, the mentoring weekend has been used as part of the Fall recruiting initiative for STEM minority graduate students (see Appendix A). During the mentoring weekend, students learn about the nature of teaching and research in STEM disciplines and professional career opportunities from faculty, alumni and accomplished professionals. These STEM-related topics stimulate conversation, provide a climate for an exchange of ideas and help students make decisions about graduate school and career prospects. While the idea was to organize the activities over a weekend, the mentoring program could occur over any period of time (a week, a month, a semester), as the campus schedule allows. Furthermore, although the mentoring weekend was designed for minority students in SMET, the model can be adjusted to be used with any type of student group.[v] It is a flexible plan that can be used repeatedly and adjusted according to the size of the audience, available resources, and duration of time for programming and events.

Endnotes

[i] In an article entitled, "Mentoring: The Components for Success," in the *Journal of Instructional Psychology* (Sept, 2001), co-authors Clara Y. Young and James V. Wright conclude: "it appears that having a mentor may be more crucial for minorities, because when they did not have a mentor, their perceptions of the academic climate were significantly worse than Caucasian and international students."

[ii] In a review of literature and research conducted at 29 Midwest universities, it was found that mentoring reduces isolation and improves retention rates among both minority and non-minority students. See "Promoting Diversity: Recommendations for Recruitment and Retention of Minorities in Higher Education," *College Student Journal*, Sept 2001.

[iii] Seymour, Charlena; Tony Jno Baptiste, Susan Cocalis, Kathy Foley, Tanya Kachwaha, Ann Lewis, Shantikumar Nair, Klaus Nusslein, Sarah Scarchilli, Julian Tyson, Robert Wolff. 2001. "Report of the task force on graduate student mentoring." University of Massachusetts Amherst Graduate School.

[iv] Ashiagbor, Apefa and Suner, Asuman. 1998. The Graduate Student Mentoring Network: A model developed for a culturally diverse University Environment, University of Massachusetts Amherst Graduate School.

[v] Melby, Bernie, Desiree Roff, Phylis Gedeon, Pilar Mendoza. 2001. Mentoring Graduate Students: One Rung in the Ladder to Success, University of Massachusetts Amherst Graduate School.

APPENDIX A
Weekend Mentoring Plan for
Minority Graduate Students in STEM

Friday

5:00 p.m. – 6:00 p.m. ***Program Registration***
5:30 p.m. – 6:15 p.m. ***Social Hour "Meet and Greet"***
6:15 p.m. - 7:30 p.m. ***Dinner - Welcome: Provost***

Brief background about AGEP and UMass STEM graduate programs.
Students seated with their particular STEM faculty.
Packet containing information:

- *about AGEP and STEM programs on campus.*
- *on all of the mentors involved in the STEM Program.*
- *on the protégés who have attended this weekend workshop.*

7:30 p.m. – 8:30 p.m. ***"Recognizing Our Diversity"***
Guest Speaker: Prominent Role Model
8:30 p.m. – 'til p.m. ***Free-time***

Movie will be shown. A listing of nightlife in the surrounding areas provided.

Saturday

7:30 a.m. – 11:00 a.m. ***Program Registration***
7:30 a.m. – 8:30 a.m. ***Breakfast Buffet***

Conference updates and changes.

8:30 a.m. – 9:45 a.m. ***"Discovering Yourself in Your Program."***

STEM faculty panel discuss choosing a mentor.

9:45 a.m. – 10:00 a.m. ***Break - Coffee, tea and snacks***
10:00 a.m. – 11:30 a.m. ***Breakout Session: "Finding a Place"***

Panel of STEM graduate students discuss expectations and types of STEM assistance.

11:45 a.m. – 1:30 p.m. ***Lunch***
1:45 p.m. – 2:45 p.m. ***"Diversity Does it Matter"***

Diversity and its impact in the various STEM programs discussed.

3:00 p.m. – 6:00 p.m. ***Free Time***
6:00 p.m. – 7:30 p.m. ***Entertainment***

Faculty and student artistic performances given.

7:30 p.m. – 9:00 p.m. ***Dinner "Celebrating the STEM Graduates"***
Recognition of STEM alumni, new students, peer and faculty mentors, and administrators.

Sunday

7:30 a.m. – 8:30 a.m. ***Breakfast Buffet --*** *Housekeeping and Checkout*
8:45 a.m. – 9:45 a.m. ***"Future Career Perspectives for STEM Graduates"***
Faculty discuss careers and offer practical advice about academic lifestyle and other career options in STEM. Representatives from STEM industries discuss the various internships, co-ops, and summer or full-time employment opportunities available at their companies.

9:45 a.m. – 10:00 a.m. ***Break***
10:00 a.m. – 11:00 a.m. ***"Making The Steps Easier"***
Students will be informed about campus and community-based support programs.

12:30 p.m. – Until ***Closing Remarks & Lunch on the Run***